PROJECT MANUAL

WILLIAM PATERSON UNIVERSITY
SOCCER FIELD IMPROVEMENTS

JANUARY 11, 2016

CHA PROJECT #: 30059

Prepared for:

WILLIAM PATERSON UNIVERSITY

Prepared by:

CHA
6 Campus Drive
Parsippany, NJ 07054

WILLIAM PATERSON UNIVERSITY

SOCCER FIELD IMPROVEMENTS

TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS

Section Number	Section Title
Information Available for Bidders	
Division 01 – General Requirements	
011000	Summary
011400	Work Restrictions
012300	Alternates
012600	Contract Modification Procedures
012900	Payment Procedures
013000	Project Management and Coordination
013200	Construction Progress Documentation
013300	Submittal Procedures
014000	Quality Requirements
015000	Temporary Facilities and Controls
017300	Execution
017329	Cutting and Patching
017700	Closeout Procedures
Division 02 – Existing Conditions	
023219	Exploratory Excavations
Division 03 – Concrete	
033000	Cast-In-Place Concrete
Division 04 – Masonry	
042000	Unit Masonry Assemblies
Division 05 – Metals	
055000	Metal Fabrication
057000	Miscellaneous and Ornamental Metals
Division 06 – Woods, Plastics, and Composites	
061000	Rough Carpentry
061753	Wood Trusses
062000	Finish Carpentry
Division 07 – Thermal and Moisture Protection	
072100	Thermal Insulation
073113	Asphalt Shingles
074600	Fiber Cement Siding
076200	Sheet Metal Flashing and Trim
079200	Joint Sealants

Section Number	Section Title
Division 08 – Openings	
081113	Hollow Metal Doors and Frames
082200	Fiberglass Doors
087100R	Finish Hardware
Division 09 – Finishes	
092900	Gypsum Board Assemblies
093100	Ceramic Tile
096513	Resilient Wall Base and Accessories
099100	Painting
Division 10 – Specialties	
101423	Signage
102800	Toilet Accessories
Division 11 – Equipment	
116510	Athletic Field Sound System
116833	Outdoor Sports Equipment
Division 13 – Special Construction	
131250	Grandstand Seating System
131260	Pressbox
Division 22 – Plumbing	
220000	General Requirements for Plumbing Systems
220004	Coordination with Other Trades
220500	Basic Plumbing Materials and Methods
220503	Pipes and Tubes for Plumbing Piping and Equipment
220513	Electrical Requirements for Plumbing Equipment
220519	Meters and Gauges
220523	General Duty Valves for Plumbing Piping
220529	Hangers and Supports for Plumbing Piping and Equipment
220553	Identification for Plumbing Piping and Equipment
220700	Plumbing Insulation
221100	Facility Water Distribution
221116	Water Distribution Piping
221119	Plumbing Specialties
221300	Facility Sanitary Sewerage
221316	Drainage and Vent Systems
224000	Plumbing Fixtures
Division 23 – Heating, Ventilation, & Air Conditioning	
230000	General Requirements for HVAC Systems
230004	Coordination with Other Trades
230500	Basic Mechanical Materials and Methods
230513	Electrical Requirements for HVAC Equipment
230529	Supports and Anchors
230593	Testing, Adjusting, and Balancing
230700	Mechanical Insulation
230951	Motors
233100	HVAC Ducts and Castings
233113	Metal Ducts
233300	Duct Accessories

Section Number	Section Title
233400	HVAC Fans
238200	Convection heating and Cooling Units

Division 26 – Electrical

260001	Site Electrical
260002	Building Electrical

Division 31 - Earthwork

310519.13	Geotextiles
311000	Site Clearing
312000	Earth Moving
312316.26	Rock Removal
312319	Dewatering
312333	Trenching and Backfilling
312500	Soil Erosion and Sediment Controls
315000	Excavation Support and Protection

Division 32 – Exterior Improvements

321116	Subbase Courses
321216	Asphalt Paving
321613.16	Concrete Curb
321630	Concrete Sidewalks
321813	Synthetic Turf Playing Field System
321814	Synthetic Turf Subsurface Drainage System
321815	Athletic Channel Drain System
323113	Chain Link Fence and Gates
328424	Manual Sports Field Irrigation System
329113	Soil Preparation
329200	Turf and Grasses
329300	Plantings

Division 33 - Utilities

330500	Common Work Results for Utilities
330513	Manholes and Structures
331112	High Density Polyethylene (HDPE) Pipe and Fittings
331120	Water Services
333216.13	Packaged Sewage Grinder Pump Units

SECTION 011000 – SUMMARY

PART 1 – GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: Project consists of Conversion of the existing soccer field from natural grass to synthetic turf, perimeter fencing, bleacher, press box, restroom building, netting systems: electrical, storm sewer, sanitary lift station & force main and water utilities, paving, landscaping, signage, retaining wall and all work indicated on the contract documents. The synthetic turf and infill will be purchased by the University. The installation of the turf will be part of the general construction contract.

1. Project Location: William Paterson University, Pompton Road, Wayne NJ.).
2. Owner: William Paterson University, Pompton Road, Wayne NJ.

B. Engineer Identification: The Contract Documents, dated [Insert date indicated on the Contract Documents, were prepared for Project by CHA Consulting Inc., 6 Campus Drive Parsippany, NJ.

1.2 CONTRACT[S]

A. Project will be constructed under a general construction contract.

1.3 WORK SEQUENCE

A. The anticipated contract award will be prior to March 1, 2016. Onsite field work can commence on or after March 1, 2016. All Field & Turf work to be completed by July 15, 2016. All other work is to be substantially completed by August 5, 2016.

1.4 USE OF PREMISES

A. General: Contractor shall have full use of premises for construction operations, including use of Project site, during construction period. Contractor's use of premises is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

1.5 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 48-division format and CSI/CSC's "Master Format" numbering system.

1. Section Identification: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.

2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
   a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

1.6 MISCELLANEOUS PROVISIONS

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 SCHEDULE OF PRODUCTS ORDERED IN ADVANCE

END OF SECTION

SECTION 011400 – WORK RESTRICTIONS

PART 1 – GENERAL

1.1 USE OF PREMISES

A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated.

1. Limits: Confine construction operations to areas within the contract limits indicated.
2. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
   a. Schedule deliveries to minimize use of driveways and entrances.
   b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 012300 – ALTERNATES

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Add Alternate No. 1: grandstand, Press box and Sound System. Provide and install the grandstands, press box and sound system in accordance with the contract documents. The GC contract shall include the preparatory earthwork and grandstand and press box foundations in this alternate.

B. Add Alternate No. 2: Restroom Building. Provide and install the restroom building and all associated utility work for the restroom building.

C. Add Alternate No. 3: Pedestrian Lighting and Pave Pedestrian path to restroom. Provide and install all pedestrian lighting and the paving of the pedestrian path to the restroom building.

D. Add Alternate No. 4: Landscape Plantings and Entry Sign including boulder removals/relocations and fence slats for the existing lift station enclosure.

E. Add Alternate No. 5: Sports Lighting Ballasts. Replace 64 existing Musco Light Ballasts and change out capacitors.

F. Add Alternate No. 6: Soccer Team Shelters. Provide and install 2 covered team shelters as specified in specification section 11 68 33 Outdoor Sports Equipment.

G. Add Alternate No. 7: Grandstand Seating Upgrade – Center Section. Provide and Install molded seats as specified in specification section 11 68 33 Outdoor Sports Equipment.

H. Add Alternate No. 8: Goal Storage Area. Construct Goal storage area as shown on the contract drawings.

END OF SECTION

SECTION 012600 – CONTRACT MODIFICATION PROCEDURES

PART 1 – GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

A. Engineer will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

1.3 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
   1. Proposal Requests issued by Engineer are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
   2. Within 7 days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
      a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
      b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
      c. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Engineer .
   1. Include a statement outlining 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 the Contract Time.
   2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
   3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
   4. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
   5. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

C. Proposal Request Form: For Change Order Proposals, use CSI Change Order Request (proposal format). A sample copy is included at end of this Section.

1.4 ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, base each Change Order proposal on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
   1. Include installation costs in purchase amount only where indicated as part of the allowance.
   2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
   3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the Purchase Order amount or Contractor's handling, labor, installation, overhead, and profit. Submit claims within 21 days of receipt of the Change Order or Construction Change Directive authorizing work to proceed. Owner will reject claims submitted later than 21 days after such authorization.
   1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
   2. No change to Contractor's indirect expense is permitted for selection of higher- or lower- priced materials or systems of the same scope and nature as originally indicated.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, Engineer will issue a Change Order for signatures of Owner and Contractor on form included at end of Part 3.

1.6 WORK CHANGE DIRECTIVE

A. Work Change Directive: Engineer may issue a Work Change Directive on form included at end of Part 3. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
   1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.
   1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 012900 – PAYMENT PROCEDURES

PART 1 – GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 DEFINITIONS

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

1.3 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
   1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
      a. Contractor’s progress schedule.
      b. Application for Payment form.
      c. List of subcontractors.
      d. Schedule of allowances.
      e. Schedule of alternates.
      f. List of products.
      g. List of principal suppliers and fabricators.
      h. Schedule of submittals.
   2. Submit the Schedule of Values to Engineer at earliest possible date but no later than 14 days after notice to proceed.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
   1. Identification: Include the following Project identification on the Schedule of Values:
      a. Project name and location.
      b. Name of Engineer.
      c. Project number.
      d. Contractor's name and address.
      e. Date of submittal.
   2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
      a. Generic Name
      b. Related Specification Section or Division.
      c. Description of the Work.
      d. Name of subcontractor.
      e. Name of manufacturer or fabricator.
      f. Name of supplier.

g. Change Orders (numbers) that affect value.

h. Dollar value:

1) Percentage of the Contract Sum to nearest one-hundredth percent adjusted to total 100 percent.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts where appropriate.

4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored but not yet installed.

a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.

6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

7. Allowances: Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.

8. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be either shown as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

9. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.4 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Engineer and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Times: The date for each progress payment is the 15th day of each month. The period covered by each Application for Payment starts on the day following the end of the preceding period and ends 15 days before the date for each progress payment.

D. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets or EJCDC C-620 for Applications for Payment.

E. Payment Application Forms: Use forms provided by Owner for Applications for Payment. Sample copies are included at end of this Section.

F. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Engineer will return incomplete applications without action:

1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

G. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Engineer by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required:

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

I. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application:

1. Submit partial waivers on each item for amount requested, before deduction for retainage, on each item.
2. When an application shows completion of an item, submit final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Waiver Delays: Submit each Application for Payment with Contractor's waiver of mechanic's lien for construction period covered by the application.
    a. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit waivers of lien on forms executed in a manner acceptable to Owner.

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

1. List of subcontractors.
2. Schedule of Values.
3. Contractor's Construction Schedule (preliminary if not final).
4. Products list.
5. Schedule of unit prices.
6. Submittals Schedule (preliminary if not final).
7. List of Contractor's staff assignments.
8. List of Contractor's principal consultants.
9. Copies of building permits.
10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
11. Initial progress report.
12. Report of preconstruction conference.
13. Certificates of insurance and insurance policies.
14. Performance and payment bonds.

15. Data needed to acquire Owner's insurance.
16. Initial settlement survey and damage report if required.

K. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
   1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
   2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

L. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
   1. Evidence of completion of Project closeout requirements.
   2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
   3. Updated final statement, accounting for final changes to the Contract Sum.
   4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
   5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
   6. AIA Document G707, "Consent of Surety to Final Payment."
   7. Evidence that claims have been settled.
   8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
   9. Final, liquidated damages settlement statement.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 013000 – PROJECT MANAGEMENT AND COORDINATION

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. Coordination.
   2. Submittals.
   3. Administrative and supervisory personnel.
   4. Project meetings.
   5. General installation provisions.
   6. Cleaning and protection.

1.2 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 these 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, cooperate with scheduled 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.
   4. Coordinate construction activities with public and private utilities.
      a. Notify New Jersey One Call a minimum of 48 hours prior to excavation or blasting.
      b. Notify the Owner and Engineer of any utility locations encountered which conflict with the work. Coordinate with the Owner and Utility Company in the protection, removal, relocation or replacement of conflicting utility locations.

B. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.
   1. Prepare similar memoranda for the Owner and separate Contractors where coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of Contractor's Construction Schedule.
   2. Preparation of the Schedule of Values.
   3. Installation and removal of temporary facilities and controls.
   4. Delivery and processing of submittals.
   5. Progress meetings.
   6. Pre-installation conferences.
   7. Project closeout activities.

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

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

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

B. Staff Names: Within 15 days of starting construction operations, submit a list of principal staff assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone.

1.4 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Engineer of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Engineer, within 3 days of the meeting.

B. Preconstruction Conference: Schedule a preconstruction conference and organizational meeting at the Project site or other convenient site prior to commencement of construction activities. Conduct the meeting to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, the Engineer, Engineer and their consultants; the Contractor and its superintendent; major subcontractors; manufacturers; suppliers and other concerned parties shall each be represented at the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:
   a. Tentative construction schedule.
   b. Phasing.
   c. Critical work sequencing.
   d. Designation of responsible personnel.
   e. Procedures for processing field decisions and Change Orders.
   f. Procedures for processing Applications for Payment.

g. Distribution of the Contract Documents.
h. Submittal procedures.
i. Preparation of Record Documents.
j. Use of the premises.
k. Responsibility for temporary facilities and controls.
l. Parking availability.
m. Office, work, and storage areas.
n. Equipment deliveries and priorities.
o. Safety procedures.
p. First aid.
q. Security.
r. Progress cleaning.
s. Working hours.
t. Housekeeping.
u. Subcontractors.
v. Preliminary Schedule of Shop Drawings and Samples.
w. Minority Business Enterprise Goals.
x. Co-ordination with other contractors.
y. Insurance in Force.
z. Contractor's Schedule of Values.

C. Pre-installation Conferences: Conduct a pre-installation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise the Engineer of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for the following:
   a. Contract Documents.
   b. Options.
   c. Related Change Orders.
   d. Purchases.
   e. Deliveries.
   f. Shop Drawings, Product Data and quality control Samples.
   g. Review of mockups.
   h. Possible conflicts.
   i. Compatibility problems.
   j. Time schedules.
   k. Weather limitations.
   l. Manufacturer's written recommendations.
   m. Warranty requirements.
   n. Compatibility of materials.
   o. Acceptability of substrates.
   p. Temporary facilities and controls.
   q. Space and access limitations.

r. Governing regulations.
s. Testing and inspecting requirements.
t. Required performance results.
u. Protection of construction and personnel.
v. Safety.
w. Recording requirements.

3. Record significant discussions, agreements and disagreements of each conference along with the approved progress schedule. Distribute the record of the meeting to everyone concerned, promptly, including the Owner and Engineer.
4. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Conduct progress meetings at the Project Site at regularly scheduled intervals. Coordinate dates of meetings with preparation of payment requests.

1. Attendees: In addition to representatives of the Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of Project.
   a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
   b. Review present and future needs of each entity present, including the following:
      1) Interface requirements.
      2) Time.
      3) Sequence of operations.
      4) Status of submittals.
      5) Deliveries.
      6) Off-site fabrication.
      7) Access.
      8) Site utilization.
      9) Temporary facilities and controls.
      10) Work hours.
      11) Hazards and risks.
      12) Progress cleaning.
      13) Quality and work standards.
      14) Change Orders.
      15) Documentation of information for payment requests.
3. Reporting: No later than 3 days after each progress meeting date, distribute copies of minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.

a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue the revised schedule concurrently with the report of each meeting.

E. Coordination Meetings: Conduct Project coordination meetings at regularly scheduled intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and pre-installation conferences.

1. Attendees: In addition to representatives of the Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work

2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to Combined Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

b. Schedule Updating: Revise Combined Contractor's Construction Schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.

c. Review present and future needs of each contractor present, including the following:

1) Interface requirements.
2) Time.
3) Sequence of operations.
4) Status of submittals.
5) Deliveries.
6) Off-site fabrication.
7) Access.
8) Site utilization.
9) Temporary facilities and controls.
10) Work hours.
11) Hazards and risks.
12) Progress cleaning.
13) Quality and work standards.
14) Change Orders.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

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

END OF SECTION

SECTION 013200 – CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
   1. Preliminary Construction Schedule.
   2. Contractor's Construction Schedule.
   3. Submittals Schedule.
   4. Construction photographs.

1.2 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
   1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
   2. Predecessor activity is an activity that must be completed before a given activity can be started.

B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

C. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Event: The starting or ending point of an activity.

E. Float: The measure of leeway in starting and completing an activity.
   1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
   2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.
   3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

F. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

G. Major Area: A story of construction, a separate building, or a similar significant construction element.

H. Milestone: A key or critical point in time for reference or measurement.

I. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

1.3 SUBMITTALS

A. Qualification Data: For firms and persons specified in "Quality Assurance" Article and in-house scheduling personnel to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. Submittals Schedule: Submit 3 copies of schedule. Arrange the following information in a tabular format:
   1. Scheduled date for first submittal.
   2. Specification Section number and title.
   3. Submittal category (action or informational).
   4. Name of subcontractor.
   5. Description of the Work covered.
   6. Scheduled date for Engineer's and Construction Manager final release or approval.

C. Preliminary Construction Schedule: Submit 2 printed copies; one a single sheet of reproducible media, and one a print.

D. Contractor's Construction Schedule: Submit 2 printed copies of initial schedule, one a reproducible print and one a blue- or black-line print, large enough to show entire schedule for entire construction period.

E. Construction Photographs: Submit a digital photo of each view within 7 days of taking photographs.
   1. Format: Digital JPG image with minimum resolution of 2584x1936 and image quality set to fine/high or better.
   2. Identification: A photo-log shall be provided containing a record for each submitted photo with the following information:
      a. File Name of Photo.
      b. Name of Project.
      c. Name and address of photographer.
      d. Name of Engineer and Construction Manager.
      e. Name of Contractor.
      f. Date photograph was taken.
      g. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
   3. Photo-logs may be scanned hard-copy forms, though digital formats such as MS Word, MS Excel or MS Access are preferred. If the delivery method for the photos is via an online file management system, photo-log records should be entered into that system provided it supports entering the above information.
   4. Delivery: If an online document management system or project collaboration website is used on the project, all photos and accompanying identification will be uploaded to it. Otherwise, digital photos will be delivered via traditional media such as CD, DVD, or uploaded to an FTP site.

1.4 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting.

1.5 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
   1. Secure time commitments for performing critical elements of the Work from parties involved.
   2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

C. Auxiliary Services: Cooperate with photographer and provide auxiliary services requested, including access to Project site and use of temporary facilities including temporary lighting.

PART 2 – PRODUCTS

2.1 SUBMITTALS SCHEDULE

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

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."

B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.
   1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
   1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Engineer.
   2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

3. Submittal Review Time: Include review and resubmittal times indicated in Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
   a.
4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
   1. Phasing: Arrange list of activities on schedule by phase.
   2. Work under More Than One Contract: Include a separate activity for each contract.
   3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
   4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
   5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
   6. Work Restrictions: Show the effect of the following items on the schedule:
      a. Coordination with existing construction.
      b. Limitations of continued occupancies.
      c. Uninterruptible services.
      d. Partial occupancy before Substantial Completion.
      e. Use of premises restrictions.
      f. Provisions for future construction.
      g. Seasonal variations.
      h. Environmental control.
   7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
      a. Subcontract awards.
      b. Submittals.
      c. Purchases.
      d. Mockups.
      e. Fabrication.
      f. Sample testing.
      g. Deliveries.
      h. Installation.
      i. Tests and inspections.
      j. Adjusting.
      k. Curing.
      l. Startup and placement into final use and operation.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to the Notice to Proceed, Substantial Completion, and Final Completion.

F. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.

1. Refer to Section "Payment Procedures" for cost reporting and payment procedures.

G. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

2.3 PRELIMINARY CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within 7 days of date established for the Notice to Proceed.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed. Base schedule on the Preliminary Construction Schedule and whatever updating and feedback was received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require 3 months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.5 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. Projects using CPM schedules should begin with a preliminary network diagram of type described below or a preliminary bar-chart schedule.

B. CPM Schedule: Prepare Contractor's Construction Schedule using a CPM network analysis diagram.

1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for the Notice to Proceed.
2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time.

C. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
   a. Preparation and processing of submittals.

b. Purchase of materials.
c. Delivery.
d. Fabrication.
e. Installation.

2. Processing: Process data to produce output data or a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
3. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
   a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

D. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Principal events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the Schedule of Values).

E. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

PART 3 – EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At bi-weekly intervals, update schedule to reflect actual construction progress and activities. Issue schedule 1 week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Engineer, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

3.2 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified commercial photographer to take construction photographs.

B. Date Stamp: Unless otherwise indicated, date and time stamp each photograph as it is being taken so stamp is integral to photograph.

C. Preconstruction Photographs: Before starting construction, take photographs of Project site and surrounding properties from different vantage points, as directed by Engineer. Show existing conditions adjacent to property.

D. Periodic Construction Photographs: Take color photographs monthly, coinciding with cutoff date associated with each Application for Payment. Photographer shall select vantage points to best show status of construction and progress since last photographs were taken.

1. Field Office Prints: Retain an electronic set of photographs in field office at Project site, available at all times for reference. Identify photographs the same as for those submitted to Engineer.

E. Final Completion Construction Photographs: Take photographs after date of Substantial Completion for submission as Project Record Documents. Engineer will direct photographer for desired vantage points.

END OF SECTION

SECTION 013300 – SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other miscellaneous submittals.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Engineer's responsive action.

B. Informational Submittals: Written information that does not require Engineer's approval. Submittals may be rejected for not complying with requirements.

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.3 Submittal Administrative Requirements:

A. Engineer's Digital Data Files: Electronic digital data files of the Contract Drawings will] be provided by Engineer for Contractor's use in preparing submittals.
   1. Engineer will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
      a. Engineer makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
      b. Digital Drawing Software Program: The Contract Drawings are available in AutoCad
      c. Contractor shall execute data licensing agreement.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
   3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
   4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
      a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.

D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Engineer.
3. Include the following information for processing and recording action taken:
   a. Project name.
   b. Date.
   c. Name of Engineer.
   d. Name of Construction Manager.
   e. Name of Contractor.
   f. Name of subcontractor.
   g. Name of supplier.
   h. Name of manufacturer.
   i. Submittal number or other unique identifier, including revision identifier.
      1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
   j. Number and title of appropriate Specification Section.
   k. Drawing number and detail references, as appropriate.
   l. Location(s) where product is to be installed, as appropriate.
   m. Other necessary identification.
4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Engineer or Construction Manager observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
   a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Engineer.
5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Engineer will return without review submittals received from sources other than Contractor.
   a. Transmittal Form for Paper Submittals: Use AIA Document G810 Transmittal Form for Paper Submittals: Provide locations on form for the following information:
      1) Project name.
      2) Date.
      3) Destination (To:).
      4) Source (From:).
      5) Name and address of Engineer.
      6) Name of Construction Manager.

7) Name of Contractor.
8) Name of firm or entity that prepared submittal.
9) Names of subcontractor, manufacturer, and supplier.
10) Category and type of submittal.
11) Submittal purpose and description.
12) Specification Section number and title.
13) Specification paragraph number or drawing designation and generic name for each of multiple items.
14) Drawing number and detail references, as appropriate.
15) Indication of full or partial submittal.
16) Transmittal number, numbered consecutively.
17) Submittal and transmittal distribution record.
18) Remarks.
19) Signature of transmitter.

E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
   a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Engineer.
4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:
   a. Project name.
   b. Date.
   c. Name and address of Engineer.
   d. Name of Construction Manager.
   e. Name of Contractor.
   f. Name of firm or entity that prepared submittal.
   g. Names of subcontractor, manufacturer, and supplier.
   h. Category and type of submittal.
   i. Submittal purpose and description.
   j. Specification Section number and title.
   k. Specification paragraph number or drawing designation and generic name for each of multiple items.
   l. Drawing number and detail references, as appropriate.
   m. Location(s) where product is to be installed, as appropriate.
   n. Related physical samples submitted directly.
   o. Indication of full or partial submittal.
   p. Transmittal number, numbered consecutively.
   q. Submittal and transmittal distribution record.
   r. Other necessary identification.
   s. Remarks.

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
   a. Project name.
   b. Number and title of appropriate Specification Section.
   c. Manufacturer name.
   d. Product name.

F. Options: Identify options requiring selection by Engineer.

G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
   1. Note date and content of previous submittal.
   2. Note date and content of revision in label or title block and clearly indicate extent of revision.
   3. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.

I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

PART 2 – PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
   1. Submit electronic submittals via email as PDF electronic files.
      a. Engineer, will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
   2. Action Submittals: Submit 3 paper copies of each submittal unless otherwise indicated. Engineer will return 2 copies.
   3. Informational Submittals: Submit 2 paper copies of each submittal unless otherwise indicated. Engineer will not return copies.
   4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
      a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
      b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
   1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.

2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.
4. For equipment, include the following in addition to the above, as applicable:
    a. Wiring diagrams showing factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:
    a. PDF electronic file.
    b. 3 paper copies of Product Data unless otherwise indicated. Engineer, will return 2 copies.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data,
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.
    g. Seal and signature of professional engineer if specified.
2. Submit Shop Drawings in the following format:
    a. PDF electronic file.
    b. Submit 3 opaque copies of each submittal. Engineer ill retain 2 copies; remainder will be returned.

D. 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 applicable Specification Section.
    e. Specification paragraph number and generic name of each item.

3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
4. 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.
    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
    a. Number of Samples: Submit 1 full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer, will return submittal with options selected.
6. 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 3 sets of Samples. Engineer will retain 2 Sample sets; remainder will be returned.
        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least 3 sets of paired units that show approximate limits of variations.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.
5. Submit product schedule in the following format:
    a. PDF electronic file.
    b. Submit 3 paper copies of product schedule or list unless otherwise indicated. Engineer, will return 2 copies.

F. Coordination Drawing Submittals: Comply with requirements specified in Division 01 Section "Project Management and Coordination."

G. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

H. Application for Payment and Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."

I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."

J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."

K. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

L. LEED Submittals: Comply with requirements specified in Division 01 sustainable design requirements Section.

M. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of Engineers and owners, and other information specified.

N. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

O. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

P. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

Q. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

R. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

S. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

T. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

U. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
   1. Name of evaluation organization.
   2. Date of evaluation.
   3. Time period when report is in effect.
   4. Product and manufacturers' names.

5. Description of product.
6. Test procedures and results.
7. Limitations of use.

V. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

W. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

X. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

Y. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

Z. Engineer Construction Photographs: Comply with requirements in Division 1 Section "Construction Progress Documentation."

2.2 DELEGATED-DESIGN SERVICES

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

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and 3 paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
   1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

2.3 CONTRACTOR'S PROJECT HEALTH & SAFETY PLAN

A. No later than the Pre-construction meeting, the Contractor shall submit to the Engineer a written Project Health & Safety Plan, which states the Contractor's company policy relative to safety. The plan must also address specific health and safety concerns, which are expected to be encountered on the project. As a minimum this plan shall include:
   1. Listing of project and company safety officers.
   2. Specific company safety policies.
   3. Employee Safety Training Program.
   4. Administrative procedures to handle employee health & safety concerns.
   5. Procedures for insuring worker compliance with health and safety requirements.

B. The Contractor shall be responsible to insure that each Subcontractor employed on the project complies with the requirements of this section either by submitting a copy of the subcontractor's Project Health & Safety Plan or by submitting a letter from the Subcontractor stating that they will comply with the provisions of the Contractor's Project Health & Safety Plan.

C. Submission of the required Project Health & Safety Plan by the Contractor is primarily for information or record purposes and shall not be construed to imply approval by the Engineer or to relieve the Contractor from the responsibility to adequately protect the health & safety of all workers involved in the project.

PART 3 – EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ENGINEER'S ACTION

A. General: Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or modifications required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

1. Final Unrestricted Release: Where submittals are marked "No Exceptions Taken," 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 "Make Corrections 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.
3. Returned for Resubmittal: When submittal is marked "Revise and Resubmit," "Rejected," or "Submit Specified Item," 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 "Revise and Resubmit," "Rejected," or "Submit Specified Item" 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 "Action Not Required."

C. Informational Submittals: Engineer will review each submittal and will not return it, or will reject and return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.

D. Submittals not required by the Contract Documents will not be reviewed and may be discarded.

END OF SECTION

SECTION 014000 – QUALITY REQUIREMENTS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Engineer.

C. Mockups: Full-size, physical example assemblies to illustrate finishes and materials. Mockups are used to verify selections made under Sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples.

D. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

1.3 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

1.4 SUBMITTALS

A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
   1. Specification Section number and title.
   2. Description of test and inspection.
   3. Identification of applicable standards.
   4. Identification of test and inspection methods.
   5. Number of tests and inspections required.
   6. Time schedule or time span for tests and inspections.
   7. Entity responsible for performing tests and inspections.
   8. Requirements for obtaining samples.
   9. Unique characteristics of each quality-control service.

D. Reports: Prepare and submit certified written reports that include the following:
   1. Date of issue.
   2. Project title and number.
   3. Name, address, and telephone number of testing agency.
   4. Dates and locations of samples and tests or inspections.
   5. Names of individuals making tests and inspections.
   6. Description of the Work and test and inspection method.
   7. Identification of product and Specification Section.
   8. Complete test or inspection data.
   9. Test and inspection results and an interpretation of test results.
   10. Ambient conditions at time of sample taking and testing and inspecting.
   11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
   12. Name and signature of laboratory inspector.
   13. Recommendations on retesting and reinspecting.

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

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in 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 the system, assembly, or products that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade-union jurisdictional settlements and similar conventions.

G. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E548, and that specializes in types of tests and inspections to be performed. Each testing agency shall be authorized by the authorities having jurisdiction in the state in which the project is located.

H. Preconstruction Testing: Testing agency shall perform preconstruction testing for compliance with specified requirements for performance and test methods.

1. Contractor responsibilities include the following:
   a. Provide test specimens and assemblies representative of proposed materials and construction. Provide sizes and configurations of assemblies to adequately demonstrate capability of product to comply with performance requirements.
   b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   c. Fabricate and install test assemblies using installers who will perform the same tasks for Project.
   d. When testing is complete, remove assemblies; do not reuse materials on Project.
2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Engineer, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

I. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Engineer.
2. Notify Engineer 7 days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Engineer's approval of mockups before starting work, fabrication, or construction.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed, unless otherwise indicated.

1.6 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of the types of testing and inspecting they are engaged to perform.
2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Unless otherwise indicated, provide quality-control services specified and required by authorities having jurisdiction.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
   a. Contractor shall not employ the same entity engaged by Owner, unless agreed to in writing by Owner.
2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Special Tests and Inspections: Owner will engage a testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner.

1. Testing agency will notify Engineer and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
2. Testing agency will submit a certified written report of each test, inspection, and similar quality-control service to Engineer with copy to Contractor and to authorities having jurisdiction.
3. Testing agency will submit a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
4. Testing agency will interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
5. Testing agency will retest and reinspect corrected work.

D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.

E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.

F. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
3. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
4. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
5. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field-curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for Notice to Proceed.
1. Distribution: Distribute schedule to Owner, Engineer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Sections of these Specifications. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching.
2. Comply with the Contract Document requirements for Division 1 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 015000 – TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes requirements for temporary services, facilities and controls, including temporary utilities, support facilities, and security and protection facilities.

B. Temporary utilities include, but are not limited to, the following:
1. Sewers and drainage.
2. Water service and distribution.
3. Sanitary facilities, including toilets, wash facilities, and drinking-water facilities.
4. Heating and cooling facilities.
5. Ventilation.
6. Electric power service.
7. Lighting.

C. Temporary construction and support facilities include, but are not limited to, the following:
1. Temporary roads and paving.
2. Dewatering facilities and drains.
3. Project identification and temporary signs.
4. Waste disposal facilities.
5. Field offices.
6. Construction aids and miscellaneous services and facilities.
7. Temporary enclosures.
8. Temporary heat.
9. Security and protection facilities include, but are not limited to, the following:
10. Environmental protection.
11. Stormwater control.
12. Tree and plant protection.
13. Sidewalk bridge and/or site enclosure fence.
14. Security enclosure and lockup.
15. Barricades, warning signs, and lights.
16. Temporary enclosures.

1.2 DEFINITIONS

A. Permanent Enclosure: As determined by Engineer, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.3 USE CHARGES

A. General: The cost of all use charges for temporary facilities are not chargeable to Owner or Engineer and shall be included in the Contract Sum. The contractor shall be responsible for paying all use charges until the project is substantially complete. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:

1. Owner's construction forces.
2. Occupants of Project.
3. Engineer.
4. Testing agencies.
5. Personnel of authorities having jurisdiction.

B. Water Service: Use water from Owner's existing water system without metering and without payment of use charges.

C. Electric Power Service: Use electric power from Owner's existing system without metering and without payment of use charges.

1.4 SUBMITTALS

A. Temporary Utility Reports: Submit reports of tests, inspections, utility billings, and similar procedures performed on temporary utilities.

B. Implementation and Termination Schedule: Within 15 days of date established for submittal of Contractor's Construction Schedule, submit a schedule indicating implementation and termination of each temporary utility.

1.5 QUALITY ASSURANCE

A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.
1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
2. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
3. Refer to Guidelines for Bid Conditions for Temporary Job Utilities and Services, prepared jointly by AGC and ASC, for industry recommendations.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Regulations: Comply with industry standards and applicable laws and regulations of 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.

1.6 PROJECT CONDITIONS

A. Temporary Utilities: At earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of permanent service. Prepare a schedule indicating date for implementation and terminations of each temporary facility.
1. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

B. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:

1. Keep temporary services and facilities clean and neat.
2. Relocate temporary services and facilities as required by progress of the Work.
3. Operate in a safe and efficient manner.
4. Take necessary fire prevention measures.
5. Dot not overload facilities or permit them to interfere with progress.
6. 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. Undamaged, previously used materials in serviceable condition may be used if approved by Engineer. Provide materials suitable for use intended.

B. Pavement: Comply with Division 32 pavement Sections.

C. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.76-mm-) thick, galvanized steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top rails . OR

D. Portable Chain-Link Fencing: Minimum 2-inch (50-mm) 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide galvanized steel bases for supporting posts.

E. Lumber and Plywood: Comply with requirements in Section "Rough Carpentry."

1. For job-built temporary offices, shops and 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 fences and vision barriers, provide exterior type, minimum 3/8" thick plywood.
4. For safety barriers, sidewalk bridges and similar uses, provide minimum 5/8" thick exterior plywood.

F. 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.

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

2.2 EQUIPMENT

A. Field Offices: Prefabricated or Mobile units or Job-built construction with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading.

B. Fire Extinguishers: Provide hand-carried, portable UL-rated, class "A fire extinguishers for temporary offices and similar spaces. In other locations provide hand-carried, portable, UL-rated, class "ABC dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures.

1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

C. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

D. Drinking-Water Fixtures: Containerized, or bottled-water drinking-water units, including paper cup supply.

E. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.

F. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

G. 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.

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

I. First Aid Supplies: Comply with governing regulations.

J. 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.

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Engage appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
2. Provide adequate capacity at each stage of construction. Before temporary utility is available, provide trucked-in services.
3. Obtain easements to bring temporary utilities to Project site where Owner's easements cannot be used for that purpose.

B. Water Service: Use of Owner's existing water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

1. Provide rubber hoses as necessary to serve Project site.

C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.
1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Provide separate facilities for male and female personnel.
3. Drinking-Water Facilities: Provide bottled-water, drinking-water units.
4. Locate toilets and drinking-water fixtures so personnel need not walk more than two stories vertically or 200 feet (60 m) horizontally to facilities.

D. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed.

E. Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnecting means, automatic ground-fault interrupters, and main distribution switchgear.
1. Install electric power service underground, unless overhead service must be used.
2. Install power distribution wiring overhead and rise vertically where least exposed to damage.
3. Connect temporary service to Owner's existing power source, as directed by electric company officials.

F. Electric Power Service: Use of Owner's existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to Owner.

G. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.
1. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
2. Provide metal conduit, tubing, or metallic cable for wiring exposed to possible damage. Provide rigid steel conduits for wiring exposed on grades, floors, decks, or other traffic areas.
3. Provide metal conduit enclosures or boxes for wiring devices.
4. Provide 4-gang outlets, spaced so 100 foot (30 m) extension cord can reach each area for power hand tools and task lighting. Provide a separate 125-V ac, 20-A circuit for each outlet.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
2. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines. Comply with NFPA 241.
3. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate to support loads and to withstand exposure to traffic during construction period. Locate temporary roads and paved areas as indicated on Drawings.

C. Dewatering Facilities and Drains: Comply with requirements in applicable Division 31 Sections for temporary drainage and dewatering facilities and operations not directly associated with construction activities included in individual Sections. Where feasible, use same facilities. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining property nor endanger permanent Work or temporary facilities.

D. Waste Disposal Facilities: Collect waste from construction areas and elsewhere daily. Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste. Comply with Division 1 Section "Execution Requirements" for progress cleaning requirements.

1. If required by authorities having jurisdiction, provide separate containers, clearly labeled, for each type of waste material to be deposited.
2. Develop a waste management plan for Work performed on Project. Indicate types of waste materials Project will produce and estimate quantities of each type. Provide detailed information for on-site waste storage and separation of recyclable materials. Provide information on destination of each type of waste material and means to be used to dispose of all waste materials.

E. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility services. Sheds may be open shelters or fully enclosed spaces within building or elsewhere on-site.

1. Construct framing, sheathing, and siding using fire-retardant-treated lumber and plywood.
2. Paint exposed lumber and plywood with exterior-grade acrylic-latex emulsion over exterior primer.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site.

B. Stormwater Control: Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of stormwater from heavy rains.

C. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from construction damage. Protect tree root systems from damage, flooding, and erosion.

D. Site Enclosure Fence: Before construction operations begin, install enclosure fence with lockable entrance gates. Locate where indicated, or enclose entire Project site or portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering site except by entrance gates.

1. Set fence posts in compacted mixture of gravel and earth.
2. Provide gates in sizes and at locations necessary to accommodate delivery vehicles and other construction operations.
3. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide Owner with one set of keys.

E. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

1. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.

F. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.

1. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8 inch (16 mm) thick exterior plywood.

G. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. [Provide temporary weathertight enclosure for building exterior].

1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
2. Vertical Openings: Close openings of 25 square feet (2.3 sq. m) or less with plywood or similar materials.
3. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
4. Install tarpaulins securely using fire-retardant-treated wood framing and other materials.
5. Where temporary wood or plywood enclosure exceeds 100 square feet (9.2 sq. m) in area, use fire-retardant-treated material for framing and main sheathing.

H. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

1. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
   a. Field Offices: Class A stored-pressure water-type extinguishers.
   b. Other Locations: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.

c. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.

2. Store combustible materials in containers in fire-safe locations.
3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for fire fighting. Prohibit smoking in hazardous fire-exposure areas.
4. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
5. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.
6. Develop and supervise an overall fire-prevention and first-aid fire-protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
7. Provide hoses for fire protection of sufficient length to reach construction areas. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.
8. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 OPERATION, TERMINATION, AND REMOVAL

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

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
2. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

C. Temporary Facility Changeover: Except for using permanent fire protection as soon as available, do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Unless the Engineer requests that it be maintained longer, remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are the property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.

3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 1 Section "Closeout Procedures."

END OF SECTION

SECTION 017300 – EXECUTION REQUIREMENTS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
   1. Construction layout.
   2. Field engineering and surveying.
   3. General installation of products.
   4. Coordination of Owner-installed products.
   5. Progress cleaning.
   6. Starting and adjusting.
   7. Protection of installed construction.
   8. Correction of the Work.

1.2 SUBMITTALS

A. Qualification Data: For land surveyor to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.3 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 EXAMINATION

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

B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
   1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.

2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

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

B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer and Owner not less than 48 hours in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer's and Owner's written permission.

C. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests on CSI Form 13.2A, "Request for Interpretation."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Engineer promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.

3. Inform installers of lines and levels to which they must comply.
4. Check the location, level and plumb, of every major element as the Work progresses.
5. Notify Engineer when deviations from required lines and levels exceed allowable tolerances.
6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
1. Do not change or relocate existing benchmarks or control points without prior written approval of Engineer Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Engineer before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of 2 permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: 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.

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.

2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
4. Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.
2. Allow for building movement, including thermal expansion and contraction.

G. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

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

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

3.9 CORRECTION OF THE WORK

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

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

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

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

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

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

END OF SECTION

SECTION 017329 – CUTTING AND PATCHING

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. Refer to other sections for specific requirements and limitations applicable to cutting and patching individual parts of the work.

1. Requirements in this Section apply to mechanical and electrical installations. Refer to Divisions 15 and 16 Sections for other requirements and limitations applicable to cutting and patching of mechanical and electrical installations.

1.2 DEFINITIONS

A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.3 SUBMITTALS

A. Cutting and Patching Proposal: Where approval of procedures for cutting and patching is required before proceeding, submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

1. Extent: Describe the extent of cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
2. Changes to Existing Construction: Describe anticipated results in terms of changes to existing construction; include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
3. Products: List products to be used and firms or entities that will perform the Work.
4. Dates: Indicate dates when cutting and patching will be performed.
5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.
6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
7. Engineer’s Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right of the Engineer to later require removal and replacement of unsatisfactory work.
8. Describe means for the protection of adjacent areas to where cutting and patching shall take place.

1.4 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

1. Foundation construction
2. Bearing and retaining walls

3. Structural concrete
4. Structural steel
5. Lintels
6. Timber and primary wood framing
7. Miscellaneous structural metals
8. Shoring, bracing, and sheeting
9. Structural systems of special construction in Division 13

B. Operational Elements: Do not cut and patch the following operating elements or safety related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
1. Primary operational systems and equipment.
2. Air or smoke barriers.
3. Fire-protection systems.
4. Control systems.
5. Communication systems.
6. Conveying systems.
7. Electrical wiring systems.
8. Operating systems of special construction in Division 13 Sections.

C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Exterior curtain-wall construction.
4. Equipment supports.
5. Piping, ductwork, vessels, and equipment.
6. Noise- and vibration-control elements and systems.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
1. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.
   a. Processed concrete finishes.
   b. Ornamental metal.
   c. Preformed metal panels.
   d. Roofing.
   e. Firestopping.
   f. Window wall system.
   g. Finished wood flooring.
   h. Fluid-applied flooring.
   i. Wall covering.
   j. HVAC enclosures, cabinets, or covers.

1.5 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 – PRODUCTS

2.1 MATERIALS

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

B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Prior to cutting existing services, examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed. Take corrective action before proceeding. If unsafe or unsatisfactory conditions are encountered, investigate both sides of the surface involved. Determine exact location of structural members.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary shoring and support of Work to be cut to prevent settlement or other damage to existing construction to remain.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid interruption of services to occupied areas.

E. Take all precautions necessary to avoid cutting existing pipe, conduit or ductwork serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, where cutting is required, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Existing Finished Surfaces: To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 02 Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Bypass utility services such as pipe or conduit, before cutting, where services are shown or required to be moved, relocated, or abandoned. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Comply with specified tolerances. Provide materials and comply with installation requirements specified in other Sections of these Specifications. Perform patching around items penetrating existing construction in a manner that will maintain the water and fire resistive capability of the existing construction.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance
   a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
   b. Where surfaces exposed by removals are to remain as exposed surfaces, paint such areas to match adjacent surfaces as closely as practicable using paint with the same characteristics and appearance as the existing to remain.
4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
6. Where reinstallation of removed items is indicated, reinstall them to a condition equal to or better than their condition before removal.

END OF SECTION

SECTION 017700 – CLOSEOUT PROCEDURES

PART 1 – GENERAL

1.1 SUMMARY

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

1.2 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
   1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   2. Advise Owner of pending insurance changeover requirements.
   3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
   6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
   7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
   8. Complete startup testing of systems.
   9. Submit test/adjust/balance records.
   10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
   11. Advise Owner of changeover in heat and other utilities.
   12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
   13. Complete final cleaning requirements, including touchup painting.
   14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.
   1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

2. Results of completed inspection will form the basis of requirements for Final Completion.

1.3 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
   1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."
   2. Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
   4. Submit pest-control final inspection report and warranty.
   5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
   1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.4 PROJECT RECORD DOCUMENTS

A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Engineer's reference during normal working hours.

B. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.
   1. Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
      a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
      b. Accurately record information in an understandable drawing technique.
      c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
      d. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.
   2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
   3. Mark important additional information that was either shown schematically or omitted from original Drawings.
   4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.

5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.

C. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
   3. Note related Change Orders, Record Drawings and Product Data, where applicable.

D. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

1.5 OPERATION AND MAINTENANCE MANUALS

A. Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:
   1. Operation Data:
      a. Emergency instructions and procedures.
      b. System, subsystem, and equipment descriptions, including operating standards.
      c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
      d. Description of controls and sequence of operations.
      e. Piping diagrams.
   2. Maintenance Data:
      a. Manufacturer's information, including list of spare parts.
      b. Name, address, and telephone number of Installer or supplier.
      c. Maintenance procedures.
      d. Maintenance and service schedules for preventive and routine maintenance.
      e. Maintenance record forms.
      f. Sources of spare parts and maintenance materials.
      g. Copies of maintenance service agreements.
      h. Copies of warranties and bonds.

B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

1.6 WARRANTIES

A. Submittal Time: Submit written warranties on request of Engineer for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
   1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (115-by-280-mm) paper.
   2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark 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 Installer.
   3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 – PRODUCTS

2.1 MATERIALS

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

PART 3 – EXECUTION

3.1 DEMONSTRATION AND TRAINING

A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Provide instructors experienced in operation and maintenance procedures.
   2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
   3. Schedule training with Owner with at least **7** days advance notice.
   4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.

B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:
   1. System design and operational philosophy.
   2. Review of documentation.
   3. Operations.
   4. Adjustments.
   5. Troubleshooting.
   6. Maintenance.
   7. Repair.

3.2 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
   a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
   b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
   c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
   d. Remove tools, construction equipment, machinery, and surplus material from Project site.
   e. Remove snow and ice to provide safe access to building.
   f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
   g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
   h. Sweep concrete floors broom clean in unoccupied spaces.
   i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
   j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
   k. Remove labels that are not permanent.
   l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
      1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
   m. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
   n. Replace parts subject to unusual operating conditions.
   o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
   p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
   q. Clean ducts, blowers, and coils if units were operated without filters during construction.
   r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
   s. Leave Project clean and ready for occupancy.

C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.

D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION

SECTION 023219 – EXPLORATORY EXCAVATION

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes exploratory excavations for the purpose of verifying the exact locations of underground utilities, structures, and other subsurface conditions.

1.2 SUBMITTALS

A. Sketches: Submit a sketch showing the location of the subsurface features which were uncovered in the test pit, including the following information:
   1. Horizontal location of the subsurface feature relative to three individual surface features.
   2. Depth of feature below ground surface.
   3. Diameter, type, material, and condition of pipe or conduit.
   4. Orientation of pipe, conduit or structure relative to other site features.
   5. Other pertinent dimensions.
   6. Exploratory excavation identification number.
   7. Discrepancies from design plan

1.3 JOB CONDITIONS

A. Perform exploratory excavations only within the limits of the work, easements and rights of way.

B. Excavate exploratory excavations with care to avoid damage to structures and utilities. Excavate by hand if necessary. Promptly repair any damaged utilities and structures at no cost to the Owner.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.1 GENERAL

A. Exploratory excavations shall be performed in advance of construction, where necessary, at the locations shown on the Drawings, or where directed by the Engineer. Determine the exact location of all pipes, conduits, duct, or other interfering structures in both horizontal and vertical locations. Excavate to the depth and width necessary to accurately determine the locations of the utilities of interest.

B. Upon satisfactory execution of the required exploratory excavations the Engineer shall adjust pipe elevations, alignment or design he feels necessary to minimize interferences.

C. Backfill exploratory excavations in accordance with Section “Trenching and Backfilling”

D. Exploratory excavations performed in areas to be further disturbed shall be graded for temporarily traffic or use.

E. Exploratory Excavations performed in areas not to be further disturbed shall be restored to pre construction conditions.

END OF SECTION

SECTION 033000 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Footings.
   2. Foundation walls.
   3. Slabs-on-grade.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

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

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
   1. Shoring and Re-shoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and re-shoring installation and removal.

E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
   1. Location of construction joints is subject to approval of the Architect.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer, and testing agency.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Semi-rigid joint filler.
13. Joint-filler strips.
14. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Section 1 Through 5 and Section 7, “Lightweight Concrete”
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
   a. Contractor's superintendent.
   b. Independent testing agency responsible for concrete design mixtures.
   c. Ready-mix concrete manufacturer.
   d. Concrete subcontractor.
   e. Retain first subparagraph below if special concrete finishes are included in Project.
   f. Special concrete finish subcontractor.
2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semi-rigid joint fillers, forms and form removal limitations, shoring and re-shoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
   a. High-density overlay, Class 1 or better.
   b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
   c. Structural 1, B-B or better; mill oiled and edge sealed.
   d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

G. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

H. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive damp-proofing or waterproofing.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland cement: ASTM C 150, Type I gray.
   a. Fly Ash: ASTM C 618, Class F or C.

B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Lightweight Aggregate: ASTM C 330

D. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: 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. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

C. Chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch (10 by 19 mm).

2.6 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
1. Products: Subject to compliance with requirements, provide the following:
a. Stego Industries, LLC; Stego Wrap 10 mil Class A.

B. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch (9.5-mm) sieve, 10 to 30 percent passing a No. 100 (0.15-mm) sieve, and at least 5 percent passing No. 200 (0.075-mm) sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
b. BASF Construction Chemicals - Building Systems; Confilm.
c. ChemMasters; SprayFilm.
d. Conspec by Dayton Superior; Aquafilm.
e. Dayton Superior Corporation; Sure Film (J-74).
f. Edoco by Dayton Superior; BurkeFilm.
g. Euclid Chemical Company (The), an RPM company; Eucobar.
h. Kaufman Products, Inc.; Vapor-Aid.
i. Lambert Corporation; LAMBCO Skin.

j. L&M Construction Chemicals, Inc.; E-CON.
k. Meadows, W. R., Inc.; EVAPRE.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group; MONOFILM.
n. Sika Corporation; SikaFilm.
o. SpecChem, LLC; Spec Film.
p. Symons by Dayton Superior; Finishing Aid.
q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
r. Unitex; PRO-FILM.
s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

2.8 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber

B. Semi-rigid Joint Filler: Two-component, semi-rigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.9 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.10 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, by not less than 40 percent.
   1. Fly Ash: 25 percent.
   2. Combined Fly Ash and Pozzolan: 25 percent.
   3. Ground Granulated Blast-Furnace Slag: 50 percent.
   4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent Portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
   5. Silica Fume: 10 percent.
   6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
   7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
   4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 4000 psi at 28 days.
   2. Maximum Water-Cementitious Materials Ratio: 0.45.
   3. Slump Limit: 5 inches for concrete with verified slump of 4 to 6 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
   4. Air Content: 5 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

B. Foundation Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength 4000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 5 inches for concrete with verified slump of 4 to 6 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
4. Air Content: 5 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 3000 psi at 28 days.
2. Minimum Cementitious Materials Content: 470 lb/cu. yd.
3. Slump Limit: 5 inches, plus or minus 1 inch.
4. Air Content: 5 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.12 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
   1. Class A, 1/8 inch for smooth-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Install keyways, reglets, recesses, and the like, for easy removal.
   2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
   2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
   3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation, and removal of shoring and reshoring.
1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

C. Granular Course: Cover vapor retarder with fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch (0 mm) or minus 3/4 inch (19 mm).
1. Place and compact a 1/2-inch- (13-mm-) thick layer of fine-graded granular material over granular fill.

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.

3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water 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. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part Portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part Portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. 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.

3.10 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.

1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings] [to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic, or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
   a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
   b. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
   c. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
   d. Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24.
3. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.11 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.12 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (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.
   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.13 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than seven days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.14 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least [**one**] month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.15 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area 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.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.16 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel reinforcement placement.
2. Headed bolts and studs.

3. Verification of use of required design mixture.
4. Concrete placement, including conveying and depositing.
5. Curing procedures and maintenance of curing temperature.
6. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.
   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C 31/C 31M.
   a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
   b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
   a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
   b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 24 hours of finishing.

3.17 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION

SECTION 042000 UNIT MASONRY ASSEMBLIES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide unit masonry work, as indicated on Drawings and as specified herein. Include, but do not limit to:

1. Concrete masonry unit (CMU) work.
2. Masonry reinforcing, anchors, and ties.
3. Reinforced unit masonry work.
4. Masonry flashings.
5. All other unit masonry work shown on Drawings or reasonably required to make work of this Section complete in all respects.

1.02 REFERENCES

A. Comply with applicable requirements of following standards. Where these standards conflict with other specified requirements, most restrictive shall govern.

1. American Society for Testing and Materials (ASTM):

A 82	Cold-Drawn Steel Wire for Concrete Reinforcement
A 116	Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric
A 153	Zinc-Coating (Hot-Dip) on Iron and Steel Hardware
A 185	Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement.
A 496	Steel Wire, Deformed, for Concrete Reinforcement
A 615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
C 90	Load Bearing Concrete Masonry Units
C 140	Concrete Masonry Units, Sampling and Testing
C 144	Aggregate for Masonry Mortar
C 150	Portland Cement
C 207	Hydrated Lime for Masonry Purposes

C 236	Steady-State Thermal Performance of Building Assemblies by Means of the Guarded Hot Box
C 270	Mortar for Unit Masonry
C 404	Aggregate for Masonry Grout
C 476	Grout for Reinforced and Nonreinforced Masonry
C 952	Bond Strength of Mortar to Masonry Units
D 226	Asphalt-Saturated Organic Felt Used In Roofing and Waterproofing
D 1056	Flexible Cellular Materials - Sponge or Extruded Rubber
E 119	Fire Tests for Building Construction and Materials
E 447	Compressive Strength of Masonry Prisms

2. International Masonry Institute (IMI):

Ref. 1	Recommended Practices & Guide Specifications for Cold Weather Masonry Construction

1.03 TESTS

A. Fire Resistance: Where fire-resistance ratings are indicated or required by authorities having jurisdiction, provide materials and assemblies tested in compliance with ASTM E 119 by an independent testing laboratory acceptable to Architect and authorities that have jurisdiction.

B. Testing and inspection of mortar and masonry materials will be conducted by testing laboratory selected and paid for as described under Division 01, GENERAL REQUIREMENTS.

C. No materials shall be used on work without prior test and written approval of Testing Laboratory. Materials shall be submitted to Testing Laboratory at least three weeks in advance of proposed first use in structure for subjection to basic acceptance tests and determination of basic mixtures.

D. At start of field operations, and periodically during course of work, Testing Laboratory will test materials and mortar and conduct on-job inspections of measuring, mixing, laying, and curing of mortar and masonry materials, including prism tests, in conformance with ASTM C 952 and ASTM E 447 (Method B), to ensure compliance with these specifications and originally approved samples. Number and frequency of tests shall be determined by Testing Laboratory and Architect. Recommendations of Testing Laboratory shall be strictly followed.

E. Prepare seven-day and 28-day prisms for each 5,000 sq. ft. of CMU wall area installed, and deliver to testing laboratory as directed.

1. Height:thickness ratio for CMU prisms shall be no less than 1.33:1 and no more than 3:1.

1.04 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for the following:

1. Control Joint Shop Drawings: Submit shop drawings for locations of control joints in concrete unit masonry work.

B. Masonry Samples: Submit representative samples for each material as follows. Delivered materials shall closely match approved samples.

1. Split faced masonry units: Submit six full size units of each type, size, and color for approval prior to construction of Field Mock-Ups.
2. Mortar: Submit sample box containing actual mortar samples of full range of mortar colors available. Submit cured mortar samples of each mortar color selected.

C. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents, unless such deviations are specifically brought to the attention of the Architect and approved in writing.

D. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

E. Material Test Reports: From a qualified testing agency indicating and interpreting test results of the following for compliance with requirements indicated:

1. Each type of masonry unit required.
2. Include size-variation data for masonry, verifying that actual range of sizes falls within specified tolerances.
3. Grout mixes complying with compressive strength requirements of ASTM C 476. Include description of type and proportions of grout ingredients.

F. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Each type of masonry unit required. Include size-variation data for units, verifying that actual range of sizes falls within specified tolerances.

a. Each cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.
b. Each material and grade indicated for reinforcing bars.
c. Each type and size of joint reinforcement.
d. Each type and size of anchor, tie, and metal accessory.

e. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.05 QUALITY ASSURANCE

A. Mockups: Build one (1) mockup to verify selections made and to demonstrate aesthetic effects and set quality standards for materials and execution.

B. Build mockups for typical exterior wall in sizes approximately 72 inches (1800 mm) long by 72 inches (1800 mm) high by full thickness, including face and backup wythes and accessories.

C. Protect accepted mockups from the elements with weather-resistant membrane.

D. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.

1. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.

1.06 PROJECT CONDITIONS

A. Hot Weather Protection: Use mortar within 1-1/2 hours after mixing. Discard mortar over 1-1/2 hours old and mortar stiffened due to hydration (setting).

B. Cold Weather Protection: Strictly comply with IMI Ref. 1.

C. Protection: Cover walls at end of each days work. Extend cover 24 in. down sides of walls and hold securely in place.

D. Loading: Do not apply loads until work has set and cured and is ready to accept loading.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered, stored, and handled fully protected from wetting, staining, chipping, and other damage. Store masonry materials on raised timber or platforms, above ground, under weathertight covers or indoors, and kept clean and dry.

B. Deliver and store cement, lime, and other perishable materials in their original containers, plainly marked with brand name and manufacturer's name, indoors or in weathertight sheds.

C. Protect metal accessories and reinforcement from elements. Immediately before placing, remove loose rust, dirt, and other foreign materials.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. Provide moisture-controlled, normal weight, load bearing units of Portland cement, water, sand, and gravel. Provide hollow and/or solid configurations as indicated, and conforming to ASTM C 90. Provide concrete masonry units with following characteristics:

1. Moisture Content: Not more than 35% of total absorption when tested in accordance with ASTM C 140. Maintain moisture content within this limit throughout storage and construction.
2. Residual Linear Shrinkage: Not more than 0.01% when dried to equilibrium of 50% relative humidity at 73oF. ambient temperature.
3. Provide block exposed in finished work with uniform medium-fine texture for interior of building and split face texture for exterior exposures. Manufacture units in a single run, uninterrupted except at ends of normal working days, to assure uniformity of color and texture. Moderate "manufacturing range" of variation in color and texture will be permitted, but such variations shall not exceed those shown on approved sample panels.
4. Size: Provide units 8 in. by 16 in. nominal face size, and of indicated nominal thicknesses.
5. Color: Provide Owner with selection of manufacturer's standard colored block selections.
6. Faces of units exposed in finished work shall be handled and stored with extreme care to prevent chipping or marring. Chipped or otherwise damaged faces will not be permitted in exposed work.
7. Provide half-blocks, lintel blocks, beam "U" blocks, other special blocks, and required special cutting. Provide jamb blocks, end blocks, control joint blocks, and lintel blocks with exposed ends closed.

2.04 MORTAR MATERIALS

A. Portland cement: ASTM C 150, Type I, free from water soluble salts and alkalies. Provide cement which exhibits no efflorescence when tested in conformance with these specifications.

B. Lime: ASTM C 207, hydrated, Type S.

C. Grout Aggregate: Complying with ASTM C 404.

D. Mortar Aggregate: Complying with ASTM C 144, well graded.

E. Mortar Pigment: Natural and synthetic oxides of iron and chrome, compounded for use in mortar. Use only pigments with proven record of performance. Provide products equal to Davis Colors or Solomon Grind-Chem.

F. Water: Clean, potable.

G. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer. Subject to compliance with requirements, provide one of the following:

1. Mortar Tite; Addiment Inc.
2. Dry-Block Mortar Admixture; W. R. Grace & Co., Construction Products Division.
3. Rheopel; Master Builders.

2.05 REINFORCING TIES AND ANCHORS

A. Horizontal Joint Reinforcing and Masonry to Masonry Ties: Provide ladder type, welded wire units fabricated from 3/16 in. ASTM A 82 cold-drawn steel wire, deformed side rods and smooth cross wires spaced 16 in. o.c. maximum. Provide prefabricated corners and tees. Provide one side rod for each concrete masonry shell face. Provide two-piece adjustable eye and pintel type units for concrete masonry composite wall construction with pintel units welded to truss-type reinforcing. Provide width as recommended by manufacturer for wall which gives minimum of 5/8 in. cover on exterior walls. Provide units factory welded equal to Hohman and Barnard Lox-All Adjustable Eye Wire Truss Type #170. Hot-dip galvanize units after fabrication.

B. Masonry to Concrete Anchors: Furnish 24 gauge hot-dip galvanized steel dovetail slots to General Contractor for installation by concrete trade. Provide hot-dip galvanized flexible dovetail ties equal to Hohman and Barnard #315, sized for dovetail slot.

C. Masonry to Structural Steel Anchors: Provide two-piece, hot-dip galvanized flexible anchors that permit horizontal and vertical movement and that provide secure lateral restraint.

D. Miscellaneous Ties: Provide hot dip galvanized steel straps, bars, rods, and similar items which are fabricated from minimum 16 gage steel sheet or 3/16 in. diameter steel wire.

E. Reinforcing Bars: ASTM A 615, Grade 60, deformed rebars.

F. Galvanizing: Provide hot-dip galvanized, ASTM A 153, Class B, 1.5 oz./ft.2 zinc coating on ties, joint reinforcing, anchors, and similar items which extend into exterior wall assemblies.

2.06 FLASHING MATERIALS

A. Through-Wall Flashing: Electrolytically deposited sheet of copper weighing not less than 5 oz. per sq. ft., bonded to two layers of asphalt saturated fiberglass fabric, equal to that produced by Wasco/York Mfg. Co., Sandell Mfg. Co., or Afco Products Co. Flexible polyester reinforcement mat for use at control joints shall be equal to Karnak "Poly-Mat" used with Karnak "AR Elastomeric" mastic.

Note: Sample cuts of delivered materials may be taken by Owner for testing to assure compliance with the specified weight requirements.

B. Membrane Flashing: Perm-A-Barrier Wall Flashing manufactured by Grace Construction Products, or approved equal, consisting of 32 mils of self-adhesive rubberized asphalt integrally bonded to 8 mils of cross-laminated, high-density polyethylene film to provide a min. 40 mil thick membrane. Membrane flashing shall be interleaved with disposable silicone-coated release paper until installed. Performance Requirements:

1. Water Vapor Transmission: ASTM E 96, Method B – 2.9 ng/m2sPa (0.05 perms) maximum

2. Water Absorption: ASTM D 570 – Max. 0.1% by weight
3. Puncture Resistance: ASTM E 154 – 178 N (40 lbs.)
4. Tear Resistance:
   a. Initiation – ASTM D 1004 – min. 58 N (13.0 lbs.) M.D.
   b. Propagation – ASTM D 1938 – min. 40 N (9.0 lbs.) M.D.
5. Lap Adhesion at -4ºC (25ºF): ASTM D 1876 – 880 N/M (5.0 lbs./in.) of width
6. Low Temperature Flexibility – ASTM D 1970 – Unaffected to -43ºC (-45ºF)
7. Tensile Strength: ASTM D 412, Die C Modified – Min. 5.5 MPa (800 psi)
8. Elongation, Ultimate Failure of Rubberized Asphalt: ASTM D412, Die C – Min. 200%.
9. Roll Width: 12 in., 18 in., or 36 in. as required.

C. Elastomeric Membrane Flashing Accessories: Provide manufacturer's standard surface conditioners, primers, preformed corners, end dams, and other related materials as required for proper installation.

2.07 MISCELLANEOUS MATERIALS

A. Bond Breaker: 15 lb. roofing felt complying with ASTM D 226.

B. Control Joint for CMU: Solid rubber strips, Shore A hardness of 60-80 and designed to fit standard control joint concrete masonry units and maintain lateral stability.

C. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, 3/8 by 1-1/2 by 3-1/2 inches. Subject to compliance with requirements, provide one of the following:

D. Rigid Insulation: Specified under Section 072100, THERMAL INSULATION.

E. Cavity Drainage Material: thickness as required to fit firmly between back of masonry veneer and face of cavity wall insulation, free-draining mesh; made from polyethylene strands and shaped to avoid being clogged by mortar droppings. Subject to compliance with requirements, provide one of the following:

1. Mortar Break; Advanced Building Products, Inc.
2. CavClear Masonry Mat; CavClear.
3. Mortar Net; Mortar Net USA, Ltd.
4. Mortar Stop; Polytite Manufacturing Corp.

F. Masonry Cleaning Materials: Provide one of the following products as applicable for cleaning mortar stains, job dirt, and job stains from masonry work:

1. Cleaning Material for Dark Colored Masonry: Sure Klean 600 Detergent; ProSoCo, Inc., Kansas City, KS 66117.
2. Cleaning Material for Light Colored Masonry: Sure Klean 101 Lime Solvent; ProSoCo, Inc., Kansas City, KS 66117.
3. Cleaning Material for Masonry with Colored Mortar Joints: Sure Klean Vana-Trol; ProSoCo, Inc., Kansas City, KS 66117.

2.08 MORTAR AND GROUT MIXES

A. Mortar: Provide mortar complying with ASTM C 270. Mix using known volume measures. Do not batch by shovel.

1. Provide Type N mortar for masonry above grade and interior and exterior work, except as indicated otherwise.
2. Provide Type M mortar for reinforced and load bearing masonry, and elsewhere as indicated.
3. Provide Type M mortar for masonry below grade and in contact with earth and elsewhere as indicated.

B. Grout: Provide grout complying with ASTM C 476 and with consistency appropriate to conditions so that grout will completely fill spaces intended to receive grout.

C. Do not use admixtures or anti-freeze agents. Do not use masonry cement. Do not use calcium chloride or any compounds or mortar ingredients containing chlorides.

1. To prevent color variations, do not re-temper mortar which contains color pigments.

D. Mortar Color: Provide mortar color as selected by Architect. Do not exceed pigment to mortar ratio by 1:10.

PART 3 EXECUTION

3.01 MASONRY CONSTRUCTION, GENERAL

A. Masonry work shall be done by skilled masons, fully instructed as to requirements of this specification, and adequately supervised during work.

B. Cold weather masonry shall conform to BIA Ref. 1 and following:

1. Do no masonry work when outdoor temperature is less than 40oF. unless provisions are made to adequately protect materials and finished work from frost by heating materials, enclosing work, and heating enclosed spaces.
2. If masonry work must be done when ambient temperature is freezing or below, all masonry material must be at temperature between 50oF. and 90oF., and mortar, when used, shall have a temperature between 60oF. and 80oF. In addition, all masonry shall be protected from temperatures below 40oF. for at least 48 hours after being laid.

C. Lay masonry plumb, true to line, and with level courses, with straight, clean, uniform joints, and true surfaces, and plumb corners. Maintain vertical alignment of joints as required by bond patterns indicated. Align horizontal joints with tops of openings, as indicated. Lay units in solid partitions to provide same evenness of surface on each side.

D. Adjust each masonry unit in final position while mortar is still soft and plastic. Remove units disturbed after mortar has stiffened and re-lay with fresh mortar.

E. Provide chases, slots, and recesses as required to accommodate work of other trades. Close only after such work has been installed, tested, and approved. As work progresses, set anchors, bolts, frames, and work of other Sections required to be built into masonry. No cutting and patching of completed masonry work will be permitted except as approved by Architect.

F. Do not use installed masonry work to support or in any way receive scaffolding or other temporary supports.

G. Grout steel frames solidly into masonry openings. Grout under continuous blockings bearing on masonry walls to provide uniform continuous bearing. Grout elevator thresholds solidly and to proper levels.

H. Install loose steel lintels furnished under Section 055000, METAL FABRICATIONS.

I. Cooperate and coordinate work of this Section with Waterproofing trades. Coordinate work of this Section with installation of flashings by other trades. Apply 6 in. depth of weep baffle material directly above built-in flashings to ensure free weepage. Provide weepholes 16 in. on center horizontally at courses of exterior wythes above flashings.

J. Maintain masonry clean as work progresses. Exercise extreme care at exposed work to prevent smearing or staining with mortar.

K. At completion of work cut out and rejoint holes and defective joints, leaving entire work free of blemishes.

3.02 CONCRETE MASONRY UNIT WORK

A. Lay concrete masonry units in “Running Bond” pattern unless otherwise indicated. Finish height of each course of block (unit plus one joint) shall be 8 in. Construct concrete masonry unit work to conform to approved mock-up panels.

1. Provide solid units at corners and control joints.

B. Use full mortar bedding when laying starting courses, courses in load-bearing walls, and courses of fire-resistive walls. Use face shell bedding when laying other courses. Fully butter shells of vertical joints. Fully mortar webs and face shells at masonry ties and anchors. Strike joints flush with exposed faces of block when units are laid, and then finish as specified below.

C. Cutting of exposed units shall be done with a dry, motor-driven carborundum blade to insure straight, even cut edges. Cutting by hand or wet cutting will not be permitted. Drill and cut holes, chases, notches, and other penetrations with power tools.

D. Where it is necessary to decrease thickness of face web in order to accommodate conduit, pipes, and similar items, void surrounding such items shall be filled solidly with mortar to reduce danger of cracking. Also, longitudinal reinforcing shall not be cut or otherwise interrupted at these points.

E. In addition to grouting at structural reinforcing, hollow concrete masonry unit work shall be grouted solidly with pouring grout at following locations:

1. The first two cells of units abutting wall openings and wall ends.
2. Cells of course immediately above and below wall openings.
3. Cells where necessary for embedment of concealed anchor plates, anchors, bolts, bearing on structural members, and similar items, as indicated or reasonably required.
4. Cells of other units where specifically called for on Drawings.

F. Where anchor plates, anchors, bolts, and other metal items are embedded in concrete unit masonry, provide screening in joint below to prevent mortar from dropping through voids.

G. When mortar at exposed joints of regular concrete masonry units has become partially set and will make a thumb-print under pressure without displacement of mortar, tool joints to a glassy-hard, smooth, concave finish using 1 in. diameter stainless steel sled jointer.

1. Horizontal and vertical joints at exposed interior face of scored block shall be raked to match vertical score line.
2. At concealed work, strike joints flush and do not finish.

H. Control Joints in Concrete Masonry Unit Work: Provide control joints as follows:

1. Provide vertical control joints in field of interior concrete masonry unit work, including inner wythes of exterior walls, as shown on Drawings. Unless otherwise indicated, construct control joint with closed-end type block to form a continuous, full-height open joint approximately 3/8 in. wide. Omit mortar from joint and substitute compressible semi-rigid glass fiber joint filler to within 3/4 in. of each face, ready to receive joint backing and sealant by sealant trade.
2. Provide control joints at ends of interior concrete masonry unit walls at steel columns. Longitudinal reinforcing "Tees" (concrete unit masonry-to-concrete unit masonry) and masonry anchors (masonry-to-steel columns) at these joints shall be as specified in this Section. Fill masonry-to-masonry joints solidly with mortar and rake out 3/4 in. deep, ready to receive joint backing and sealant. Install compressible joint filler at masonry-to-steel column joints, held back 3/4 in. on each face to receive joint backing and sealant.
3. Provide control joints at top of each interior non-bearing wall and partition and ceiling or framing member above, as indicated. Control joints shall be thickness as required by conditions encountered, but not less than 1-1/2 in. at steel framing members and 1 in. at steel deck.

3.03 BRICK MASONRY WORK -NOT USED

A. Face brick shall be studied for permeability before laying. Lay hard impervious brick dry to assure maximum bonding. Lay bricks with high rate of absorption (in excess of 0.025 oz. per sq. in. per minute under ASTM C 67) moist, but free of surface moisture, to permit proper moisture retention on mortar.

B. Lay face brick in pattern indicated on Drawings. Construct brickwork to conform to approved sample panel.

1. Finish height of three courses (three bricks plus three joints) shall be 8 in.

C. Shove bricks into place (do not lay) in full mortar beds, with vertical and horizontal joints completely filled. Do not slush. Strike exposed joints flush with face of brick, then finish as specified below. At cavity construction install face brick after dampproofing mastic and rigid insulation has been installed over back-up construction. Provide temporary wood or metal strips in cavities, raised as work is carried up, or other suitable method to prevent mortar from falling into cavity and from bridging across to back-up wythe.

D. When mortar at exposed joints has become partially set, but still sufficiently plastic to flow under pressure (i.e., is "thumb-print" hard), tool joints to a glassy hard, smooth, concave finish using 1 in. sled-type stainless steel jointer.

E. Provide control joints in brick masonry work, located as shown on Drawings, ready to receive joint backing and sealant. Control joint shall be straight joint as required. Carefully review Drawings to determine exact scope and nature of control joint work. Rake joints between brickwork and adjoining different materials approximately 3/4 in. deep, ready to receive joint backing and sealant provided under Section 079200, JOINT SEALANTS.

F. Weep Holes: Provide full open head joints in first course immediately above flashing locations. Maximum spacing of weepholes shall be 24 in. o.c. horizontally. Install specified weep vent material in open head joints as the work progresses. Keep weepholes and area above flashing free of mortar droppings.

G. Place weep baffle drainage material immediately above flashing in cavities.

3.04 INSTALLATION OF THROUGH WALL FLASHINGS – NOT USED

A. At exterior walls, in general, through wall flashings shall be installed at the following locations, but the work is not limited to the applications listed. Carefully review the Drawings to determine the exact scope and nature of the work.

1. Horizontally at bases of all cavities and veneers in exterior masonry finished walls, but not lower than 4 in. above adjacent finish grade or pavement.
2. Horizontally under sills and over heads of all openings in exterior masonry finished walls.
3. Horizontally at all lintels and shelf angles in exterior masonry finished walls.
4. Vertically at jambs of all openings in exterior masonry finished walls.
5. Horizontally and/or vertically to cover all structural framing members exposed to cavity spaces of exterior masonry finished walls.
6. Vertically over control joints and expansion joints in back up wythes of exterior masonry finished walls.
7. At other places where through flashings are called for on the Drawings.

B. Through Wall Flashing Installation:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches (200 mm), and attached to back-up with termination bars.
3. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches (200 mm) and attached to back-up construction with termination bars, with upper edge counterflashed with elastic membrane flashing material lapping at least 4 inches (100 mm).
4. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.05 WEEP HOLES, CAVITY DRAINAGE, AND VENTS – NOT USED

A. General: Install weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install weep vent material within open head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use specified weep vent material.
2. Space weep holes 24 inches o.c. unless otherwise indicated.

C. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

3.06 TIE, AND ANCHOR INSTALLATION

A. General: Space Wall ties to comply with code and manufacturer's recommendations. Provide at least one tie every 16 in. horizontally and 16 in. vertically. At control joints in the veneer, provide ties within 8 in. of each side of the joint.

B. Provide ties, and anchors for work using appropriate specified type for each condition.

1. Where wall ties penetrate the air and vapor barrier membrane, provide proper seal in order to maintain required air and membrane barrier permeance.

3.07 INSULATION INSTALLATION – NOT USED

A. Install rigid insulation in cavities where indicated. Build-in insulation as the work progresses. Fit boards tightly together, neatly working around masonry ties as brick veneer work progresses.

3.08

CLEANING, AND POINTING

A. Soon after masonry work is completed, vacuum clean interior work with brush type head attachment to remove loose granules and building dust from pores of units prior to subsequent finishing operations.

B. Upon completion, thoroughly clean exposed exterior masonry with a solution of specified detergent and water, using stiff fiber or stainless steel brushes. Cleaners or other solutions which may cause discoloration or damage will not be permitted. Muriatic acid is not permitted.

1. Prior to applying any cleaning materials on finished masonry work, provide a test cleaning mock-up on masonry mock-ups at locations acceptable to the Architect.
2. Test cleaning techniques and solutions to determine the best methods for the conditions encountered. Demonstrate Contractor's quality control system to ensure uniform final appearance. Test adjacent non-masonry surfaces for possible adverse reactions to cleaning methods. Use all cleaning products in strict compliance with the manufacturers' instructions and recommendations. Keep accurate, detailed records of concentrations, solutions, and techniques used to assist in replicating satisfactory results.

C. Rake out imperfect mortar joints of masonry work and repoint to match appearance of surrounding acceptable work. Leave entire work free of defects.

END OF SECTION

SECTION 055000 METAL FABRICATIONS

PART 1 GENERAL

1.01 WORK INCLUDED

A. The work of this Section includes, but is not limited to the following:

1. Furnishing loose steel lintels to masonry trade for installation.

1.02 RELATED WORK

A. Examine Contract Documents for requirements that affect Work of this Section. Other Specification Sections that directly relate to Work of this Section include, but are not limited to:

1. Section 042000, UNIT MASONRY ASSEMBLIES; Installation of loose steel lintels.

1.03 SUBMITTALS

A. Shop Drawings: Submit shop drawings of work showing size and thickness of each member. Show dimensions, clearances, relationships to surrounding work, coatings, and other pertinent details of fabrication and installation.

1. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.

B. Product Data: Provide manufacturer's product data, installation instructions, use limitations, and recommendations for each material used. Provide certifications that materials comply with requirements.

C. Calculations: Where installed metal fabrication work is indicated to comply with certain design loadings, provide professionally prepared calculations, material properties, certification, and other information required for structural analysis of performance of work.

D. Welders Certification: Provide certifications, signed by Contractor, certifying that welders employed at project comply with requirements specified under AWS D1.1 and AWS D1.2.

1.04 QUALITY ASSURANCE

A. Shop fabricate work to greatest extent possible. Label each piece in shop to facilitate field assembly.

B. Welding: Perform welding in conformance with AWS D1.1.

1.05 PRODUCT HANDLING AND STORAGE

A. Store work off ground and under cover. Protect from damage. Repair and clean work before erection.

PART 2 PRODUCTS

2.01 MATERIALS

A. General: Provide products and materials of new stock, free from defects, and of best commercial quality for each intended purpose.

B. Steel Plates, Shapes, and Bars: ASTM A 36.

C. Welding rods: Conform to AWS Standards and recommendations of welding rod manufacturer.

2.02 FABRICATION - GENERAL

A. Fabricate work of this Section to be straight, plumb, level and square, and to sizes, shapes and profiles indicated on approved shop drawings. Ease exposed edges. Cut, reinforce, drill and tap metal work as required for proper assembly.

1. Shear and punch metals accurately. Remove burrs.
2. Ease exposed edges to a radius of approximately 1/32 in., unless indicated otherwise. Form bent corners to smallest radius possible without causing grain separation or impairing work.
3. Remove sharp or rough areas on exposed traffic surfaces.
4. Weld seams continuously. Spot welding is permitted for temporary welding only.

B Work Exposed to View: For work exposed to view, select materials with special care. Provide materials which are smooth and free of blemishes such as pits, roller marks, trade names, scale and roughness. Fabricate work with uniform hairline joints. Form welded joints and seams continuously. Grind welds flush to be smooth after painting.

C. Loose Steel Lintel Fabrication: Fabricate lintels from angles or shapes for openings, recesses in walls, where shown, and elsewhere where needed. Provide for minimum of 8 in. bearing at each end. Weld individual angles or shapes together to form composite members where indicated or required.

1. Where Custom Steel Lintels are indicated, fabricate lintels to shapes, profiles and dimensions indicated from steel plate. Grind smooth all welded.

2.03 FINISHING

A. General: Shop prime work to greatest extent possible, except those items indicated to be embedded in concrete, and those items indicated to receive fireproofing. Field touch-up shop applied coatings after installation.

B. Touch-Up for Galvanized Surfaces: Touch-up damaged or abraded galvanized surfaces with products equal to one of the following:

1. Cold Galvanizing Compound; ZRC.
2. Speedhide Galvanized Steel Paint; PPG.
3. Series 90-93 Zinc-Rich Primer; Tnemec.

C. Galvanizing: All ferrous metal under this Section for exterior use, including loose steel lintels in exterior masonry walls, shall be hot-dip galvanized by dipping into a bath of molten zinc to which at least 0.5% nickel and other state of the art alloys have been added.

1. Hot-dip galvanizing process shall comply with ASTM A123, A153, A385, and A386 as applicable. After galvanizing, processed items shall be straightened to remove all warpage and distortion caused by the process.
2. Furnish a certified statement that galvanizing complies fully with this Specification. Unpainted galvanized steel shall bear mill stamp.

D. Shop Painting of Galvanized Steel:

1. Galvanized Surfaces: Galvanized steel work under this Section shall be shop painted at the galvanizer's plant with high-performance epoxy primer and polyurethane top coat.

   a. Primer: Within 12 hours after the galvanizing process has been completed, all exposed to view hot-dip galvanized steel shall be thoroughly cleaned, pretreated for positive paint adhesion, and then given one coat of galvanizing processor's performance-guaranteed polyamide-epoxy primer, "Primergalv" system by Duncan Industries, using paint by Tnemec Co., Carboline Co., or DuPont Co., as approved by Architect, at the galvanizing plant, in strict accordance with manufacturer's published specification standards.
   b. Polyurethane Top Coat: Top coat applied over epoxy primer coat shall be Acrylic Polyurethane Enamel equal to Duncan "Colorgalv" system, using Tnemec Series 73 Endura Shield III, DuPont Imron 333 or Hempel's 551U Urethane. Dry film thickness shall be 1.5-2.5 mils.

2. Scope of Work for Galvanized Fabrications to be Shop Primed and Shop Finish Painted:

   a. Epoxy Primer Coating and Polyurethane Color Coating: All loose steel lintels.

PART 3 EXECUTION

3.01 INSTALLATION

A. Loose Lintels: Furnish loose lintels to masonry trade for installation.

END OF SECTION

SECTION 057000 MISCELLANEOUS AND ORNAMENTAL METALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Architectural stamped and lattice grilles.

B. Architectural bar grilles.

C. Architectural bar grates.

D. Mushroom ventilators.

1.2 RELATED SECTIONS

A. Section 06 40 00 - Architectural Woodwork: Grilles, registers, diffusers and bar grates for custom casework.

B. Section 23 30 00 - HVAC Air Distribution: Grilles, registers, diffusers and bar grates for terminal fixtures for ductwork.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 30 00.

B. Shop Drawings: Indicate component sizes, materials, and thickness.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging in a dry, heated storage area until ready for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. KEES, Inc. (Basis of Design)

B. Substitutions: Section 016000 - Product Requirements.

2.2 ARCHITECTURAL STAMPED AND LATTICE GRILLES

A. Profile:

1. Rectangular face.
2. Square face.
3. Round face.
4. Convex curved face.
5. Concave curved face.

6. Flat face with radiused sides.
7. As scheduled on drawings.

B. Dimensions: Refer to drawings for scheduled grilles and dimensions.

C. Application:

1. Opposed Blade Damper (OBD): Provide where scheduled or as required.
2. Hinged Perforated Panel (HPP): Provide where scheduled or as required.
3. Hinged Solid Panel (HSP): Provide where scheduled or as required.
4. Debris Screen (DS): Provide where scheduled or as required for floor applications.

D. Mounting:

1. Surface mounted with flat head fasteners to match material and finish: Mounting A.
2. Concealed mounted with loose angle: Mounting C.
3. Concealed mounted with integral angle: Mounting D.
4. Concealed mounted with integral sleeve: Mounting E.
5. Concealed mounted with integral angle tabs: Mounting F.

E. Material and Thickness:

1. Steel: 14 gauge (1.90 mm) 0.0239 inch (0.607 mm) through 7 gauge (4.55 mm) 0.1875 inch (4.76 mm) thick.
2. Steel: 0.250 inch (6.35 mm) thick.
3. Galvanized Steel: 14 gauge (1.90 mm) 0.0239 inch (0.607 mm) through 10 gauge (3.51 mm) 0.1875 inch (4.76 mm) thick.
4. Electro-Galvanized (Paintable) Steel: 14 gauge (1.90 mm) 0.0239 inch (0.607 mm) through 10 gauge (3.51 mm) 0.1875 inch (4.76 mm) thick.
5. Stainless Steel Type 304: 14 gauge (1.90 mm) through 10 gauge (3.42 mm).
6. Stainless Steel Type 316: 14 gauge (1.90 mm) through 10 gauge (3.42 mm).
7. Aluminum: 0.080 inch (2.03 mm) through 0.1875 inch (4.76 mm) thick.
8. Muntz Alloy 280 (architectural bronze/brass): 0.080 inch (2.03 mm) through 0.1875 inch (4.76 mm) thick.
9. Commercial Bronze Alloy 220: 0.080 inch (2.03 mm) through 0.1875 inch (4.76 mm) thick.

F. Finishes:
1. Steel:
   a. Mill.
   b. Primer.
   c. Enamel Paint:
      1) Refer to drawings for finish color.
      2) White.
      3) Flat Black.
      4) Satin Black.
      5) Gloss Black.
      6) Grey.
      7) Tan.
      8) Silver/Aluminum.
      9) Brass.

10) Commercial Bronze.
11) Light Bronze.
12) Medium Bronze.
13) Dark Bronze.

d. Epoxy Paint:
1) Refer to drawings for finish color.
2) White.

2. Galvanized Steel:
a. Mill.
b. Primer Over Galvanizing.
c. Enamel Paint:
1) Refer to drawings for finish color.
2) White.
3) Flat Black.
4) Satin Black.
5) Gloss Black.
6) Grey.
7) Tan.
8) Silver/Aluminum.
9) Brass.
10) Commercial Bronze.
11) Light Bronze.
12) Medium Bronze.
13) Dark Bronze.

d. Epoxy Paint:
1) Refer to drawings for finish color.
2) White.

3. Electrogalvanized Steel:
a. Mill.
b. Primer Over Galvanizing.
c. Enamel Paint:
1) Refer to drawings for finish color.
2) White.
3) Flat Black.
4) Satin Black.
5) Gloss Black.
6) Grey.
7) Tan.
8) Silver/Aluminum.
9) Brass.
10) Commercial Bronze.
11) Light Bronze.
12) Medium Bronze.
13) Dark Bronze.

d. Epoxy Paint:
1) Refer to drawings for finish color.
2) White.

4. Stainless Steel, Type 304:
a. Mill.
b. Satin polish.
c. Mirror polish.

d. Enamel Paint:
    1) Refer to drawings for finish color.
    2) White.
    3) Flat Black.
    4) Satin Black.
    5) Gloss Black.
    6) Grey.
    7) Tan.
    8) Silver/Aluminum.
    9) Brass.
    10) Commercial Bronze.
    11) Light Bronze.
    12) Medium Bronze.
    13) Dark bronze.
e. Epoxy Paint:
    1) Refer to drawings for finish color.
    2) White.

5. Stainless Steel, Type 316:
    a. Mill.
    b. Satin polish.
    c. Mirror polish.
    d. Enamel Paint:
        1) Refer to drawings for finish color.
        2) White.
        3) Flat Black.
        4) Satin Black.
        5) Gloss Black.
        6) Grey.
        7) Tan.
        8) Silver/Aluminum.
        9) Brass.
        10) Commercial Bronze.
        11) Light Bronze.
        12) Medium Bronze.
        13) Dark bronze.
    e. Epoxy Paint:
        1) Refer to drawings for finish color.
        2) White.
6. Aluminum:
    a. Mill.
    b. Clear or Color anodize:
        1) Clear 204R1.
        2) Light Bronze 311.
        3) Medium Bronze 312.
        4) Dark Bronze 313.
        5) Black 335.
    c. Enamel paint:
        1) Refer to drawings for finish color.
        2) White.
        3) Flat Black.
        4) Satin Black.

5) Gloss Black.
6) Grey.
7) Tan.
8) Silver/Aluminum.
9) Brass.
10) Commercial Bronze.
11) Light Bronze.
12) Medium Bronze.
13) Dark Bronze.

d. Epoxy Paint:
1) Refer to drawings for finish color.
2) White.

7. Muntz Alloy 280 (architectural bronze):
a. Satin polish.
b. Satin polish with lacquer.
c. Mirror polish.
d. Mirror polish with lacquer.
e. Satin polished light oxidized with lacquer.
f. Satin polished light oxidized without lacquer.
g. Mirror polish light oxidized with lacquer.
h. Mirror polish light oxidized without lacquer.
i. Satin polish medium oxidized with lacquer.
j. Satin polish medium oxidized without lacquer.
k. Mirror polish medium oxidized with lacquer.
l. Mirror polish medium oxidized without lacquer.
m. Satin polish dark oxidized with lacquer.
n. Satin polish dark oxidized without lacquer.
o. Mirror polish dark oxidized with lacquer.
p. Mirror polish dark oxidized without lacquer.

8. Commercial Bronze Alloy 220:
a. Satin polish.
b. Satin polish with lacquer.
c. Mirror polish.
d. Mirror polish with lacquer.
e. Satin polish light oxidized with lacquer.
f. Satin polish light oxidized without lacquer.
g. Mirror polish light oxidized with lacquer.
h. Mirror polish light oxidized without lacquer.
i. Satin polish medium oxidized with lacquer.
j. Satin polish medium oxidized without lacquer.
k. Mirror polish medium oxidized with lacquer.
l. Mirror polish medium oxidized without lacquer.
m. Satin polish dark oxidized with lacquer.
n. Satin polish dark oxidized without lacquer.
o. Mirror polish dark oxidized with lacquer.
p. Mirror polish dark oxidized without lacquer.
q. Pattern:
r. BR100 BRICK.
s. CA200 CASABLANCA.
t. CT238 CATHEDRAL.

9. CI125 CIRCLELINK.
10. CI200 CIRCLELINK.
11. CS200 CLASSIC.
12. CL050 CLOVERLEAF.
13. CL100 CLOVERLEAF.
14. CR075 CROSS-LINK.
15. CR150 CROSS-LINK.
16. DI050 DIAMOND/CAMELOT.
17. DI075 DIAMOND/CAMELOT.
18. DI100 DIAMOND/CAMELOT.
19. EG100 EGYPTIAN.
20. EG200 EGYPTIAN.
21. FL300 FORMED LOUVER.
22. GO053 GOTHIC.
23. GO106 GOTHIC.
24. GR125 GRECIAN/UNION JACK.
25. GR250 GRECIAN/UNION JACK .
26. GR500 GRECIAN/UNION JACK.
27. HA150 HALF SHELL.
28. HA250 HALF SHELL.
29. HO075 HONEYCOMB.
30. LA025 LATTICE.
31. LA038 LATTICE.
32. LA050 LATTICE.
33. LA075 LATTICE.
34. LA081 LATTICE.
35. LA100 LATTICE.
36. MJ225 MAJESTIC.
37. MA175 MALTESE.
38. MO138 MOSAIC.
39. OC044 OCTAGONAL.
40. OC075 OCTAGONAL.
41. PE062 PERFEX/MALTESE.
42. PE088 PERFEX/MALTESE.
43. PE168 PERFEX/MALTESE.
44. PT188 PETALS.
45. RE125 RECTANGULAR CANE.
46. RE163 RECTANGULAR CANE.
47. RE169 RECTANGULAR CANE.
48. RE175 RECTANGULAR CANE.
49. RE188 RECTANGULAR CANE.
50. RO070 ROUND CANE.
51. RO131 ROUND CANE.
52. SA031 ROUND, STAGGERED.
53. SR025 ROUND, STRAIGHT.
54. SC138 SCHOOL SLOT.
55. SC188 SCHOOL SLOT.
56. SE050 SEASHELL.
57. SE088 SEASHELL.
58. SE175 SEASHELL.
59. SE250 SEASHELL.

60. SQ100 SQUARE LINK.
61. SQ125 SQUARE LINK.
62. SQ150 SQUARE LINK.
63. SQ200 SQUARE LINK.
64. SQ225 SQUARE LINK.
65. TR119 TRIPLEX/PARQUET.
66. TR200 TRIPLEX/PARQUET.
67. WI062 WINDSOR.
68. W100 WINDSOR.
69. WI200 WINDSOR.

2.3 ARCHITECTURAL BAR GRILLES

A. Profile:

1. Rectangular or square face.
2. Round face.
3. Convex curved face.
4. Concave curved face.
5. Flat face with radiused sides.
6. As scheduled on drawings.

B. Dimensions: Refer to drawings for scheduled grilles and application.

C. Core construction:

1. Provide core style and blade size at spacing and angle:
   a. 1300-25 (1/8 inch (3.18 mm) bar, 1/4 inch (6.35 mm) O.C. at 0 degrees).
   b. 1300-38 (1/8 inch (3.18 mm) bar, 3/8 inch (9.53 mm) O.C. at 0 degrees).
   c. 1300-50 (1/8 inch (3.18 mm) bar, 1/2 inch (12.70 mm) O.C. at 0 degrees).
   d. 1315-25 (1/8 inch (3.18 mm) bar, 1/4 inch (6.35 mm) O.C. at 15 degrees). Not available for floor or curved grilles.
   e. 1315-38 (1/8 inch (3.18 mm) bar, 3/8 inch (9.53 mm) O.C. at 15 degrees). Not available for floor or curved grilles.
   f. 1315-50 (1/8 inch (3.18 mm) bar, 1/2 inch (12.70 mm) O.C. at 15 degrees). Not available for floor or curved grilles.
   g. 1315F-25 (1/8 inch (3.18 mm) bar, 1/4 inch (6.35 mm) O.C. at 15 degrees). Available for floor or curved grilles.
   h. 1315F-38 (1/8 inch (3.18 mm) bar, 3/8 inch (9.53 mm) O.C. at 15 degrees). Available for floor or curved grilles.
   i. 1315F-50 (1/8 inch (3.18 mm) bar, 1/2 inch (12.70 mm) O.C. at 15 degrees). Available for curved grilles.
   j. 2500-50 (1/4 inch (6.35 mm) bar, 1/2 inch (12.70 mm) O.C. at 0 degrees).
   k. 2515-50 (1/4 inch (6.35 mm) bar, 1/2 inch (12.70 mm) O.C. at 15 degrees). Not available for floor or curved grilles.

D. Frame Style and Application:

1. Floor mounted with face frame - Style FF.
2. Floor mounted with straight sided frame (without face frame) - Style S.
3. Wall mounted with face frame - Style FS with square corners.

4. Wall mounted with face frame - Style FM with mitered corners.
5. Wall mounted with straight sided frame (without face frame) - Style S.
6. Wall mounted with face frame - Style FS with square corners.
7. Wall mounted with face frame - Style FM with mitered corners.
8. Wall mounted with straight sided frame (without face frame) - Style S.
9. Wall mounted Gym Style with face frame - Style FS with square corners.
10. Wall mounted Gym Style with face frame - Style FM with mitered corners.
11. Wall mounted Gym Style with straight sided frame (without face frame) - Style S.

E. Options:

1. Opposed Blade Damper (OBD): Provide where scheduled.
2. Hinged Access Panel: Provide where scheduled.
3. Lift-out Access Panel: Provide where scheduled.
4. Debris Screen: Provide where scheduled.
5. Mitered Corners: Provide where indicated on drawings.
6. Inside or Outside Corners: Provide where indicated on drawings.

F. Material:

1. Stainless Steel Type 304.
2. Stainless Steel Type 316.
3. Aluminum.
4. Brass Alloy: 385 architectural bronze.

G. Finishes:

1. Stainless Steel, Type 304:
   a. Mill.
   b. Satin polish.
   c. Mirror polish.
   d. Enamel Paint:
      1) Refer to drawings for finish color.
      2) White.
      3) Flat Black.
      4) Satin Black.
      5) Gloss Black.
      6) Grey.
      7) Tan.
      8) Silver/Aluminum.
      9) Brass.
      10) Commercial Bronze.
      11) Light Bronze.
      12) Medium Bronze.
      13) Dark Bronze.
   e. Epoxy Paint:
      1) Refer to drawings for finish color.
      2) White.

2. Stainless Steel, Type 316:
   a. Mill.

b. Satin polish.
c. Mirror polish.
d. Enamel Paint:
    1) Refer to drawings for finish color.
    2) White.
    3) Flat Black.
    4) Satin Black.
    5) Gloss Black.
    6) Grey.
    7) Tan.
    8) Silver/Aluminum.
    9) Brass.
    10) Commercial Bronze.
    11) Light Bronze.
    12) Medium Bronze.
    13) Dark Bronze.
e. Epoxy Paint:
    1) Refer to drawings for finish color.
    2) White.

3. Aluminum:
    a. Mill.
    b. Satin polish.
    c. Clear or Color Anodize:
        1) Clear 204R1.
        2) Light Bronze 311.
        3) Medium Bronze 312.
        4) Medium Bronze 313.
        5) Black 335.
    d. Enamel Paint:
        1) Refer to drawings for finish color.
        2) White.
        3) Flat Black.
        4) Satin Black.
        5) Gloss Black.
        6) Grey.
        7) Tan.
        8) Silver/Aluminum.
        9) Brass.
        10) Commercial Bronze.
        11) Light Bronze.
        12) Medium Bronze.
        13) Dark Bronze.
    e. Epoxy Paint:
        1) Refer to drawings for finish color.
        2) White.

4. Brass Alloy 385 (Architectural Bronze):
    a. Satin polish with lacquer.
    b. Satin polish light oxidized with lacquer.
    c. Satin polish medium oxidized with lacquer.

d. Satin polish dark oxidized with lacquer.

2.4 ARCHITECTURAL BAR GRATES

A. Profile:

1. Rectangular face.
2. Square face.
3. Radius sides with flat face.
4. As scheduled on drawings.

B. Dimensions: Refer to drawings for scheduled grilles and application.

C. Construction: Provide grates with 0.093 inch (2.36 mm) by 0.156 inch (3.96 mm) wire face bars spaced with 0.125 inch (3.18 mm) clear welded to support bars spaced 1 inch O.C.

D. Frame Style and Mounting:

1. Floor mounted with angle frame - Style SF.
2. Wall mounted with face frame - Style F.
3. Wall mounted with angle frame - Style SW.
4. Wall mounted with face frame F and optional mounting angle.
5. Wall mounted with angle frame SW and optional mounting angle.

E. Material: Stainless steel (type 304).

F. Finishes: Satin polish.

2.5 MUSHROOM VENTILATORS

A. Model MV as manufactured by Kees, Inc.

1. Diameter:
2. Material and Finish: Cast iron with black paint finish.
3. Debris Screen required as scheduled.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all rough carpentry work, as indicated on the Drawings and as specified herein. Rough carpentry shall include but not be limited to:

B. Rough hardware, inserts, and related metal components, for work of this Section, except those items specifically specified to be provided by other trades.

C. Plywood backing panels for electrical, telephone work and where indicated covered with 5/8" Fire-Rated Gypsum Board.

D. Rough carpentry sleepers, blockings, curbs, cants, edgings, grounds, nailers, furring, strapping, etc., required for all trades.

E. Wood preservative treatments and applications.

F. Other usual items of normal rough carpentry work indicated on the Drawings or necessary for the proper completion of the Project, even though not specifically mentioned herein.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's printed product data, specifications, standard details, installation instructions, use limitations and recommendations for each material used. Provide certifications that materials and systems comply with specified requirements.

B. Field Measurements: Take field measurements before preparation of shop drawings and fabrication. Do not delay progress of the job. If field measurements are not possible prior to fabrication, allow for field cutting and fitting.

C. Initial Selection Samples: Submit samples showing complete range of colors, textures, and finishes available for each material used.

D. Verification Samples: Submit representative samples of each material that is to be exposed in the completed work. Show full color ranges and finish variations expected. Provide samples having minimum size of 144 sq. in.

1.3 QUALITY ASSURANCE

A. Materials and workmanship shall conform to governing laws and building code.

B. Lumber and plywood shall bear the grade-trademark of the association under the rules or standards of which they were produced. Grade-trademarks shall conform to the rule or standard under which the material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification.

C. Grades specified are the minimum acceptable. Lumber grades shall be determined in accordance with ASTM D 245.

D. Lumber shall bear the grade mark of an American Lumber Standards Committee, Board of Review-approved agency. Lumber shall conform to USDC PS 20.

E. Lumber shall bear a mark of mill identification.

F. Plywood shall comply with APA Ref. 1 grading requirements, USDC PS 1, and ANSI A199.1.

1.4 COORDINATION

A. Work under this section shall be properly coordinated with the work of other sections to assure the steady progress of all the work of the Contract.

1.5 PRODUCT DELIVERY AND STORAGE

A. Materials when delivered to site shall be stacked and stored above the ground under protective coverings or indoors in such manner as to insure proper drainage, ventilation, and protection. No kiln dried materials shall be placed in the building until concrete and masonry work have been completed, and are sufficiently dry.

B. Rough carpentry materials shall be stored on elevated piles to allow for air circulation below and tipped in one direction to effectively drain moisture. Lumber shall be wrapped completely, including bottoms, in waterproof tarps. Tarps shall be tied down to protect against wind blow-off. Should delays in Project be anticipated, lumber shall be stored in covered storage trailers.

C. Do not leave any newly installed wood blocking exposed. Cover and protect all new wood daily with the new roof systems or other suitable covering approved by the Architect.

PART 2 - PRODUCTS

2.1 LUMBER

A. Lumber shall be of sound stock, new, straight, of consistent size, free of stains and mildew, and kiln dried to a moisture content of not more than 19%, by weight. Where exposed or semi-exposed, wood members shall be selected for best possible appearance from the grade of stock specified.

B. Lumber shall be surfaced four sides (S4S) and shall bear the grade and trademark of the association under whose rules it is produced, and a mark of mill identification.

C. Lumber shall be furnished in longest practical lengths with respect to each intended use, and single length pieces shall be used wherever possible.

D. Plywood shall conform to the requirements of APA Ref. 1.

E. General Carpentry Material Schedule shall be as follows:

Item	Grade	Species
Lumber 2 in. nominal thickness or greater:	No. 2 Structural or better	Spruce-Pine-Fir
Lumber less than 2 in. nominal thickness	No. 2 Common	Hem-Fir or Spruce

Item	Grade	Species
Plywood	APA Rated sheathing Exposure 2, APA C-D Plugged	Group 1 Species

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

B. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

D. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

E. Application: Treat items indicated on Drawings, and the following:

F. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2.3 FIRE-TREATED LUMBER

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
   1. Use treatment that does not promote corrosion of metal fasteners.
   2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
   3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.[Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.]

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Application: Treat all rough carpentry unless otherwise indicated.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
   1. Use treatment that does not promote corrosion of metal fasteners.
   2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
   3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

E. Retain first option in "Application" Paragraph below and delete subparagraphs if all wood is required to be fire-retardant treated; otherwise, retain second option and applicable subparagraphs.

F. Application: Treat plywood indicated on Drawings, and the following:
   1. Equipment backing panels.
   2. Elsewhere as indicated.

2.5 ROUGH HARDWARE

A. Provide all rough hardware required to complete this work and to attach this work in a secure and rigid manner to work of this and other trades, including all inserts, anchors, anchor bolts, lag bolts, screws, washers, nuts, nails, and other rough hardware. Assist other trades as necessary in the placement of inserts and anchor bolts in concrete and masonry and furnish full instructions regarding locations, sizes, and other requirements of the items in order that they may properly prepare their work to receive same. Rough hardware shall comply in all respects with requirements of the governing laws and codes.

B. Rough hardware items for use at roof framing, blocking, nailers, etc., and other exterior uses, and to be exposed in the finished interior work, shall be hot-dip galvanized zinc or cadmium-plated steel, or stainless steel in accordance with ASTM A 153, or non-ferrous, as indicated or as approved by Architect. Galvanizing shall conform to ASTM A 153. Concealed interior nails shall be bright. Other concealed items shall be cadmium plated or zinc chromate plated. Rough hardware items shall be of appropriate type and of proper capacity and size as required for each specific application.

C. Unless otherwise called out, wood framing, blockings, nailers, etc., of 2 in. nominal thickness or greater shall be bolted to back-up material with 1/2 in. bolts (galvanized at exterior locations and at roofs) located 4 in. from ends and splices, and spaced not greater than 32 in. on center along lengths

of the members, to develop positive and secure anchorage to the back-up material. Nails shall be of sufficient length to penetrate the receiving member a minimum of 1-1/2 in.

D. Fasteners for securing wood framing, blocking or plywood into brick masonry if required, shall be hammer drive anchors of sufficient length to penetrate the receiving member a minimum of 1-1/2 in.

E. Unless otherwise called out, wood framing, nailers, furring, etc., less than 2 in. nominal thickness shall be secured to back-up material by use of appropriate fasteners located 4 in. from ends and spaced not greater than 16 in. on center along lengths of the members. Type and length of fastening devices shall be such as to develop positive and secure anchorage to the back-up material.

PART 3 - EXECUTION

3.1 ROUGH CARPENTRY WORK

A. No attempt is made in this Specification to list the various elements of rough carpentry work, as the major part of the work to be done is clearly shown on or reasonably inferred from the Drawings. The rough carpentry work required shall include all such work, regardless of whether or not each and every item is specifically called for. Refer to Drawings to determine the major extent of the rough carpentry work required.

B. The Contractor shall be responsible for structural integrity, connections, and anchorage of all rough carpentry work.

C. Discard units of material which are unsound, warped, bowed, twisted, improperly treated, not adequately seasoned, or too small to fabricate with minimum number of joint or optimum jointing arrangements, or which are of defective quality with respect to surfaces or sizes.

D. Butt joints in wood shall be flush to provide a smooth, uniform line with no irregularities. Built-up blocking shall have butt joints staggered 4 in. minimum layer to layer. The minimum length of any individual piece of woodwork shall be 12 in. All lengths of woodwork shall have a minimum of four fasteners.

E. Construct all rough carpentry work plumb, level, and true with tight, close fitting joints, securely attached and braced to surrounding construction, all in a first class workmanlike manner. Counterbore for bolt heads, nuts, and washers where required to avoid interference with other materials.

F. Wood blockings, nailers, edgings, etc., shall be installed as indicated or specified and shall be furnished in lengths not less than 12 ft., except where shorter lengths are required.

G. Nailing of rough carpentry work shall conform to requirements of the governing laws and codes.

H. Install all wood grounds required including those required by other trades to properly attach their work, such as grounds to assure proper lines and levels and for attachment of fixtures and louvers, etc.

I. If nailing, drilling, or powder-driving into concrete or masonry causes puncturing of conduits, pipes, ducts, etc., embedded in such work, repair all damage so caused.

3.2 FASTENING OF WOODWORK

A. Wood shall be secured to wood substrates and other wood to wood connection with nails spaced 12 in. on center maximum staggered along the centerline of the member being installed. All nail heads must be flush with the top surface.

B. Wood to masonry connections shall be completed using hammer driven anchors through predrilled holes spaced 8 in. on center maximum. Predrill the hole, insert fastener sleeve, and secure in place with nail.

3.3 CLEANING

A. Upon completion of rough carpentry work in any given area, remove all rubbish and debris from the work area and leave in broom clean condition.

END OF SECTION

SECTION 061753 WOOD TRUSSES

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. CONTRACTOR shall furnish all labor, materials, and equipment to install prefabricated wood trusses for roof framing as indicated on the Drawings and specified herein.

1.3 DEFINITIONS

A. ALSC - American Lumber Standard Committee: Softwood Lumber Standards.

B. ANSI/ASTM A446 - Sheet Steel, Zinc Coated (Galvanized) by the Hot-Dip Process, Physical (Structural) Quality.

C. APA - American Plywood Association.

D. AWPA - American wood Preservers' Association.

E. NFPA - National Forest Products Association.

F. TPI - Truss Plate Institute.

G. ASCE - American Society of Civil Engineers.

1.4 SYSTEM DESCRIPTION

A. Design Roof Live and Dead Load - Truss shall be designed for the following and the Building Code of New York State:

1. Roof Live Load: 20 psf
2. Roof Snow Load:
   a. Ground Snow Load: 30 psf
   b. Roof Live Load: 20 psf
   c. Snow Exposure Factor 1.0
   d. Snow Load Importance 1.0
   e. Thermal Factor 1.0
3. Wind Design Data:
   a. Basic Wind Speed: 115 MPH
   b. Wind Importance Factor 1.0
   c. Wind Exposure Category: B

4. Truss Bottom Chord: 10 psf, Dead Zone

B. Deflection shall be limited to 1/360.

1.5 QUALITY ASSURANCE

A. Manufacturer - Company specializing in manufacture of prefabricated wood trusses with three years minimum experience.

B. Design trusses under direct supervision of Professional Engineer, registered in the State of New York, experienced in structural framing design of trusses. The calculations shall bear his stamp and signature.

C. Lumber Grading Agency - Certified by ALSC.

D. Truss Plates - In accordance with Design Specifications for Light Metal Plate Connected Wood Trusses, TPI-74 (or latest revision) by Truss Plate Institute.

1.6 SUBMITTALS

A. Design Calculations - Submit the design calculation for framing system, sizes and spacing joists, loads bearing and anchor details, bridging and bracing, and framed openings. The calculations must be sealed and signed by the New York State Registered Professional Engineer.

B. Provide technical product data on wood preservative materials.

1.7 DELIVERY, STORAGE AND HANDLING

A. Transport and store trusses in vertical position resting on bearing ends.

B. Protect trusses from moisture, warpage, and distortion during transit and when stored.

PART 2 PRODUCTS

1.8 MATERIALS

A. Wood Trusses:

1. Lumber Grading Rules: NFPA
2. Truss chords: Truss top and bottom chord shall be fabricated out of kiln-dried lumber conforming to the grades and dimensions shown in the calculations and shop drawings.
3. Metal plate connectors shall be of prime commercial quality galvanized sheet steel meeting the requirements of ASTM A446, Grade A, or approved equivalent.
4. All plates shall be coated in accordance with ASTM A525 “Specification for Steel Sheet, Zinc Coated, Galvanized by the Hot Dip Process, General Requirements”.
5. Bearing Plate Anchors: Provide anchor bolts as shown of the Drawings.

B. Fabrication:

1. Verify dimensions and site conditions prior to fabrication.
2. Cut members accurately to length to achieve tight joint connections.

PART 3 EXECUTION

1.9 INSTALLATION

A. Inspection:

1. Verify that supports are ready to receive trusses.
2. Verify sufficient end bearing area.
3. Beginning of installation means acceptance of existing conditions.

B. Preparation:

1. Coordinate placement of bearing support items with truss locations.

C. Installation:

1. Install trusses in accordance with manufacturer's instructions, at a spacing of 24 inches, unless noted otherwise on Drawings.

D. Place trusses true to line and level.

E. Provide temporary bracing to hold trusses in place until permanently secured.

F. Place permanent bridging, bracing, and anchors to maintain trusses straight and in correct positions before inducing loads.

G. Do not field cut trusses.

H. Place headers and supports to frame openings as required.

1.10 TOLERANCES

A. Framing Members - 1/2 inch maximum from true position.

END OF SECTION

SECTION 062000 FINISH CARPENTRY

PART 1 GENERAL

1.1 WORK INCLUDED

A. Provide all finish carpentry and millwork as indicated on the Drawings and as specified herein. Include, but do not limit to:

1. Interior standing and running trim, including miscellaneous moldings, trim and sills.
2. Plastic laminate work.
3. Solid surfacing work.
4. Wood casework at VIP Suite.
5. Shelving, closet rods, and hardware.

1.2 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 061000, ROUGH CARPENTRY.
2. Section 099100, PAINTING; Field finishing of work of this Section.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern.

1. American National Standards Institute (ANSI):

A161.2	Performance Standards for Fabricated High Pressure Decorative Laminate Countertops
A208.1	Particleboard, Mat-Formed Wood

2. American Society for Testing and Materials (ASTM):

E 84	Surface Burning Characteristics of Building Materials

3. National Electric Manufacturers Association (NEMA):

LD 3	High Pressure Decorative Laminates

4. The Architectural Woodwork Institute (AWI):

Quality Standards	Architectural Woodwork Quality Standards, Guide Specifications and Quality Certification Program

1.4 SUBMITTALS

A. Certifications: Provide certifications stating that materials and fabrication complies with specification requirements.

B. Shop Drawings: Provide large scale shop drawings for fabrication, installation and erection of all parts of the work. Provide large scale detailed plans, elevations, and details of anchorages, connections and accessory items.

C. Field Measurements: Take accurate field measurements before preparation of shop drawings and fabrication. Do not delay job progress; allow for field cutting and fitting where taking field measurements before fabrication is not possible.

D. Verification Samples: Submit at least two fully finished representative samples of each material that is to be exposed in the finished work, showing the full range of color and finish variations expected. Provide samples having minimum area of 144 square inches.

1.5 QUALITY STANDARDS

A. Quality Standard: Provide work complying with applicable requirements of AWI Quality Standards. Where not otherwise indicated, fabricator may choose among options permitted by AWI for grade of work specified.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials and products only after wet work has been completed and environmental conditions similar to those of the finished work are established and maintained. Store and handle work to prevent deterioration and damage. Comply with AWI Quality Standards and recommendations. Sequence deliveries to avoid delays, but minimize on-site storage.

1.7 PROJECT CONDITIONS

A. Maintain optimum environmental conditions to prevent woodwork from shrinkage, swelling and all other forms of damage.

PART 2 PRODUCTS

2.1 FINISH CARPENTRY, GENERAL

A. Do not deliver materials to site until building has been closed in, wet work is completed and sufficiently dry, and building is continuously maintained at a temperature above 65oF. Obtain Architect's approval before delivering materials or fabricated items. Store materials off the floor, fully protected from damage.

B. Provide fasteners and hardware required to complete the work. Use concealed fastenings wherever possible. Provide cadmium plated or zinc chromate plated fasteners at concealed locations; stainless steel or chrome plated at exposed interior locations.

C. Provide materials and products which meet or exceed the requirements of the indicated AWI Quality Standards specified for each type of work.

D. Provide solid lumber, kiln-dried to moisture content of 5% to 10% by weight, with average not to exceed 8%.

E. Furnish lumber in longest practical lengths. Use single-length pieces wherever possible.

F. Take necessary field measurements before starting fabrication of built-in work.

2.2 INTERIOR STANDING AND RUNNING TRIM

A. Scope: Standing and running trim work includes, but is not limited to, the following:

1. Window stools, sills, and aprons.
2. Miscellaneous molding and trim.

B. Quality Standard: Provide AWI Premium Grade materials and workmanship.

C. Wood Species and Cuts: Provide as follows:

1. Painted Work: Provide any wood complying with AWI Quality Standards.
2. Transparent Finished Work: Provide Quartered White Maple.

D. Shop Assembly: Shop assemble casings and frames with accurately mitered joints, pressure glued with lemon shaped splines.

2.3 PLASTIC LAMINATE PRODUCTS

A. Plastic Laminate Manufacturers: Provide plastic laminate materials from full range of color options, that meet or exceed specified requirements from one of the following manufacturers, or Architect approved equals:

1. Formica Decorative Laminates; Formica Corporation, Cincinnati, OH 45241
2. Laminart Decorative Laminate; Laminart, Elk Grove, IL 60007.
3. Nevamar Decorative Laminates; Nevamar Corporation; Odenton, MD 21113.
4. Pioneer Decorative Laminates; Sterling Engineered Products, Auburn, ME 04210.
5. Wilsonart Decorative Laminates., Ralph Wilson Plastics Co.; Temple, TX 76501

B. Provide laminate complying with NEMA LD 3, and the following:

1. Horizontal and Vertical Surfaces (Except Postformed Surfaces): General Purpose Standard Grade, GP-50 (0.050 in. nominal thickness).
2. Postformed Surfaces: Postforming Type, PF-42 (0.042 in. nominal thickness).
3. Balance Sheet: Backer Type, BK-20 (0.020 in. nominal thickness).
4. Color/Texture/Pattern: Provide laminates in colors, textures and patterns selected by Architect from industry-wide available choices.

C. Scope: Plastic laminate work includes, but is not limited to:

1. Countertops.

D. Core: Provide lumber-core plywood. Do not use hardboard or particle board.

E. Construction: Provide balancing sheets for all work. Fabricate work for use in wet environment at bathrooms. Exposed surfaces of core shall be covered with laminate. Exposed-to-view surfaces shall be covered with "face" laminate.

1. Splashes: Provide loose splashes with all six sides covered with laminate.

F. Preparation for Related Work: Prepare countertops for all related appliances and plumbing work. Cut holes to fit templates of appliances and fixtures. Trim openings so that all core materials are covered with laminate.

G. Fabricate countertops with fewest possible seams. Conceal fasteners.

2.4 PLASTIC LAMINATE CASEWORK

A. Scope: Plastic laminate casework includes, but is not limited to, the following:

1. Wall and base cabinets.
2. Miscellaneous plastic laminate casework items.

B. Quality Standard: Provide AWI Premium Grade materials and workmanship. Provide exposed facing materials as follows:

1. Provide vertical grade high pressure plastic laminate for both sides of swing doors, drawer fronts, and all exposed cabinet ends.

2. Color/Texture/Pattern: Provide laminates in colors, textures and patterns selected by Architect from industry-wide available choices.

C. Preparation for Related Work: Prepare casework for all related electrical, telephone, mechanical, and plumbing work.

D. Cabinets and Casework: Provide casework matching elevations and details indicated. Provide cabinets having the following features and characteristics:

1. Construction/Style: Provide overlay construction with flush doors and drawer fronts, unless otherwise detailed. Provide cabinets with fully finished exposed interior and exterior surfaces. Provide 4 mil vinyl laminated interiors for cabinets, shelves, and drawers.

2. Doors: Provide minimum 3/4 in. MDF with both faces laminated to core. Provide laminate self-edge on all four edges.

3. Drawers: Provide piece cabinet drawers with applied drawer fronts.

4. Cabinet Backs: Provide 1/4 in. thick hardboard with 4 mil vinyl laminate on exposed interior surfaces grooved into ends and locked into place with minimum 1/2 in. x 3-1/2 in. stretcher rails on wall cabinets and minimum 1/2 in. x 6-1/2 in. stretcher rails on base cabinets.

5. Cabinet Tops and Bottoms: Provide minimum 3/4 in. MDF.

6. Cabinet Ends: Provide minimum 3/4 in. MDF with 4 mil vinyl laminate on exposed interior surfaces, and with exposed exterior surfaces laminated to core with p.v.a. adhesives. Groove ends to receive front frame, top, bottom and back.

7. Shelves: Provide minimum 3/4 in. MDF with 4 mil vinyl laminate, unless otherwise noted, on all exposed interior surfaces, top, bottom and edges. All shelves shall be adjustable on concealed standards and shall meet AWI standards for deflection.

8. Dust Panels: Provide plywood dust panels in all work.

9. Casework Joinery: Do not use any exposed fasteners, including finish nails or staples.

E. Plastic Laminate Casework Hardware: Provide the following or Architect approved equal:

1. Hinges: Stanley 1560 series self-closing type, or equal manufactured by Blum or Hafele. Provide at least two hinges per door leaf.

2. Drawer and Door Pulls: Provide 4 in. wire pulls with dull chrome finish, manufactured by Stanley, or equal manufactured by Blum or Hafele.

3. Drawer Slides: 75 lb. Accuride C3800, or equal manufactured by Blum or Hafele.

4. Door Silencers: Glynn Johnson GJ-65, or equal manufactured by Blum or Hafele. Provide resilient pads to silence door and drawer closing.

2.5 WOOD CASEWORK

A. Scope: Provide wood casework at following locations:

1. VIP Suite.

B. Quality Standard: Provide AWI Premium Grade materials and workmanship.

C. Wood Species and Cuts: Provide as follows:

1. Transparent Finished Work: Quartered White Maple.

D. Dust Panels: Provide plywood dust panels in work.

E. Preparation for Related Work: Prepare casework for related electrical, telephone, mechanical, and plumbing work.

F. Hardware: Provide following or Architect approved equal:

1. Hinges: Stanley 1560 series, self-closing.
2. Drawer and Door Pulls: Stanley 4484.
3. Drawer Slides: Accuride C3800.

G. Casework Joinery: Do not use any exposed fasteners, including finish nails or staples.

2.6 SOLID SURFACING MATERIAL

A. Manufacturers: Provide one of the following solid surfacing materials, or Architect approved equal:

1. Corian; Du Pont Company, Wilmington, DE 19898
2. Fountainhead; Nevamar Corporation; Odenton, MD 21113.
3. Surell; Formica Corporation, Cincinnati, OH 45241.

B. Scope: Solid surfacing work includes, but is not limited to:

1. Countertops.

C. Provide solid surfacing material in sizes, profiles, and configurations indicated on Drawings. Color shall be standard color selected by Architect. Thickness shall be 1/2 in.

D. Backing Substrate: Provide minimum 3/4 in. thick exterior grade plywood backing sheet for solid surfacing tops.

2.7 CLOTHES RODS, AND SHELF HARDWARE

A. Scope: Shelving work includes, but is not limited to, the following:

1. Plastic laminate shelving with hardwood edges.
2. Shelf and clothes hardware.

B. Quality Standard: Provide AWI Premium Grade materials and workmanship.

C. Shelving: Provide as follows:

1. Plastic Laminate Shelving: Provide plastic laminate veneered solid lumber core plywood shelving with solid White Maple edge.

D. Hardware: Provide the following, or Architect approved equal:

2. Clothes Rods: Knape and Vogt 770-5CHR.
3. Rod Supports: Knape and Vogt 764.
4. Adjustable Shelf Hardware: Knape and Vogt 87 at 2 ft.-6 in. on center with 187 brackets for six shelves, 12 in. wide.

E. Joinery: Do not use any exposed fasteners, including finish nails or staples.

PART 3 EXECUTION

3.1 WORKMANSHIP AND INSTALLATION REQUIREMENTS

A. Dressed and sand finish carpentry work free from machine and tool marks, abrasions, raised grain, or other defects on surfaces exposed to view.

B. Provide tight joints formed to conceal shrinkage. Fit butt joints with concealed spline. Glue and dowel shop miters which are four inches or greater. Glue and spline miters less than 4 in., with spline concealed.

C. Blind nail finish work to the greatest extent possible. Where surface nailing is used, set and fill nails to match adjacent wood.

D. Wherever nailing into concrete is done, care shall be taken to protect pipes or conduits embedded in the slab. No puncturing of pipes or conduits will be allowed. Damage to embedded work shall be corrected without further cost to Owner. Inserts and anchor bolts shall be placed before the pouring of concrete.

E. Secure work to prevent checks or warps. Finish carpentry work shall be properly framed, closely fitted, and accurately set to the required lines and levels and shall be rigidly secured in place.

3.2 PAINTING AND FINISHING

A. Field painting and finishing is specified under Section 099100, PAINTING. All finish carpentry items shall be primed or sealed, as work of this section, before installation. Paint or seal coats must be dry before items are installed.

B. Sand all finish work at field joints and where required by installation. Leave work in perfect condition for finishing under Section 099100, PAINTING.

3.3 SPECIFIC INSTRUCTIONS

A. Important Note: No attempt is made in the following specific instructions to list all elements of finish carpentry and architectural woodwork required on this project. It is the responsibility of the Contractor to determine for himself from the Drawings the scope and nature of the work required. These specific instructions are intended only to provide additional instructions regarding those portions of the finished carpentry and architectural woodwork for which information beyond that given on the Drawings or covered in the AWI Quality Standards seems needed to properly describe the work. Where the scope of a category is listed it is done in a general manner to assist the Contractor in determining the general nature of work he shall look for as being required in said category, and not to limit the work.

3.4 FINISH CARPENTRY WORK

A. Fabricate and install finish carpentry work in accordance with the Drawings, the specifications, and AWI Quality Standards applicable or referenced to this work.

B. Miscellaneous Items: Install all required standing and running trim and other miscellaneous items throughout, as indicated on the Drawings and as required to satisfactorily complete the entire work, whether or not each and every required piece is specifically indicated on the Drawings. Trim shall be of same material and finish as the larger member to which applied.

3.5 COMPLETION

A. Just prior to completion of work of this Section, inspect work in the company of Architect and make adjustments and corrections to work leaving operating parts in perfect operating condition, all jointing to adjacent material tight, all surfaces without blemishes or stains, all work properly executed and complete, and all defects and damaged work replaced or corrected.

END OF SECTION

SECTION 072100 THERMAL INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 WORK INCLUDED

A. Provide building insulation work as indicated on Drawings, and as specified, including but not limited to:

1. Rigid extruded polystyrene exterior cavity wall insulation.

1.03 RELATED WORK

A. Examine Contract Documents for requirements that affect Work of this Section. Other Specification Sections that directly relate to Work of this Section include, but are not limited to:

1. Section 042000, UNIT MASONRY ASSEMBLIES.

1.04 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American Society for Testing and Materials (ASTM):

C 578	Specifications for Preformed, Cellular Polystyrene Thermal Insulation.

1.05 SUBMITTALS

A. Product Data: Submit manufacturer's printed product data, specifications, standard details, installation instructions, use limitations and recommendations for each material used. Provide certifications that materials and systems comply with specified requirements.

B. Verification Samples: Submit representative samples of each insulation material. Provide samples having minimum size of 100 sq. in.

1.06 QUALITY ASSURANCE

A. Thickness: Where R values are indicated, provide thicknesses of insulation materials required to achieve value specified.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Materials shall be delivered to site in original, unopened packages or containers bearing manufacturer's names, brand names, and types and thicknesses of contents.

B. Store off floor in interior spaces, adequately protected against damage from all sources.

PART 2 PRODUCTS

2.01 RIGID EXTRUDED POLYSTYRENE INSULATION

A. Provide extruded polystyrene insulation conforming to ASTM C 578, minimum 25 lbs. per sq. in. compressive strength at 0.1 in. deformation, 2.0 lbs. per cu. ft. density "K" factor of 0.185 at 40oF. and 0.20 at 75oF. per in. thickness, water vapor transmission of 1.0 perm, and water absorption by volume of 0.1%. Provide boards with manufacturer's standard tongue and groove edges. Provide one of the following products, or Architect approved equal:

1. "Amofoam" by Amoco Foam Products Company.
2. "Styrofoam Cavity Mate" by Dow Chemical Co.
3. "Foamular 250" by Owens Corning.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Insulating materials and installation shall be in strict accordance with manufacturer's printed instructions and specific recommendations, and health and safety precautions, for each of project conditions and in accordance with governing laws and building code.

3.02 RIGID CAVITY WALL INSULATION

A. Furnish rigid insulation to masonry trade and metal wall panel trade for installation.

END OF SECTION

SECTION 073113 ASPHALT SHINGLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes asphalt shingle roof systems shown on the Drawings and specified herein.

1.3 REFERENCES

A. ASTM - American Society for Testing and Materials.

B. TIMA - Thermal Insulation Manufacturer's Association.

C. UL - Underwriter's Laboratories, Inc.

1.4 SYSTEM DESCRIPTION

A. Asphalt Shingle Roof System - Asphalt fiberglass shingles or asphalt organic shingles, felt underlayment, and concealed flashing, installed over the structural deck.

1.5 SUBMITTALS

A. Product Data - Provide manufacturer's catalog cuts, specifications, and installation instructions for each material specified.

B. Samples:
   1. Shingles - one (1) shingle selected from each of the manufacturer's standard colors.
   2. Concealed flashing - two (2) 6-inch sq. pieces.

C. Quality Control Submittals; Manufacturer's Warranty - Sample copy of the shingle manufacturer's warranty.

D. Contract Closeout Submittals - Warranty and proof of purchase (dated itemized sales receipts or invoices) for warrantee materials.

1.6 QUALITY ASSURANCE

A. Fire Resistance Rating - The asphalt shingle roof system shall have an Underwriters Laboratories External Fire Resistance Rating as follows:
   1. Asphalt Fiberglass Shingles - UL Class A, per ASTM D 3462.

B. Wind Resistance Rating - The asphalt shingle roof system shall have an Underwriters Laboratories "Wind Resistant" label.

C. Shingle packages shall bear the UL fire resistance and wind resistant labels.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to the site in manufacturer's labeled, unbroken containers.

B. Store materials on raised platforms protected from the weather with waterproof covers.
   1. Do not stack bundles of shingles more than 4-feet high.
   2. Store roll goods on end.

1.8 PROJECT CONDITIONS

A. Do not install underlayment or shingles on wet surfaces.

B. Do not apply shingles when air temperature is below 40 degrees.

C. Do not perform the Work of this Section unless the Owner's Representative is present or unless he directs that the Work be performed during his absence.

D. Moisture Protection:
   1. Cover, seal, or otherwise protect the roof and flashings so that water cannot accumulate or flow under completed portions. When and where necessary to accomplish this, provide temporary water cut-offs.
   2. Limit the removal of existing materials to areas that can be completely re-roofed or temporarily protected within the same day.

1.9 WARRANTY

A. Manufacturer's Warranty - Furnish the shingle manufacturer's warranty certifying that the shingles will not warp, shrink, or deteriorate, and that they are free from manufacturing defects as follows:
   1. Laminated Fiberglass - 30-year warranty.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Asphalt Shingles:
   1. Description:
      a. UL Classified, fiberglass laminated, no cut out, three dimensional, self-sealing wind resistant shingle with 30-year warranty, ASTM D 3462.
      b. Color - as approved from the manufacturer's standard colors.
   2. Manufacturer:
      a. CertainTeed Corp.
      a. GAF Materials Corp.
      b. KO Mfg., Inc.
      c. Owens-Comings, Inc.

B. Underlayment - No. 15 asphalt saturated felt, non-perforated, ASTM D 226.

C. Starter Course - 90 lb mineral surfaced felt, ASTM D 249 or asphalt shingles with tabs removed.

D. Shingle and Underlayment Fasteners:
   1. Nails Galvanized or aluminum, 11 or 12 gage, barbed shank roofing nails with 3/8-inch minimum diameter head, and a sufficient length to penetrate through the roofing materials and a minimum 3/4-inch into the roof sheathing.

E. Plastic Cement - flashing grade, fibrated asphalt roofing cement ASTM D 4586.

F. Ice and Water Shield - Self-adhering, self-sealing, rubberized asphalt sheet membrane.
   1. Description:
      a. Thickness - 40 mils minimum ASTM ID 3767 Method A.
      b. Tensil strength - 250 psi ASTM D 412.
      c. Elongation (ultimate failure of the rubberized asphalt) 250% ASTM D 412 Die C Modified.
      d. Permeance - 0.05 Perms max. ASTM E 96.
   2. Manufacturers:
      a. "Vycor Ice and Water Shield° by W.R. Grace Co., 62 Whittemore Ave., Cambridge, MA 02140, (800) 354-5414.
      a. "Celo-Guard Underlayment" by the Celotex Corporation, P.O. Box 31602, Tampa, Fl 33631, (800) 235-6839; AC POLY.
      b. Ice and Storm Seal by NEI Advanced Composite Technology, 50 Pine Road, Brentwood, NH, (800) 998-4634.

PART 3 - EXECUTION

3.1 PREPARATION

A. Cover cracks in existing roof deck exceeding 1/4-inch in width and knotholes with sheet metal nailed securely in place.

B. Do not proceed with application of shingles until all surfaces are dry, free of all debris and protruding nails, and properly supported for shingle nailing and application_

3.2 APPLICATION

A. Installing Ice and Water Shield:
   1. Eaves - Unless shown otherwise on the drawings extend the flashing from the roof edge to a line a minimum of 2-feet beyond the heated interior face of the building wall.
   2. Valleys - Install the flashing centered on the valley so that the flashing sheet extends a minimum of 18-inches on each side of the valley centerline.

B. Installing Underlayment:
   1. Slopes 4-Inches Per Foot and More - Install one-ply of underlayment over the entire surface to be shingled. Lap edges a minimum of 2-inches and ends a minimum of 6-inches.

2. Slopes Less Than 4-Inches Per Foot - Install two (2) plies of underlayment over the entire surface to be shingled. Install underlayment shingle fashion, lapping each ply 19-inches over the preceding ply.
3. Install the underlayment parallel to the eaves. Secure the underlayment with only enough fasteners to hold it in place until the shingles are installed.
4. At eaves install the underlayment over the metal drip edge, at rakes install the underlayment beneath the metal drip edge.

C. Installing Asphalt Shingles:
1. Except as shown or specified otherwise, layout, install, and fasten the shingles in accordance with the shingle manufacturer's instructions and specifications.
2. Fastening:
   a. Slopes Up To 60 Degrees (20 Inches Per Foot) - Install four (4) fasteners per shingle.
   b. Slopes Over 60 Degrees (20 Inches Per Foot) - Install six (6) fasteners per shingle. Place a one-inch diameter dab of plastic cement under the center of each shingle tab above the cut out.
3. Eaves - Start shingles at eaves with a starter course. Overlap drip edge 1/4-inch.
4. Valley:
   a. Open Metal Valleys, if indicated - Lap shingles over the metal valley flashing 5-inches. Lay the shingles to that the exposed portion of the valley at the top is 5-inches wide on each side of the valley centerline and increases in width 1/8-inch per foot towards the eaves. Cut off one-inch of the upper outside corner of each shingle. Set the portion of the shingle that overlaps the valley in plastic cement.
5. Stepped Metal Base Flashing - Interlace shingles with the base flashing. Lap shingles a minimum of 5-inches over the base flashing. Set the portion of the shingle that overlaps the base flashing in plastic cement.
6. Continuous Metal Base Flashing - Lap the shingles a minimum of 5-inches over the base flashing. Set the portions of the shingle that overlaps the base flashing in plastic cement.
7. Hips and Ridges - Form the hips and ridges with pieces cut from the roof shingles or use the manufacturer's hip and ridge shingles. Secure each shingle with one (1) nail one each side, 5-1/2 inches back from the exposed end and one inch up from the edge.

END OF SECTION

SECTION 07460 - FIBER CEMENT SIDING

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 contains fiber cement exterior siding, trim, and accessories.

1.3 REFERENCES

A. ASTM C 1185-96 - Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards.

B. ASTM E 72-95 - Conduct Strength Tests of Panels for Building Construction.

C. ASTM E 84 - Surface Burning Characteristics of Building Materials.

D. ASTM E 119-95a - Fire Tests of Building Construction and Materials.

E. ASTM E 136 - Non-Combustible.

F. ASTM E 330-96 - Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

G. ASTM G 26-95 - Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmatallic Materials.

1.4 SUBMITTALS

A. Product Data - Provide manufacturer's catalog sheets, specifications, and installation instructions for specified products.

B. Samples - Provide 6" x 6" piece of each type, color, and pattern specified.

1.5 QUALITY ASSURANCE

A. Product shall be tested in accordance with ASTM standards of the following specifications:
   1. International Conference of Building Code Officials ER-5735.
   2. National Evaluation Service, Inc., report no. NER-537.
   3. Texas Dept. of Insurance Product Evaluation EC-16.

1.6 WARRANTY

A. Provide manufacturer's limited product warranty against manufacturing defects in lap siding for 50 years and trim for 10 years.

PART 2 - PRODUCTS

2.1 FIBER CEMENT SIDING

A. General - Siding shall be manufactured with a multi-step, high-pressure process combining Portland cement, sand, wood fiber, and additives.

B. Manufacturer
1. Hardiplank Siding by James Hardie Building Products, Inc.
2. Weather Boards Siding by CertainTeed Corp.

C. Description
1. Style – Horizontal Tongue & Groove Siding.
2. Texture - Smooth.
3. Size - 5-1/4" x 12' length.
4. Finish - field applied acrylic latex exterior paint.

2.2 FIBER CEMENT TRIM

A. General - Trim shall be manufactured with a multi-step process combining Polyvinyl Chloride Polymer and recycled wood flour.

B. Manufacturer
1. Handitrim by James Hardie Building Products.
2. Composite Trim by CertainTeed Corp.

C. Description
1. Texture - Smooth.
2. Sizes - 3-1/2", 5-1/2" widths x 12' lengths x 7/8" thickeners.
3. Finish - Field applied acrylic latex exterior paint.

2.3 ACCESSORIES

A. Fasteners shall be corrosive - resistant, galvanized, or stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General - Conform to manufacturer's installation recommendations. Avoid breathing dust created by cutting, sawing, drilling, or otherwise abrading the material. Use with adequate ventilation and dust collection system; refer to MSDS for additional dust precautions.

B. Trim, fascia, moldings
1. Install flashing around all wall openings.
2. Fasten through trim into structural framing or code complying sheathing. Fasteners must penetrate minimum 3/4-inch or full thickness of sheathing. Additional fasteners may be required to ensure adequate security.
3. Place fasteners no closer than 3/4-inch and no further than 2-inches from side edge of trim board and no closer than 1-inch from end. Fasten maximum 16-inch on center.
4. Maintain clearance between trim and adjacent finished grade.

5. Trim inside corner with single board.
6. Install single board of outside corner board then align second corner board to outside edge of first corner board.
7. Allow 1/8-inch gap between trim and siding.
8. Seal gap with caulk.
9. Shim frieze board as required to align with corner trim.
10. Install fascia trim over structural subfascia.

C. Siding

1. Starting - Install a minimum 1/4-inch thick lath starter strip at the bottom course of the wall.
2. Apply planks horizontally with minimum 1-1/4 inch wide laps at the top. The bottom edge of the first plank overlaps the starter strip.
3. Allow minimum 1-inch vertical clearance between roofing and bottom edge of siding.
4. Align vertical joints of the planks over framing members.
5. Maintain clearance between siding and adjacent finished grade.
6. Locate splices at least one stud cavity away from window and door openings.
7. Use off-stud metal joiner when vertical joints occur between framing members. Position metal joiner so that the bottom lip is resting on the solid course of planks. Fasten plank to the framing. Position and fasten abutting plank into place insuring that the lower edges of the two planks align. Locate metal joiner centrally behind the joint. Locate off-stud splices a minimum of two stud cavities from wall corners and stagger all subsequent course splices at minimum 24-inch intervals when located in the same wall cavity.

END OF SECTION

SECTION 076200 SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide all flashing and sheet metal work as required to complete the work of the Contract. Include, but do not limit to:

1. Exposed copings, gravel stops, and fasciae.

1.02 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 061000, ROUGH CARPENTRY; Wood blockings, nailers, etc., and plywood backing for work of this Section.

1.03 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American Society for Testing and Materials (ASTM):

B 209	Aluminum and Aluminum Alloy Sheet and Plate
D 2822	Asphaltic Roof Cement

2. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

Manual	Architectural Sheet Metal Manual

1.04 SUBMITTALS

A. Product Data including manufacturer's material and finish data, installation instructions, and general recommendations for each specified flashing material and fabricated product.

B. Samples of sheet metal flashing, trim, and accessory items, in the specified finish. Where finish involves normal color and texture variations, include Sample sets composed of 2 or more units showing the full range of variations expected.

1. 8-in. square Samples of specified sheet materials to be exposed as finished surfaces.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experience Installer who has completed sheet metal flashing and trim work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials in manufacturer's sealed containers and rolls.

B. Store indoors or under cover, on raised platforms, fully protected from damage.

1.07 COORDINATION

A. Conference: Convene a preinstallation conference to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

B. Coordination: Perform work of this Section in coordination with other trades to provide the highest quality work.

PART 2 PRODUCTS

2.01 METALS

A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated and with not less than the strength and durability of alloy and temper designated below:

1. Fluoropolymer Coated Sheet: Consisting of 0.8 mil primer with 0.8 mil 70% Kynar 500 or Hylar 5000 color coat.

2. Color: Provide custom color to match Architect’s sample

2.02 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Fasteners: Same metal as sheet metal flashing or other noncorrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.

B. Asphalt Mastic: SSPC-Paint 12, solvent-type asphalt mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil dry film thickness per coat.

C. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

D. Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Division 7 Section "Joint Sealants."

E. Adhesives: Type recommended by flashing sheet metal manufacturer for waterproof and weatherresistant seaming and adhesive application of flashing sheet metal.

F. Paper Slip Sheet: 5-lb/square red rosin, sized building paper conforming to FS UU-B-790, Type I, Style 1b.

G. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work, matching or compatible with material being installed; noncorrosive; size and thickness required for performance.

H. Roofing Cement: ASTM D 4586, Type I, asbestos free, asphalt based.

2.03 FABRICATION, GENERAL

A. Sheet Metal Fabrication Standard: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.

B. Comply with details shown to fabricate sheet metal flashing and trim that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Form exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.

D. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

D. Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.

E. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.

F. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.

1. Size: As recommended by SMACNA manual or sheet metal manufacturer for application but never less than thickness of metal being secured.

2.04 SHEET METAL FABRICATIONS

A. Copings: Fabricate to cross section indicated, with riveted and soldered joints, and other special accessories as required. Fabricate in minimum 96-inch- (2400-mm-) long sections. Fabricate expansion joints and accessories from same metal as copings unless otherwise indicated.

1. Fabricate from the following materials:

a. Aluminum: 0.060 inch thick.

PART 3 EXECUTION

3.01 INSPECTION OF SURFACES

A. Carefully inspect surfaces to receive sheet metal for all conditions affecting sheet metal application and performance. Carefully check wood blockings, inserts, nailers, etc., for adequate anchorage. Defects shall be reported in writing to the Architect and sheet metal work shall not proceed until defects have been corrected.

B. Beginning of work constitutes acceptance of conditions of surfaces to which this work is to be applied.

3.02 INSTALLATION

A. General: Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of Work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install Work with laps, joints, and seams that will be permanently watertight and weatherproof.

B. Install exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Roof-Edge Flashings: Secure metal flashings at roof edges according to FM Loss Prevention Data Sheet 1-49 for specified wind zone.

D. Expansion Provisions: Provide for thermal expansion of exposed sheet metal Work. Space movement joints at maximum of 10 ft. with no joints allowed within 24 in. of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 in. deep, filled with mastic sealant (concealed within joints).

E. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant.

   1. Use joint adhesive for nonmoving joints specified not to be soldered.

F. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

G. Separations: Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.

1. Underlayment: Where installing stainless steel or aluminum directly on cementitious or wood substrates, install a slip sheet of red-rosin paper and a course of polyethylene underlayment.
2. Bed flanges of Work in a thick coat of roofing cement where required for waterproof performance.

H. Counterflashings: Coordinate installation of counterflashings with installation of assemblies to be protected by counterflashing. Install counterflashings in reglets or receivers. Secure in a waterproof manner by means of snap-in installation and sealant, lead wedges and sealant, interlocking folded seam, or blind rivets and sealant. Lap counterflashing joints a minimum of 2 in. and bed with sealant.

3.04 CLEANING AND PROTECTION

A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

B. Provide final protection and maintain conditions that ensure sheet metal flashing and trim Work during construction is without damage or deterioration other than natural weathering at the time of Substantial Completion.

END OF SECTION

SECTION 079200 JOINT SEALANTS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Caulk and seal joints as indicated on the Drawings and as specified. Include, but do not limit to:

1. Sealing of joints in exterior construction.
2. Sealing of joints between perimeter of exterior door frames, and other items occurring in openings in exterior walls, and the surrounding construction, including bed sealing of thresholds.
3. Sealing of interior perimeter joints at door frames, window frames, and other wall openings.
4. All other exterior and interior sealing called for, or reasonably inferred from the Drawings, and as required to provide weathertight conditions in exterior assemblies.

1.02 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 033000, CAST-IN-PLACE CONCRETE;
2. Section 042000, UNIT MASONRY ASSEMBLIES;
3. Section 088000, GLAZING; Glazing sealants and gaskets.

1.03 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American Association of State Highway and Transportation Officials (AASHTO):

M 220	Preformed Elastomeric Compression Joint Seals for Concrete

2. American Society for Testing and Materials (ASTM):

C 719	Adhesion and Cohesion of Elastomeric Joint Sealants under Cyclic Movement
C 790	Use of Latex Sealing Compounds
C 834	Latex Sealing Compounds
C 920	Elastomeric Joint Sealants
C 962	Use of Elastomeric Joint Sealants
D 412	Test Methods for Rubber Properties in Tension

D 624	Test Method for Rubber Property - Tear Resistance
D 2628	Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

3. Federal Specifications (Fed. Spec.):

TT-S-00227	Sealing Compound: Elastomeric Type, Multi-Component (For Calking, Sealing, and Glazing in Buildings and Other Structures)
TT-S-001543A	Sealing Compound: Silicone Rubber Base (For Calking, Sealing, and Glazing in Buildings and Other Structures)

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's printed product data, specifications, standard details, installation instructions, use limitations and recommendations for each sealant material used. Provide certifications that sealant materials comply with specified requirements.

B. Initial Selection Samples: Submit samples manufacturer's color charts showing complete range of colors, textures, and finishes available for each material used.

C. Verification Samples: Submit actual representative samples of each sealant material that is to be exposed in the completed work. Show full color ranges and finish variations expected. Provide sealant samples having minimum size of 12 in. long.

D. Test Reports: Provide certified reports for all specified tests.

1.05 COMPATIBILITY

A. Provide sealant and sealant joint backing materials suitable for the use intended and compatible with the materials with which they will be in contact. Compatibility of sealant and accessories shall be verified by the sealant manufacturer.

1.06 QUALITY ASSURANCE:

A. Source: For each sealant material type required for the work of this section, provide primary materials which are the product of one manufacturer. Provide secondary or accessory materials which are acceptable to the manufacturers of the primary materials.

B. Installer: A firm with a minimum of five years' experience in type of work required by this Section and which is acceptable to the manufacturers of the primary materials.

1.07 PROJECT CONDITIONS

A. Weather: Perform work of this Section only when existing or forecasted weather conditions are within the limits established by manufacturers of the materials and products used.

B. Substrates: Proceed with work only when substrate construction and penetration work is complete.

1.08 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Materials under this Section shall be delivered to, and stored at, the job site in unbroken factory sealed containers with labels intact.

1.09 WARRANTY

A. Furnish joint sealant manufacturer's written single-source performance warranty that joint sealant work will be free of defects related to workmanship or material deficiency for five years from date of Substantial Completion of the Project.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Before installation check each sealant for compatibility with adjacent materials and surfaces and with indicated exposures. Select sealers which are recommended by manufacturer for each application indicated. Where exposed to pedestrian or vehicular traffic, provide sealants which are non-tracking and are strong enough to withstand the traffic without damage.

B. Provide colors as selected by Architect from manufacturer's standard and special (Tremco Fastpak) colors. Where specifically requested, provide custom color matches.

2.02 SELF-LEVELING POLYURETHANE SEALANT (Sealant Type 1)

A. Provide two or more part, self-leveling, polyurethane based elastomeric sealant, complying with ASTM C 920, Fed. Spec. TT-S-00227E Type 1 Class A, having Shore A hardness of not less than 30 when tested according to ASTM C 920, cured modulus of elasticity at 100% elongation of not more than 150 psi when tested according to ASTM D 412, and tear resistance of not less than 50 lbs./inch when tested according to ASTM D 624.

B. Where joint surfaces contain bituminous materials, provide modified sealants which are compatible with bituminous materials encountered.

C. Provide one of the following products that meet or exceed specified requirements:

1. Pecora Urexpan NR-200.
2. Mameco Vulkem 245 or 255.
3. Sika 2C, SL.
4. Sonneborn Sonolastic PvJtSt.
5. Tremco THC 900.

D. Extent: Provide self-leveling polyurethane sealant for paving and floor joints not indicated to be sealed with another type of sealant.

2.03 NON-SAG POLYURETHANE SEALANT (Sealant Type 2)

A. Provide multi-part, non-sag, polyurethane based elastomeric sealant, complying with ASTM C 920 Type M, Grade NS, Class 25, Fed. Spec. TT-S-00227E Class A, having Shore A hardness of 20 to 30, cured modulus of elasticity at 100% elongation of not more than 75 psi, and tear resistance of not less than 50 lbs./inch when tested according to ASTM D 624.

B. Provide one of the following products that meet or exceed specified requirements:

1. Mameco International Vulkem 227
2. Sika Sikaflex 2c NS.
3. Sonneborn Sonolastic NP 2.
4. Tremco Dymeric

C. Extent: Provide non-sag polyurethane sealant for all masonry to masonry joints, masonry to metal joints, masonry-to-masonry joints, and other joints not indicated to be sealed with another type of sealant.

2.04 SILICONE RUBBER SEALANT (Sealant Type 3)

A. Provide one part, silicone rubber based elastomeric sealant, complying with ASTM C 920 Type S, Class 25, Grade NS and Fed. Spec. TT-S-001543A Class A.

B. Provide mold and mildew resistant, sanitary interior type sealant.

C. Provide one of the following products that meet or exceed specified requirements:

1. Dow 786.
2. General Electric 1702 Sanitary.
3. Pecora 863.
4. Rhodorsil 6b White.
5. Sonneborn OmniPlus.
6. Tremco Proglaze.

D. Extent: Provide silicone rubber sealant for interior joints around plumbing fixtures and tile to tile joints in ceramic tile work.

2.05 MISCELLANEOUS MATERIALS

A. Primer: Provide primer recommended by sealant manufacturer for surfaces to be adhered to.

B. Bond Breaker Tape: Provide polyethylene or other plastic tape recommended by sealant manufacturer to prevent three-sided adhesion.

C. Backer Rod: Provide compressible rod of durable nonabsorptive material recommended by sealant manufacturer for compatibility with sealant. Provide products of one of the following manufacturers:

1. Backer Rod Manufacturing and Supply Co.
2. Dow Chemical Co.
3. W. R. Meadows, Inc.

4. Williams Products, Inc.
5. Woodmont Products, Inc.

D. Joint backing for general use at joints in horizontal surfaces shall consist of two rows of butyl rubber or neoprene foam rod in contact with one another, and each compressed to approximately 2/3 original width when in place.

E. Provide miscellaneous materials of type that will not bleed through sealant, discolor surface, or produce other deleterious effects. Select size to provide compression to approximately 2/3 original width when in place. Provide backing material profile concave to the rear of the sealant, and equipped with a bond-breaking film.

PART 3 EXECUTION

3.01 INSPECTION

A. The Installer shall examine substrates and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning of sealant work means Installer's acceptance of joint surfaces and conditions.

3.02 PREPARATION

A. Strictly comply with manufacturers' instructions and recommendations, except where more restrictive requirements are specified in this Section.

B. Clean joint surfaces immediately before installation of sealants, primers, tapes and fillers. Remove substances which could interfere with bond. Etch or roughen joint surfaces to improve bond. Surfaces which have been given protective coatings and those that contain oil or grease shall be thoroughly cleaned with xylol or MEK solvent, with due precautions taken to minimize hazards.

C. Unless otherwise indicated, use of sealants shall conform to the following: ASTM C 790 for latex sealants and ASTM C 1193 for other sealants.

D. Tape or mask adjoining surfaces to prevent spillage and migration problems.

E. Prime surfaces as recommended by sealant manufacturer.

3.03 INSTALLATION

A. Schedule work as long as possible after completion of concrete work and finished brick paving and granite work.

B. Provide backer rods for liquid sealants except where specifically recommended against by sealant manufacturers.

C. Prevent three sided adhesion by use of bond breaker tapes or backer rods.

D. Force sealant into joints to provide uniform, dense, continuous ribbons free from gaps and air pockets. Completely wet both joint surfaces equally on opposite sides.

E. Except in hot weather, make sealant surface slightly concave. Install sealants so that compressed sealants do not protrude from joints. Dry tool sealants to form a smooth dense surface. At horizontal joints form a slight cove to prevent trapping water.

F. Provide sealants to depths indicated, or if not indicated, follow manufacturer's recommendations.

3.04 EXTENT OF SEALANT WORK

A. General Extent: Seal joints indicated, and all interior and exterior joints, seams, and intersections between dissimilar materials. Provide elastomeric sealant installation with backer rod in all interior and exterior control joints.

B. Exterior Sealing: Without limitation, the work of this Section includes sealing the following:

1. Masonry to masonry joints.
2. Metal to metal joints.
3. Joint fillers for all joints.

C. Interior Sealing: Without limitation, the work of this Section includes sealing the following:

1. Perimeters of door frames.
2. Completely around plumbing fixtures, fittings, and trim to countertops, walls and floors.

D. Thresholds of exterior doors shall be set in full beds of exterior sealant, not less than 3/8 in. thick. At Contractor's option, a polybutene or polyisobutylene sealant by same manufacturer may be used at thresholds.

3.05 CURING

A. Cure sealants in strict compliance with manufacturers' instructions and recommendations to obtain highest quality surface and maximum adhesion. Make every effort to minimize accelerated aging effects and increase in modulus of elasticity.

3.06 CLEANING AND PROTECTION

A. Remove smears from adjacent surfaces immediately, as the work progresses. Exercise particular care to prevent smearing or staining of surrounding surfaces which will be exposed in the finished work, and repair any damage done to same as result of this work without additional cost to Owner.

B. Remove and replace work that is damaged or deteriorated.

C. Clean adjacent surfaces using materials and methods recommended by sealant manufacturer. Remove and replace work that cannot be successfully cleaned.

D. Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protection immediately before final acceptance.

END OF SECTION

SECTION 081113 HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide steel doors and frames and related items as indicated on Drawings and as specified herein. Include, but do not limit to, the following:

1. Steel doors.
2. Steel door frames.

1.02 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 099100, PAINTING; Field finishing of steel doors and frames.

1.03 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American National Standards Institute (ANSI):

A250 Series	Series on Steel Door and Frame Test Procedures, Acceptance Criteria, Reinforcement, Nomenclature, and Recommended Specifications (A250.3 thru 250.10)

2. American National Standards Institute/Door and Hardware Institute (ANSI/DHI):

A115 Series	Series on Door and Frame Preparation (A115.1 thru A115.18)
A123.1	Nomenclature for Steel Doors and Steel Door Frames
A151.1	Performance Test for Standard Steel Doors, Frames, Anchors, Hinge Reinforcings and Exit Device Reinforcings

3. American Society for Testing and Materials (ASTM):

A 366	Commercial Steel (CS) Sheet, Carbon, (0.15 Percent) Cold-Rolled
A 526	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
A 569	Steel Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality

A 591	Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Mass Applications
A 653	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
C 236	Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box
E 152	Fire Tests of Door Assemblies

4. National Fire Protection Association (NFPA):

80	Standard for Fire Doors and Windows
105	Smoke Door Control Assemblies
252	Fire Tests, Door Assemblies
257	Fire Test for Windows and Glass Block Assemblies

5. Steel Door Institute (SDI):

100	Standard Steel Doors and Frames
105	Recommended Erection Instructions for Steel Frames
118	Basic Fire Door Requirements

1.04 DEFINITIONS

A. Steel Sheet Thicknesses: Thickness dimensions specified herein, are minimums as defined in referenced ASTM standards for both uncoated steel sheet and the uncoated base metal of metalliccoated steel sheets.

1.05 SUBMITTALS

A. Product Data: For each type of door and frame indicated, include door designation, type, level and model, material description, core description, construction details, label compliance, sound and fireresistance ratings, and finishes.

B. Shop Drawings: Show the following:

1. Elevations of each door design.
2. Details of doors including vertical and horizontal edge details.
3. Frame details for each frame type including dimensioned profiles.
4. Details and locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, accessories, joints, and connections.

A. Door Schedule: Use same reference designations indicated on Drawings in preparing schedule for doors and frames.

B. Oversize Construction Certificates: For door assemblies required to be fire-protection rated and exceeding size limitations of labeled assemblies.

1.06 QUALITY ASSURANCE

A. Steel Door and Frame Standard: Comply with ANSI A 250.8, unless more stringent requirements are indicated.

1.07 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 on delivery for damage, and notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect. Remove and replace damaged items that cannot be repaired as directed.

C. Store doors and frames at building site under cover. Place units on minimum 4-inch high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If door packaging becomes wet, remove cartons immediately. Provide minimum 1/4-inch spaces between stacked doors to permit air circulation.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

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

1. Pioneer Industries Inc.
2. Republic Builders Products.

2.02 MATERIALS

A. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

B. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness.

C. Metallic-Coated Steel Sheets: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with an A40 zinc-iron-alloy (galvannealed) coating; stretcher-leveled standard of flatness.

2.03 DOORS

A. General: Provide doors of sizes, thicknesses, and designs specified herein.

B. Interior Doors: Provide doors complying with requirements indicated below by referencing ANSI 250.8 for level and model and ANSI A250.4 for physical-endurance level:

1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 Seamless, with face thickness of minimum 0.053 in. thick (16 gage).

C. Exterior Doors: Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:

1. Level 4 and Physical Performance Level A (Maximum Duty), Model 2 Seamless, with face thickness of minimum 0.067 in. thick (15 gage).

2.04 FRAMES

A. General: Provide steel frames for doors that comply with ANSI A250.8 and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.

1. Frames of 0.053-inch (16 Gage) thick steel sheet for:

a. Interior door openings less than 48 inches.

2. Frames of 0.067-inch (15 Gage) thick steel sheet for:

a. Interior door openings more than 48 inches.
b. Exterior door openings.

B. Door Silencers: Except on weather-stripped frames, fabricate stops to receive three silencers on strike jambs of single-door frames and two silencers on heads of double-door frames.

C. Plaster Guards: Provide 0.016-inch thick, steel sheet plaster guards or mortar boxes to close off interior of openings; place at back of hardware cutouts where mortar or other materials might obstruct hardware operation.

D. Supports and Anchors: Fabricated from not less than 0.042-inch (18 Gage) thick, electrolytic zinccoated or metallic-coated steel sheet.

1. Wall Anchors in Masonry Construction: 0.177-inch diameter, steel wire complying with ASTM A 510 may be used in place of steel sheet.

E. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A 153/A 153M, Class C or D as applicable.

2.05 FABRICATION

A. General: Fabricate steel door and frame units to comply with ANSI A250.8 and to be rigid, neat in appearance, and free from defects including warp and buckle. Where practical, 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.

B. Exterior Door Construction: For exterior locations and elsewhere as indicated, fabricate doors, panels, and frames from metallic-coated steel sheet. Close top and bottom edges of doors flush as an integral part of door construction or by addition of 0.053-inch thick, metallic-coated steel channels with channel webs placed even with top and bottom edges.

C. Interior Door and Panel Faces: Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from the following material:

1. Cold-rolled steel sheet, unless otherwise indicated.
2. Metallic-coated steel sheet where indicated.

D. Core Construction: The following core material that produce a door complying with SDI standards:

1. Vertical steel stiffeners.

E. Clearances for Non-Fire-Rated Doors: Not more than 1/8 inch at jambs and heads, except not more than 1/4 inch between pairs of doors. Not more than 3/4 inch at bottom.

F. Single-Acting, Door-Edge Profile: Square edge, unless beveled edge is indicated.

G. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

H. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hot-rolled steel sheet.

I. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

J. 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 according to ASTM C 236 or ASTM C 976 on fully operable door assemblies.

1. Unless otherwise indicated, provide thermal-rated assemblies with U-value of 0.41 Btu/sq. ft. x h x deg F or better.

K. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware.

1. For concealed overhead door closers (if any), provide space, cutouts, reinforcement, and provisions for fastening in top rail of doors or head of frames, as applicable.

L. Frame Construction: Fabricate frames to shape shown.

1. Fabricate frames with mitered or coped and continuously welded corners and seamless face joints.
2. Provide welded frames with temporary spreader bars.

M. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surfaceapplied hardware may be done at Project site.

N. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.

2.06 FINISHES

A. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.

B. Placing Frames: Comply with provisions in SDI 105, unless otherwise indicated. 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.

1. Except for frames located in existing walls or partitions, place frames before construction of enclosing walls and ceilings.
2. For openings 90 inches or more in height, install an additional anchor at hinge and strike jambs.

C. Door Installation: Comply with ANSI A250.8. Fit hollow-metal doors accurately in frames, within clearances specified in ANSI A250.8. Shim as necessary to comply with SDI 122 and ANSI/DHI A115.1G.

3.02 ADJUSTING AND CLEANING

A. Prime-Coat Touchup: Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touch up of compatible air-drying primer.

B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION

SECTION 082200 - NON-RATED FIBERGLASS DOORS

PART 1 - GENERAL

1.1 SCOPE

A. Standards for manufacturing, machining, finishing and installation of fiberglass doors unless more specifically described under other section(s).

1.2 RELATED WORK IN OTHER SECTIONS

A. Section 087100: Finish Hardware

1.3 QUALITY ASSURANCES

A. Provide doors meeting or exceeding the minimum standards as set forth by the following organizations unless standards are modified or exceeded by this specification:
   1. Composite Fabricators Association (CFA).
   2. Composites Institute
   3. National Accreditation & Management Institute, Inc. (NAMI)

B. All doors shall be the products of the same manufacturer to insure uniformity of quality and appearance throughout the project.

C. The top of each door shall bear a quality assurance label from the manufacturer indicating the door handing and order number.

D. The door manufacturer shall provide a Certification of Compliance with this specification signed by an authorized company representative to the architect or owner at their discretion. This document shall bear a NAMI stamp of quality assurance certification.

1.4 SUBMITTALS

A. Shop Drawings
   1. Submit schedules and elevations indicating door sizes, construction, swing, undercut and applicable hardware locations.

B. Product Information
   1. Submit manufacturer's product description showing compliance with specifications, finishing instructions, installation instructions, and any general recommendations the manufacturer may have for the care and maintenance of each door type.

1.5 COORDINATION

A. Contractor shall be responsible for coordination and acquiring of all necessary information from hardware manufacturers. Door supplier shall be responsible for coordinating all necessary information received by Contractor from hardware manufacturers, to facilitate door preparation for hardware installation. Contractor shall provide door supplier with two copies of hardware schedule and all necessary hardware templates. All of the above information shall be in possession of door supplier 120 days prior to desired delivery date of doors.

1.6 DELIVERY, STORAGE AND HANDLING

A. No doors shall be delivered to the building until weatherproof storage space is available. Stack doors flat and off the floor. Protect doors from damage at all times.

B. All doors shall be individually wrapped in plastic bags to protect the finish from damage by contact with other doors.

C. Do not walk or place other material on top of stacked doors. Do not drag doors across one another.

D. Installer shall use all means necessary to protect doors from damage prior to, during and after installation. All damaged doors shall be repaired or replaced by Contractor at no cost to Owner.

E. Doors may be palletized at the factory in stacks of no more than 30 doors per pallet. Door edges shall be protected with heavy corner guards.

1.7 WARRANTY

A. All work in this Section shall be warranted (from the date of shipment) against defect in materials including the following:
   1. Delamination in any degree.
   2. Warp or twist of 1/4" or more in any 3'0" x 7'0" door.
   3. Telegraphing of any core assembly through face to cause surface variation of 1/100" or more in a 3" span.
   4. Any defect that may, in any way, impair or affect performance of the door for the purpose which it is intended.

B. Warranty Period: Doors and frames are to be guaranteed for the life of the product against corrosion induced failure and for a period of ten (10) calendar years after the date of purchase against defects.

C. Doors must be stored, finished, hung and maintained per manufacturer's recommendation set forth in their Warranty.

PART 2 - PRODUCT

2.1 MANUFACTURERS

A. Listed manufacturers are believed to conform to the criteria stated for material quality standards, function and appearance. Manufacturers are still subject to meeting the requirements of this specification. Non-conforming substitutions shall not be accepted.
   1. Oshkosh Door Company - Cor-Guard product line
   2. Corrim
   3. Edge Water

2.2 MATERIALS AND COMPONENTS

A. Core: Cores shall be closed cell polystyrene foam with a density of 2 pounds per square foot. Foam shall be placed into the door cavity before the door is inserted into a press.

B. Stiles and Rails: Stiles and rails shall be constructed with 2 ply solid polymers. Outside dimensions shall conform to hardware reinforcement requirements and overall door thickness of 1.75 inches. Door stiles and reinforcement selection shall be compatible with door facing material.

C. Door Face Skins: Door face skins shall consist of a Fiberglass Laminate manufactured by the Resin Transfer Molding (RTM) process. Skin thickness shall be 0.090 inches.

1. Gel Coat and resin selection: Gel coat and resin shall be selected to withstand the installed environment. Both UV and corrosion resistance shall be considered paramount.
2. Face sheet reinforcements shall be either type "A" or "C" glass.

D. Vision lites and louvers: These accessories shall be furnished and installed by the door manufacturer constructed from corrosion resistant materials. Doors shall be factory glazed.

PART 3 - EXECUTION

3.1 FABRICATION:

A. Fabricate all doors and accessories in strict accordance with this specification and Door Manufacturer's manufacturing specifications.

3.2 MACHINING AND FITTING:

A. All fiberglass doors shall be machined by the manufacturer or authorized manufacturer for cutouts, hinges, locks, closures and all hardware requiring routing and mortising. Doors shall be sized to allow 0.125 inches of clearance at top and each side and 5/8 inch clearance at bottom (unless specified otherwise).

3.3 INSTALLATION OF HARDWARE

A. Contractor shall install hardware according to approved hardware schedule for proper locations.

B. Install with full threaded screw furnished by hardware manufacturer.

C. Drill proper size pilot holes for all screws.

D. Securely anchor hardware in correct position and proper alignment.

E. Adjust hardware and door for proper function and smooth operation, proper latching, without force or excessive clearance.

3.4 FINISHING

A. Unfinished product shall be sanded and primed by the manufacturer and suitable for field finishing.

B. Select from manufacturers standard paint colors.

C. Custom colors shall be matched to any existing color scheme.

END OF SECTION

SECTION 087100 FINISH HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Furnishing and installation of all mechanical and electrical finish hardware necessary for all doors, and hardware as specified herein and as enumerated in hardware sets and as indicated and required by actual conditions at the building. The hardware shall include the furnishing of all necessary screws, bolts, expansion shields, drop plates, and all other devices necessary for the proper application of the hardware. Installation shall include field modification and preparation of existing doors and/or frames for new hardware being installed. Provide necessary fillers, Dutchmen, reinforcements, and fasteners for mounting new hardware and to cover existing door/frame preps.

B. Related Sections

1. Division 8 Section - Fiberglass Doors and Frames

C. Specific Omissions: Hardware for the following is specified or indicated elsewhere, unless specifically listed in the hardware sets:

1. Signage, except as noted.
2. Complete toilet accessories including coat hooks, unless note otherwise.

1.2 REFERENCES

A. Applicable state and local building codes and standards.

B. Accessibility

1. ADA - Americans with Disabilities Act

C. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware

D. ANSI - American National Standards Institute

1. ANSI/BHMA A156.1 - A156.29, and ANSI A156.31 - Standards for Hardware and Specialties

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 requirements. Prior to submittal field verify existing doors and/or frames receiving new hardware and/or existing conditions receiving new openings. Verify new hardware is compatible with the existing door/frame preparation and/or existing conditions. Advise architect within the submittal package of incompatibility or issues.

B. Catalog Cuts: Product data including manufacturers' technical product data for each item of door hardware, installation instructions, and maintenance of operating parts and finish, and other information necessary to show compliance with requirements.

C. Final Hardware Schedule Content: Submit schedule with hardware sets in vertical format as illustrated by the Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, Include the following information:

1. Door Index; include door number, heading number, and Architects hardware set number.
2. Opening Lock Function Spreadsheet; list locking device and function for each opening.
3. Type, style, function, size, and finish of each hardware item.
4. Name and manufacturer of each item.
5. Fastenings and other pertinent information.
6. Location of each hardware set cross-referenced to indications on Drawings.
7. Explanation of all abbreviations, symbols, and codes contained in schedule.
8. Mounting locations for hardware.
9. Door and frame sizes and materials.
10. Name and phone number for the local manufacturer's representative for each product.

D. Samples: If requested by the Architect, submit production sample or sample installations as requested of each type of exposed hardware unit in the finish indicated, and tagged with a full description for coordination with the schedule.

1. Samples will be returned to the supplier in like-new condition. Units that are acceptable to the Architect may, after final check of operations, be incorporated into the Work, within limitations of key coordination requirements.

E. Templates: After final approval of the hardware schedule, provide templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware.

F. Operations and Maintenance Data: Provide in accordance with Division 1 and include the following:

1. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
2. Catalog pages for each product.
3. Name, address, and phone number of local representative for each manufacturer.
4. Parts list for each product.
5. Copy of final approved hardware schedule, edited to reflect “As installed.”
6. One (1) complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
7. Copy of warranties including appropriate reference numbers for manufacturers to identify the project.

G. Certificates of Compliance: Upon request of Architect or Authority Having Jurisdiction certificates of compliance for fire-rated hardware and installation instructions shall be made available.

1.4 QUALITY ASSURANCE

A. Substitutions: Products are to be those specified to ensure a uniform basis of acceptable materials. Requests for substitutions must be made in accordance with Division 1 requirements. If proposing a substitute product, submit product data for the proposed item with product data for the specified item and indicate basis for substitution and savings to be made. Provide sample if requested. Certain products have been selected for their unique characteristics and particular project suitability.

1. Items specified as "no substitute” shall be provided exactly as listed.

2. Items listed with no substitute manufacturers listed have been requested by the Owner or Architect to match existing for continuity and/or future performance and maintenance standards or because there is no known equal product.
3. If no other products are listed in a category, then "no substitute" is implied.

B. Supplier Qualifications: A recognized architectural hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides a certified Architectural Hardware Consultant (AHC) available to the Owner, Architect, and Contractor, at reasonable times during the course of the Work for consultation.

C. Single Source Responsibility: Obtain each type of hardware (latch and locksets, hinges, exit devices, closers, etc.) from a single manufacturer.

D. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to the authorities having jurisdiction for use on types and sizes of doors indicated in compliance with requirements of fire-rated door and door frame labels.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Tag each item or package separately with identification related to the final hardware schedule, and include installation instructions with each item or package.

B. Each article of hardware shall be individually packaged in manufacturer's original packaging.

C. Contractor will provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

D. Items damaged in shipment shall be replaced promptly and with proper material and paid for by whoever did the damage or caused the damage to occur.

E. Hardware shall be handled in a manner to avoid damage, marring, or scratching. Irregularities that occur to the hardware after it has been delivered to the Project shall be corrected, replaced, or repaired by the Contractor. Hardware shall be protected against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. No direct shipments will be allowed unless approved by the Contractor.

1.6 WARRANTY

A. Provide manufacturer's warrantees as specified in Division 1 and as follows:

1. Closers: 10 years.
2. Locksets: 10 years.
3. Continuous Hinges: Lifetime warranty**,**
4. Other hardware: 1 year.

B. No liability is to be assumed where damage or faulty operation is due to improper installation, improper use, or abuse.

C. Products judged to be defective during the warranty period shall be replaced or repaired in accordance with the manufacturer's warranty, at no additional cost to the Owner.

1.7 MAINTENANCE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The Awarding Authority has determined that certain products should be selected for their unique characteristics and particular project suitability to insure continuity of existing and future performance and maintenance standards. After investigating available product offerings the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute" (NO OTHER PRODUCTS WILL BE CONSIDERED FOR THOSE LISTED IN PROJECTS DOCUMENTS.)

B. Approval of manufacturers other than those listed shall be in accordance with paragraph 1.05.A.

C. Note that even though an acceptable substitute manufacturer may be listed, the product must provide all the functions and features of the specified product or it will not be approved.

Item	Scheduled Manufacturer	Acceptable Substitute
Hinges	Not used	
Continuous Hinges	Select (SEL)	Ives, Markar, Stanley
Electric Power Transfer	Von Duprin (VON)	No Substitute
Pivots	Not used	
Flush Bolts	Not used	
Locksets & Deadlocks	Corbin Russwin (COR)	No Substitute
Exit Devices	Not used	
Power Supplies	Not used	
Door Closers	LCN (LCN)	No Substitute
Door Trim	Not used	
Protection Plates	Ives (IVE)	Burns, Rockwood
Overhead Stops	Not used	
Stops & Holders	Not used	
Thresholds & Weatherstrip	National Guard Products (NGP)	Reese, Zero
Silencers	Not used	
Cylinders	Corbin Russwin (COR)	No Substitute
Final Cores and Keying	Provided by Owner	No Substitute

D. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.

E. Where the hardware specified is not adaptable to the finished shape or size of the members requiring hardware, furnish suitable types having the same operation and quality as the type specified, subject to the Architect's approval.

2.2 MATERIALS

A. Fasteners

1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
2. Furnish screws for installation with each hardware item. 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.
3. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent that 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. Review door specification and advise Architect if thru-bolts are required.
4. Hardware shall be installed with the fasteners provided by the hardware manufacturer.

B. Continuous Hinges

1. Provide aluminum geared continuous hinges conforming to ANSI A156.25, Grade
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum, with .25 inch diameter Teflon coated stainless steel hinge pin.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Hinges shall be capable of supporting door weights up to 450 pounds, and shall be successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by a testing agency acceptable to the authority having jurisdiction.
6. Provide aluminum geared continuous hinges with electrified option where specified. Provide with sufficient number and gage of concealed wires to accommodate electric function of specified hardware.
7. Install hinges with fasteners supplied by manufacturer. Hole pattern shall be symmetrically patterned.
8. Acceptable manufacturers and/or products: Select, Ives, Markar, Stanley.

C. Mortise Locks

1. Provide mortise locks certified as ANSI A156.13, Grade 1 Operational, Grade 2 Security, and manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance. Lock case shall be multi-function and field reversible for handing without opening the case. Removable core cylinders to accept Owner’s core.
2. Provide locks with a standard 2-3/4 inches backset with a full 3/4 inch throw stainless steel mechanical anti-friction latchbolt. Deadbolt shall be a full 1 inch throw, constructed of stainless steel.
3. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
4. Lever trim shall be solid brass, bronze, or stainless steel, cast or forged in the design specified, with wrought roses and external lever spring cages. Levers shall be thru-bolted to assure proper alignment, and shall have a 2-piece spindle.
   a. Lever design shall be Corbin Russwin PSP
5. Acceptable manufacturers and/or products: Corbin Russwin ML2000 series, No Substitute.

D. Door Closers

1. Provide door closers certified to ANSI/BHMA A156.4 Grade 1 requirements by a BHMA certified independent testing laboratory. Surface mounted mechanical closers shall be certified to exceed ten million (10,000,000) full load cycles by a recognized independent testing laboratory. Closers shall be ISO 9000 certified. Units shall be stamped with date of manufacture code.
2. Door closers shall have fully hydraulic, full rack and pinion action with a high strength cast iron cylinder, and shall utilize full complement bearings at shaft. Cylinder body shall be 1-1/2 inch diameter, and double heat-treated pinion journal shall be 11/16 inch diameter.
3. Provide hydraulic fluid requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F. Fluid shall be fireproof and shall pass the requirements of the UL10C "positive pressure" fire test.
4. Spring power shall be continuously adjustable over the full range of closer sizes, and allow for reduced opening force as required by accessibility codes and standards. Hydraulic regulation shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, general speed, and backcheck.
5. Provide closers with a solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers. When closers are parallel arm mounted, provide closers which mount within a 6-inch top rail without the use of a mounting plate so that closer shall not be visible through vision panel from pull side.
6. Closer cylinders, arms, adapter plates, and metal covers shall have a powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or shall have special rust inhibitor (SRI).
7. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other finish hardware items interfering with closer mounting.
8. Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.
9. Acceptable manufacturer: LCN 4040XP, No Substitute.

E. Protection Plates

1. Provide kick plates, minimum of 0.050 inch thick as scheduled. Furnish with machine or wood screws, finished to match plates. Sizes of plates shall be as follows:
   a. Kick Plates – 10 inches high x 2 inches less width of door.
2. Acceptable manufacturers and/or products: Ives, Burns, Rockwood.

F. Thresholds, Seals, Door Sweeps, Rain Drip and Gasketing

1. Provide thresholds, seals, rain drip and gasketing as specified and per architectural details. Match finish of other items as closely as possible.
2. Provide door sweeps and seals where resilient or flexible seal strip is easily replaceable and readily available.
3. Acceptable manufacturers and/or products: National Guard Products, Reese and Zero.

2.3 FINISHES

A. Finish of all hardware shall be US26D (BHMA 626/652) with the exceptions as follows:

1. Geared Continuous Hinges: US28 (BHMA 628).
2. Mortise Locks: US32D (BHMA 630).
3. Protection Plates: US32D (BHMA 630).
4. Door Closers: Powder Coat to Match.
5. Weatherstripping: Clear Anodized Aluminum.
6. Thresholds: Mill Finish Aluminum.

2.4 KEYING

A. Provide cylinder housings to accept Owner's permanent removable cores.

1. Provide construction cores with construction master keying for use during construction. The Owner or Owner's security agent shall install permanent keyed cores upon completion of the project. The temporary construction cores are to be returned to the hardware supplier.
2. Permanent cores shall be furnished and keyed by the Owner.
3. Provide keys as follows
   a. Two construction core control keys
   b. Six construction master keys (Contractor is to provide one set of construction keys to Architect).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation of any hardware, examine all doors, frames, walls and related items for conditions that would prevent proper installation of finish hardware. Correct all defects prior to proceeding with installation.

3.2 INSTALLATION

A. Coordination:

1. Prior to installation of hardware, schedule and hold a meeting for the purpose of instructing installers on proper installation and adjustment of finish hardware. Representatives of locks, exit devices, closers, automatic operators, and electrified hardware shall conduct training; provide at least 10 days' notice to representatives. After training a letter of compliance, indicating when the training was held and who was in attendance, shall be sent to the Architect.

B. Hardware will be installed by qualified tradesmen, skilled in the application of commercial grade hardware. For technical assistance if necessary, installers may contact the manufacturer's rep for the item in question, as listed in the hardware schedule.

C. Mount hardware units at heights indicated in "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.

D. Install each hardware item in compliance with the manufacturer's instructions and recommendations, using only the fasteners provided by the manufacturer.

E. Do not install surface mounted items until finishes have been completed on the substrate. Protect all installed hardware during painting.

F. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

G. Operating parts shall move freely and smoothly without binding, sticking, or excessive clearance.

3.3 ADJUSTING, CLEANING, AND DEMONSTRATING

A. Adjust and check each operating item of hardware and each door, to insure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly.

B. 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 a 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.

C. Clean adjacent surfaces soiled by hardware installation.

D. Instruct Owner's personnel in the proper adjustment, lubrication, and maintenance of door hardware and hardware finishes.

3.4 FIELD QUALITY CONTROL

A. Prior to Substantial Completion, the installer, accompanied by representatives of the manufacturers of locks, exit devices, closer, and any electrified hardware, shall 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 Owner'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.
5. At completion of project, a qualified factory representative for the manufacturers of locksets, closer, exit devices, and access control products shall arrange and hold a training session to instruct the Owner's personnel on the proper maintenance, adjustment, and/or operation of their respective products. After training a letter of compliance, indicating when the training was held and who was in attendance, shall be sent to the Architect.

3.5 PROTECTION

A. Provide for the proper protection of complete items of hardware until the Owner accepts the project as complete. Damaged or disfigured hardware shall be replaced or repaired by the responsible party.

3.6 HARDWARE SCHEDULE

A. Provide hardware for each door to comply with requirements of Section "Finish Hardware," hardware set numbers indicated in door schedule, and in the following schedule of hardware sets.

B. It is intended that the following schedule includes complete items of finish hardware necessary to complete the work. If a discrepancy is found in the schedule, such as a missing item, improper hardware for a frame, door or fire codes, the preamble will be the deciding document.

C. Locksets, exit devices, and other hardware items are referenced in the Hardware Sets for series, type, and function. Refer to the preamble for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

1. See next page.

HARDWARE GROUP NO. 01

Qty.		Description	Catalog Number	Finish	Mfr.
1	EA	CONTINUOUS HINGE	SL24-HD x 83 x CLR x SDTF	630	SEL
1	EA	MORTISE PRIVACY LOCK	ML2069-PSP-CT6SD	US32D	COR
1	EA	SURFACE CLOSER	4111 SCUSH SRI	AL	LCN
1	EA	DRIP CAP	16A	A	NGP
1	SET	SEALS	BY FRP FRAME MANUFACTURER		
1	EA	DOOR SWEEP	BY FRP DOOR MANUFACTURER		
1	EA	THRESHOLD	8426		NGP

HARDWARE GROUP NO. 02

Qty.		Description	Catalog Number	Finish	Mfr.
1	EA	CONTINUOUS HINGE	SL24-HD x 83 x CLR x SDTF	630	SEL
1	EA	MORT. STORER'M LOCK	ML2057-PSP-CT6SD	US32D	COR
1	EA	SURFACE CLOSER	4111 SCUSH SRI	AL	LCN
1	EA	DRIP CAP	16A	A	NGP
1	SET	SEALS	BY FRP FRAME MANUFACTURER		
1	EA	DOOR SWEEP	BY FRP DOOR MANUFACTURER		
1	EA	THRESHOLD	8426		NGP

END OF SECTION

SECTION 092900 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install gypsum drywall work, as indicated on the Drawings and as specified. Include, but do not limit to:
   1. Steel suspension systems for ceilings and soffits.
   2. Screwable steel stud interior partition framing.
   3. Screwable steel stud framed and furred enclosures at columns and beams.
   4. Blockings and attachments for fixture supports.
   5. Gypsum wallboard finishes.
   6. Cementitious backer board for tile and direct applied finish soffit system.
   7. Acoustical sealing and acoustical insulation of gypsum wallboard finishes at steel stud framed partitions and furrings where indicated.
   8. Other gypsum drywall work called for on the Drawings or reasonably required to complete the Project intent.

1.2 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:
   1. Section 061000, ROUGH CARPENTRY; Wood blocking, furring, grounds, etc., except fixture support blocking.
   2. Section 083113, ACCESS DOORS AND FRAMES; Access doors.
   3. Section 092410, DIRECT APPLIED FINISH SYSTEM.
   4. Section 099100, PAINTING; Painting.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
   1. American Society for Testing and Materials (ASTM):

A 525	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
C 36	Gypsum Wallboard
C 475	Joint Treatment Materials for Gypsum Wallboard Construction
C 630	Water-Resistant Gypsum Backing Board
C 645	Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Boards

C 754	Installation of Steel Framing Members to Receive Screw-Attached Gypsum Wallboard, Backing Board, or Water-Resistant Backing Board
C 840	Application and Finishing of Gypsum Board
C 919	Sealants in Acoustical Applications
C 931	Exterior Gypsum Soffit Board
C 1002	Steel Drill Screws for the Application of Gypsum Board
E 90	Measurement of Airborne-Sound Transmission Loss of Building Partitions

1.4 SUBMITTALS

A. Shop Drawings: Furnish complete shop drawings of all work of this Section to Architect for approval, showing all pertinent details of construction and installation, and sizes, gauges, configurations, and connections of all components. Confirm on shop drawings that deflection will not exceed limitations specified.

B. Product Data: Submit manufacturer's product data and installation instructions.

1.5 QUALITY ASSURANCE

A. Reference Standards: Conform to governing laws, building code and manufacturer's printed standards.

B. Structural Performance: Limit deflection to L/270 for all work except as follows:
   1. Design and engineer exterior soffit framing systems to resist positive and negative wind pressures of 35 lbs. per sq. ft.

C. Sound Transmission Performance: Provide shaft wall assemblies with minimum STC of 47 tested in conformance with ASTM E 90, unless indicated otherwise on Drawings. Provide drywall partitions with minimum STC ratings indicated on Drawings tested in conformance with ASTM E 90.

D. Fire Resistance Ratings: Where indicated provide materials and assemblies identical to those tested and rated by testing and inspecting organization acceptable to authorities that have jurisdiction

1.6 COORDINATION

A. Work of this Section shall be coordinated with the work of other Sections to assure the steady progress of all the work of the Contract. Obtain complete information regarding wall and ceiling mounted fixtures, grilles, registers, equipment, accessories, etc. to be used on the work from other trades. In no case shall work of other Sections be concealed until it has been inspected.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver all manufactured materials to site in original packages, containers, or bundles bearing the manufacturer's name and brand names, type of material, and contents.

B. Store materials in interior spaces, above floors, under cover, away from sweating walls and other damp surfaces, and with good ventilation.

C. Handle gypsum boards to prevent damage to edges, ends, or surfaces. Protect metal corner beads, casing beads, and trim from being bent or damaged.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide acoustical joint sealants, adhesives, and other related materials that are compatible with one another and with substrates under conditions of service and application, as demonstrated by manufacturer, based on testing and field experience.

2.2 MANUFACTURERS

A. Gypsum Boards and Related Products: Provide materials, products, and systems from one of the following manufacturers that meet or exceed specified requirements:
   1. American Gypsum Co.
   2. G-P Gypsum Corp.
   3. National Gypsum Company.
   4. United States Gypsum Co.

2.3 METAL TRIM AND ACCESSORIES

A. General: Provide metal trim and accessories conforming to ASTM C 840.

B. Control Joint: 26 gauge, galvanized steel, "Vee" type, with perforated flanges, for compound finishing.

C. Corner Bead: 1 in. by 1 in. perforated flange, standard type, 26 gauge, galvanized steel, for compound finishing.

D. Metal Trim: 24 gauge, galvanized steel, with perforated flanges, for compound finishing.

E. Preformed reveals and corners for gypsum wallboard partitions shall be equal to Softforms Commercial Grade Standard Extrusions, manufactured by Softforms Division, Pittcon Industries, Inc., or approved equal. Shapes shall be extruded 6063-T5 aluminum alloy 1/8 in. thick, minimum (profile areas). Shapes shall be primed; plaster and paints shall be capable of bonding to primed surface. Fire rating shall be Class A. Provide all required shapes and radii indicated or required to complete the work.

F. Acoustical Blanket/Batt Insulation: Indicated thicknesses by 16-1/8 in. and 24-1/8 in. wide, as appropriate, equal to "UltraTouch Denim Insulation", or approved equal.

G. Packing Wool Insulation: Fiberglas or mineral wool packing insulation, equal to products manufactured by U.S. Gypsum Co. or Owens- Corning Fiberglas Corp.

H. Fire Safing Insulation: Mineral fiber fire-rated fire safing insulation in conformance with the governing laws and building code, manufactured by U.S. Gypsum Co. or approved equal.

I. Acoustical Sealant for Concealed Applications: Provide "BA-98 Acoustical Sealant", manufactured by Pecora Chemical Corp., equivalent product manufactured by U.S. Gypsum Co., National Gypsum Co., or approved equal.

J. Acoustical Sealant for Exposed Applications: Provide paintable "AC-20 Acrylic Latex Caulk", manufactured by Pecora Chemical Corp., equivalent product manufactured by DAP or Gibson Homans Co., or approved equal.

K. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 INSPECTION AND COORDINATION

A. Inspect job conditions and related work and report to Architect in writing, all conditions interfering with the proper installation of work of this Section. Commencement of work in any given area shall constitute acceptance of conditions in that area as acceptable to receive work of this Section.

B. Change and adjust work of this Section to accommodate work of other Sections, providing cutting and patching until it has been inspected.

3.2 GENERAL REQUIREMENTS

A. Provide work conforming to published specifications and installation instructions of each manufacturer, the approved shop drawings, above-referenced quality assurance standards, the governing laws and code. Refer to Drawings to determine location of fire-resistive, fire-protective, and acoustically-rated work, and construct this work to conform to the specifications and installation instructions of UL or other testing agency(ies). Also refer to the Drawings to determine the number of layers of gypsum board, thickness of board, etc., for each of the installations.

B. Erect gypsum drywall work, rigidly supported, and securely fastened in place, in such a manner that plumb, level, and true finished lines and surfaces will result in the finished work in accordance with the requirements of ASTM C 754 and ASTM C 840.

C. Construct gypsum drywall work only after all windows and door openings are enclosed and a temperature of not less than 55oF. is maintained during and up to completion of the drywall work.

3.3 GYPSUM WALLBOARD APPLICATION

A. Unless otherwise indicated, application of gypsum wallboard shall conform to ASTM C 840.

B. Apply thicknesses and layers of gypsum wallboard at ceilings, walls, partitions, column and beam enclosures as indicated. Stagger joints in each layer. Locate joints in first layer on opposite sides of partitions to occur on different studs. Apply wallboard at ceilings with long dimension perpendicular to furring channels, with each end occurring over a framing member. Install wallboard at walls and partitions with long dimension vertical, and with each end and edge lying over a framing member.

1. At double layer installations apply second layer by combination of laminating adhesive and mechanical fastenings (through first layer into the steel framing and/or furring member behind), in strict accordance with manufacturer's printed recommendations for each project condition.

C. Carry gypsum wallboard, each side, continuously from floor to underside of deck construction above, including above suspended ceilings, for acoustical and fire-resistive performances. Where installing perpendicular to steel joists, fit carefully to, and around, steel joist chords to provide positive, fire-safe barrier.

D. To minimize end joints, use maximum practical lengths. Bring gypsum wallboard panels into contact, but do not force into place. Fit abutting ends and edges neatly. Provide slots for sealant at top, bottom, ends, and corners of wallboard at all walls and partitions indicated to receive acoustical insulation, as indicated. Also provide slots for sealant where wallboard abuts other finish materials, as specified hereinbelow.

E. Spacing and installation of drywall screws for the various applications and fire-rating requirements shall conform to the printed standards of the manufacturer.

F. Set heads of fasteners flush with surface of the paper, but not breaking the paper. Where attached loosely to a framing or furring member, a second fastener shall be installed within 1-1/2 in.

G. Cut gypsum wallboard neatly at corners, edges, etc., and for pipes, electrical outlets, electrical conduit and raceway, recessed cabinets, and other projections.

H. Install wallboard cants over tops of beam enclosures in elevator hoistway as indicated, securely anchored into place.

3.4 CEMENTITIOUS BACKER BOARD INSTALLATION

A. Installation of cementitious backer board shall conform to ASTM C 840 and as recommended by cementitious backer board manufacturer.

3.5 ACOUSTICAL INSULATION

A. Walls and partitions indicated on the Drawings with STC Rating or indicated to receive acoustical insulation shall have a single, continuous layer of insulation installed as indicated and specified, filling the entire open space between the framing members. Carry insulation behind backs of all electric boxes and similar appurtenances. Provide mechanical attachment to prevent future settlement.

B. Refer to descriptions of shaft wall and furred wall construction, above, for further description of insulation work.

3.6 INSTALLATION OF WALLBOARD ACCESSORIES

A. Install accessories at gypsum wallboard installations, as follows, in strict accordance with manufacturer's instructions.
   1. Install joint reinforcement tape at all joints, and at all internal corners where abutting surfaces are both gypsum wallboard construction.
   2. Install corner beads at all external wallboard corners.
   3. Install casing bead wherever finish wallboard abuts dissimilar materials and other places where specifically called for on the Drawings.
   4. Install control joints generally over (and under) centers of all major wall openings (those greater than 40% of wall height, measured floor to ceiling), over all door frames, over control joints in back-up materials, and at maximum distance of 30 ft. in walls, 60 ft. or to limit areas to not more than 2400 sq. ft., at ceilings (except where lesser distance is indicated), and other places specifically called for on the Drawings. Interrupt furring and/or framing behind the

control joints. Specific locations of control joints shall be as indicated or as directed by Architect; submit proposed locations of control joints to Architect for approval before beginning work.

5. Install preformed reveals corners where indicated in accordance with the manufacturer's recommendations.

3.7 JOINT FINISHING

A. Finish all corners, joints, and edges of gypsum wallboard and gypsum soffit board work, and all corner beads, casing beads, control joints and other trim to provide complete finishing of all exposed wallboard surfaces, in strict accordance with manufacturer's printed instructions and ASTM C 840. Finish to absolutely flush, true surface showing no irregularity when tested by light source parallel to the plane of the nominal wallboard face.

B. Finish all concealed joints in wallboard above ceiling finishes flush with tape and a minimum of two coats of compound to provide a continuous, uninterrupted plane for acoustical and fire-resistive performance. Concealed joints may be left in rough condition without finish sanding.

C. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

D. Prefill open joints, rounded or beveled edges, and damaged surface areas.

E. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

F. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:

1. Level 1 in Ceiling Plenums and Concealed Areas: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
2. Level 4 for Panels to Receive Paints: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at surfaces receiving acoustical plaster or flat paints.

3.8 ACOUSTICAL SEALING

A. Walls and partitions designated on the Drawings with an STC Rating and/or indicated to receive acoustical or thermal insulation, including interior faces of exterior steel framed curtain walls, do all sealing work required, as indicated on the Drawing and generally as listed below.

1. Seal all joints between the gypsum wallboard and surrounding construction.
2. Seal full perimeters of all frames, sleeves, ducts, and other items set into, or passing through, gypsum wallboard construction.
3. Seal full perimeters of all projections through the gypsum wallboard construction, such as pipes, conduits, etc.
4. Seal all control joints in the gypsum wallboard work.
5. Seal all joints between gypsum wallboard and adjoining gypsum wallboard panels at corners and intersections.
6. Seal all joints between gypsum wallboard and adjoining door and window frames in exterior walls.

7. Do all other sealing called for on the Drawings or reasonably required to produce maximum thermal and sound transmission reduction through the walls and partitions.

B. Seal joints in partitions continuing above suspended ceilings, in similar manner, for acoustical purposes.

C. Sealing shall be done using sealant of type specified hereinbefore, in strict accordance with manufacturer's printed instructions and applicable requirements of ASTM C 919. Sealant shall thoroughly fill void for a complete sound and thermal seal, and shall be tooled to dense, smooth, concave finish.

1. Except as may be otherwise specifically called for on the Drawings, in two layer wallboard work seal only the outer layer.

3.9 PROTECTION AND CLEANING

A. Protect the work of other Sections and work of this Section already installed against soiling and damage by the exercise of reasonable care and precautions. Repair or replace any work so damaged or soiled.

END OF SECTION

SECTION 09310

CERAMIC TILE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section includes ceramic tile and accessories for floor and wall applications as shown on the Drawings and specified herein.

1.3 REFERENCES

A. Tile Manufacture - comply with ANSI A 137.1.

B. Installation - comply with ANSI A 108, A 118, A 136, and Tile Council of America (TCA) details as specified.

1.4 SUBMITTALS

A. Product Data - Provide manufacturer's catalog cuts, specifications, and installation instructions for each material specified:

1. Tile and trim units.
2. Setting and grouting materials.
3. Thresholds.

B. Samples:

1. Tile Samples:

a. Manufacturer's standard range of colors and textures for each type of tile specified.
b. Manufacturer's standard range of colors for each type of group required.

2. Threshold sample.

3. Accessory samples, as specified.

C. Quality Control Submittals:

1. Provide tile manufacturer's Master Grade Certificate for each tile.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not install adhesives in an unventilated environment.

B. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

1.7 EXTRA MATERIALS

A. Provide one (1) unopened carton and any remaining opened cartons of each size, color, and surface finish at time installed to ensure same lot.

PART 2 PRODUCTS

2.1 TILE

A. Manufacturers:

1. American Olean Tile Co.
2. Dal-tile Corp.
3. Summitville Tile Inc.
4. Florida Tile

B. Unglazed Ceramic Mosaic Tile - ANSI A 137.1: NOT USED

1. Composition - porcelain.
2. Size - 2” x 2” x 1/4”.
3. Face - plain with cushion edges.
4. Color - selected from manufacturer’s color price group 1.
5. Trim Units - matching bead, cove, and bullnose shapes coordinated with field tile and required by job conditions.

C. Glazed wall tile - ANSI A 137.1:

1. Standard Grade.
2. Size - 12” x 24” x 5/16”.
3. Face - plain with cushion edge and semi-gloss glaze.
4. Color - selected from manufacturer’s color price group 1.
5. Trim Units - matching bullnose shapes coordinated with field tile.

D. Glazed Paver Tile - ANSI A 137.1: NOT USED

1. Composition - porcelain.
2. Size - 12” x 12” x 5/16”.
3. Face - plain with square edges and slip-resistant surface finish.
4. Color - selected from manufacturer’s standard range.

2.2 SETTING MATERIALS

A. Adhesive:

1. Organic Adhesive - ANSI A 136.1, thin-set bond type; use Type I areas subject to prolonged moisture exposure.
2. Tile Setting Adhesive - Elastomeric, waterproof, liquid applied.

B. Mortar:

1. Mortar Bed Materials - Portland cement, sand, and water.

2. Mortar Bond Coat Materials:

a. Dry-set Portland cement type: ANSI A 118.1.
b. Latex-Portland cement type: ANSI A 118.4.

C. Grout

1. Grout - Latex-Portland cement type as specified in ANSI A 118.6.

a. Colors: as selected from standard color range.

2.3 ACCESSORY MATERIALS

A. Thresholds – NOT USED

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that sub-floor surfaces are smooth, flat, dust-free, and free of substances that would impair bonding of setting materials to sub-floor surfaces.

B. Verify that wall surfaces are smooth and flat, are dust-free, and are ready to receive tile.

3.2 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

3.3 INSTALLATION - GENERAL

A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A 108.1 through A 108.10, manufacturer's instructions, and TCA Handbook recommendations.

B. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints if used.

C. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.

D. Form internal angles square and external angle bullnosed.

E. Sound tile after setting. Replace hollow sounding units.

F. Allow tile to set for a minimum of 48-hours prior to grouting.

G. Grout tile joints. Use standard grout unless otherwise indicated.

H. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.4 SETTING - FLOORS, THIN-SET METHOD NOT USED

A. Over interior concrete substrates, install in accordance with TCA Handbook method F 113, dry-set or latex-Portland cement bond coat, with standard grout.

3.5 SETTING - WALL TILE

A. Over concrete masonry units, install in accordance with TCA Handbook method W 223, organic adhesive.

3.6 CLEANING

A. Clean tile and grout surfaces per manufacturer's instructions.

3.7 PROTECTION OF FINISHED WORK

A. Do not permit traffic over finished floor surface for four (4) days after installation.

END OF SECTION

SECTION 096513 RESILIENT WALL BASE AND ACCESSORIES

PART 1 GENERAL

1.1 WORK INCLUDED

A. Provide resilient base and related items, as indicated on the Drawings and as specified herein. Work of this Section includes, but is not limited to:

1. Rubber base.
2. Mastics.

1.2 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 096813, TILE CARPETING; Carpeting, including edge strips between carpeting and resilient flooring.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's printed product data, specifications, standard details, installation instructions, use limitations and recommendations for each material used. Provide certifications that materials and systems comply with specified requirements.

B. Initial Selection Samples: Submit samples showing complete range of colors, textures, and finishes available for each material used.

1.4 COORDINATION

A. Coordinate work of this Section with work of other Sections affecting, or affected by, this work, as necessary to ensure completion of work of the Contract on schedule.

PART 2 PRODUCTS

2.1 GENERAL MATERIAL REQUIREMENTS

A. Resilient materials shall be uniform in thickness and size.

B. Resilient material shall be cut accurately with square, true edges.

C. Plain colors shall be uniform throughout.

D. Variegated colors and patterns shall be reasonably uniform so as not to mar appearance of floor.

E. Except as otherwise indicated or specified, all colors shall be as selected by the Architect from the full range of manufacturer's standard colors.

F. Resilient materials shall be free of objectionable odors, blisters, cracks, objectionable foreign material, or other physical defects affecting appearance or serviceability.

2.2 RUBBER BASE

A. Recycled Content: Provide rubber base with the greatest amount of recycled content available from manufacturer in colors selected below.

B. Acceptable Manufacturers: Provide products of one of the following manufacturers that meet or exceed specified requirements:

1. Johnsonite
2. Armstrong World Industries, Inc.

C. Rubber Wall Base: Provide rubber wall base conforming to FS SS-W-40, Type I, with matching end stops, and premolded corner units, and as follows:

1. Height: 4 in.
2. Thickness: 0.08 in. gage.
3. Style: Straight at carpet, coved at other locations.
4. Finish: Matte.
5. Colors: As scheduled on Drawings.

2.3 ADHESIVES

A. Adhesives: Water-resistant type recommended by manufacturer to suit substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. Not more than 50 g/L.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not begin installation until work of other sections including painting, is substantially complete. Use only experienced workmen. Strictly adhere to printed instructions of manufacturer's of various materials; if found to be in conflict refer to Architect for decision.

B. Maintain room temperatures in installation areas at not less than 65oF. for a period of at least 48 hours prior to commencement of tile work, and to at least 48 hours after completion, and not less than 60oF. from that time on.

C. Clean off surplus adhesive from resilient materials and adjacent surfaces.

3.2 RESILIENT BASE INSTALLATION

A. Install resilient base in manner to ensure uniform positive contact with sub-surface, and to produce finished surfaces which are smooth, even, and in true planes, free of buckles, waves, and other imperfections. Store and use adhesive in accordance with manufacturer's printed instructions.

3.3 ADDITIONAL MATERIALS

A. Furnish additional wall base in quantity of at least 3% of the number of each type of individual units used on the project, in manufacturer's original containers.

B. Deliver the additional materials to site and place in storage area(s) within the building designated by the Architect.

END OF SECTION

SECTION 099100 PAINTING

PART 1 GENERAL

1.1 WORK INCLUDED

A. Provide painting and finishing work throughout exterior and interior of Project as indicated and scheduled on the Drawings and as specified.

B. Examine Contract Documents to determine full extent of painting and finishing work required. Materials provided under other Sections that need painting or finishing and are left unfinished under requirements of other Specification Sections, shall be painted and finished to completion under work of this Section, unless specifically scheduled herein to be left unfinished.

C. Preparatory work of materials and surfaces to receive paint beyond that specified to be done as work of other Sections, shall be included as work of this Section.

1.2 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 055000, METAL FABRICATIONS.
2. Section 061000, ROUGH CARPENTRY; Wood preservative treatments.
3. Section 081113, HOLLOW METAL DOORS AND FRAMES; Prime coat on hollow steel doors and frames.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. Federal Specifications (Fed. Spec.):

TT-D-65	Drier; Paint, Liquid
TT-T-801	Turpentine, Gum Spirits, Steam Distilled, Sulfate Wood, and Destructively Distilled

2. Steel Structures Painting Council (SSPC):

SP 2	Hand Tool Cleaning
SP 3	Power Tool Cleaning

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's printed product data, specifications, use limitations and recommendations for each material used. Provide certifications that materials and systems comply with specified requirements.

B. Initial Color Selection Samples: Submit manufacturer's standard color charts or chips showing complete range of colors, textures, and finishes available for each paint system used.

C. Verification Samples: After initial selection of colors, submit representative samples of each paint system color that is to be exposed in the completed work. Show full color ranges and finish variations expected. Provide texture to simulate actual conditions. Define each separate coat, including block fillers and primers. Resubmit samples until required sheen, color, and texture have been approved. Provide samples as follows:

1. Paint Samples for Smooth Surfaces: Provide samples of painted finishes on gypsum drywall or Masonite board having minimum size of 144 sq. in.

2. Paint Samples for Concrete Masonry Units: Provide samples of painted finishes on actual concrete masonry units having minimum size of 4 in. x 8 in.

3. Stained or Natural Finished Wood: Provide samples of stained or natural finished wood on actual samples of wood to be used in the completed work.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

A. Source: Provide primers and undercoat paint produced by same manufacturer of finish coats for each substrate.

B. Coordination: Review other Specification Sections where primers are provided to ensure compatibility with finish coatings provided under this Section.

C. Mock-Ups: Prior to commencing work of this Section, provide 100 sq. ft. mock-ups of each color, paint system, and substrate at locations acceptable to the Architect. Obtain Architect's acceptance of visual qualities. Refinish mock-ups until Architect's acceptance is obtained. Maintain acceptable mock-ups throughout the remainder of the work to serve as criteria for acceptance of the work. Acceptable mock-ups may be incorporated into the finish work.

1.7 TETS

A. The Owner may employ an independent testing agency to perform tests, evaluations, and certifications of products used. Cooperate and permit samples of materials to be taken as they are used.

1.8 PROJECT CONDITIONS

A. Weather, Temperature, and Humidity: Perform work only when existing and forecasted weather conditions fall within limits established by manufacturers of materials used.

1. Indoor Temperature: Maintain indoor temperature at 65°F. during application and drying of paints.
2. Outdoor Temperature and Conditions: Air and surface temperature shall be between 50°F. and 90°F. Surfaces shall be dry within limits of finish system manufacturer.
3. Do not paint exterior surfaces while surfaces are exposed to the hot sun.

B. Substrates: Proceed with work only when substrate construction and penetration work is complete.

C. Lighting: Since lighting conditions can alter appearances of finish painting work, perform work of this Section under lighting conditions simulating permanent lighting system to the greatest extent possible.

1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in unopened original containers bearing manufacturer's labels.

B. Store materials in fully sealed containers, outside the building, preferably in exterior storage shed, well ventilated, and with a minimum ambient temperature of 45°F. Oily rags and waste must be removed from the building every night, and under no circumstances will be allowed to accumulate. Each space containing stored paint materials shall be provided with UL labeled fire extinguisher of suitable type, class, and capacity.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Latex and Alkyd Based Paints: Provide products of one of the following manufacturers that meet or exceed specified requirements:

1. Benjamin Moore and Co. (Moore).
2. Devoe and Raynolds Co. (Devoe).
3. The Sherwin Williams Company (S-W)

B. High Performance Paint Coatings: Provide products of one of the following manufacturers that meet or exceed specified requirements:

1. Tnemec Corporation (Tnemec).
2. Carboline.
3. DuPont.

C. Materials used shall be best grade products of their respective kinds. The Painting Schedule is based on products the above named manufacturers. These are specified to establish a

standard of quality and kind of material desired. Provide these products, or equals as approved by Architect.

D. Note: If substitutes are proposed, submit complete schedule showing materials specified and equivalent materials proposed as substitutes. Provide complete manufacturer's product data on proposed materials. Substitutes must be approved by Architect before commitment for materials is made.

E. Assume full responsibility for proper performance of materials, for method of application, and for compatibility of materials applied over shop coats or other coats previously applied, including but limited to primers, sealers, preservative treatments, etc. Notwithstanding specific schedules in this Section, select primers which have been verified to be appropriate for each of the substrates and finishes encountered.

F. Provide miscellaneous painting materials such as linseed oil, shellac, turpentine, and thinner of the highest quality.

G. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
3. Shellacs, Pigmented: VOC not more than 550 g/L.

2.2 COLORS

A. Provide colors in accordance with schedule on Drawings, or as provided by Architect. Tint and match colors to the satisfaction of Architect. Provide facilities for comparison and adjustment of colors. No limit is placed on number of colors that may be required.

PART 3 EXECUTION

3.1 INSPECTION AND GENERAL PREPARATION

A. Inspect surfaces to receive finishes to ensure they are in proper condition to receive work under this Section.

B. If surfaces are not thoroughly dry, or if surfaces cannot be put in proper condition to receive paint or other finish by customary cleaning methods, sanding, or spackling, notify Architect in writing.

C. Commencing work on any surface will be construed as acceptance of the surface as being satisfactory to properly receive the work of this Section.

D. Furnish and lay drop cloths in all rooms and areas where painting and finishing is being done, to adequately protect flooring and other work from all damage during the painting work.

E. Remove hardware, accessories, device plates, lighting fixtures, factory finished work, and similar items; or provide ample in-place protection. Use skilled mechanics for removal, resetting, and protection.

F. Cleaning: Do not paint over dirt, dust, rust, grease, moisture, or other contaminants detrimental to the formation of a durable paint finish. Clean surfaces thoroughly prior to painting in any given area.

G. Touch up bare or abraded spots on surfaces with shop or existing finishes scheduled to be painted under this Section. Use same material used for shop coat. Substrate shall be smooth, free from raised grain; putty sags, cracks, rust, grease, dirt, or other foreign matter or defect.

H. Incompatible Shop Primers: Remove incompatible shop primers and reprime surfaces, or provide barrier coats in compliance with finish paint manufacturer's instructions.

3.2 SURFACE PREPARATION

A. Prepare surfaces to receive work of this Section in strict accordance with manufacturer's instructions applicable to each material, condition, and finish.

B. Gypsum Wallboard: Fill holes, dents, and similar flaws in gypsum wallboard with plaster of Paris or spackling compound. Cut out and fill cracks. Sand surface of patch smooth and flush with adjacent surfaces. Do not abrade adjacent surfaces. Patched areas shall not be detectable in finished work.

C. Plaster: Fill holes, dents, and similar flaws in plaster with plaster of Paris or spackling compound. Cut out and fill cracks. Sand surface of patch smooth and flush with adjacent surfaces. Do not abrade adjacent surfaces. Patched areas shall not be detectable in finished work.

1. Plaster Moisture Test: Before painting new plaster, test surfaces with a moisture detecting device, such as Kaydel Plaster Test, Type CP-48, manufactured by Hard Moisture Gauges, Inc. Do not apply sealer or paint when moisture content of plaster exceeds 8%. Perform testing in presence of Architect and in as many locations as directed. Dry-brush plaster thoroughly prior to painting or sealing.

2. Plaster Alkalinity Tests: Determine substrate alkalinity content and take appropriate remedial actions as recommended by paint material manufacturer.

D. Concrete and Masonry: Prepare concrete and masonry surfaces prior to painting. Allow a minimum of 60 to 90 days curing time prior to painting poured or precast concrete. Allow a minimum of 30 to 60 days curing time prior to painting concrete masonry. Determine substrate alkalinity and moisture content and take appropriate remedial actions as recommended by paint material manufacturer. Do not paint surfaces which are sufficiently alkaline to cause blistering or peeling until remedial action is taken. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's printed instructions.

1. Wire-brush clean previously painted concrete and masonry surfaces.
2. Thoroughly clean of dirt, grit, loose materials, mortar drippings, and other deleterious substances.

3. Concrete floor which is to receive sealer shall be thoroughly washed with a cleaning and degreasing solution, in accordance with the recommendations of the sealer manufacturer.
4. The first coat for masonry is a fill coat. Thoroughly brush fill coat into the surface in accordance with manufacturer's directions. Preliminary coats on masonry are to be absorbed into the surface. Provide additional undercoats as necessary to achieve perfect uniformity of finish coats.

E. Wood to be Painted: Sand surfaces smooth and free of marks prior to applying first coat. Wash sap spots and knots with mineral spirits. When dry, touch-up spots and knots with an approved sealer for exterior work, and with two coats of shellac for interior work.

1. Fill nail holes, cracks, open joints, and other defects, with putty or plastic wood filler. Sand smooth when dry.
2. Prime tops, edges, and bottoms, of unprimed wood doors immediately upon delivery. Prime hardware cut-outs in similar manner prior to installation of butts, locks, and closers.
3. Prime wood edges, ends, faces, undersides, backsides, including cabinets, casework, paneling, and mouldings and trim.
4. Prime wood glazing rabbets and sealant slots before glazing or sealant work is begun.

F. Wood to be Transparent Finished: Sand smooth and free of marks before applying the first coat. Wash sap spots and knots with mineral spirits. When dry, touch-up spots and knots with two coats of shellac.

1. Backprime work with an approved spar varnish.
2. Fill nail holes, cracks, open joints, and other defects after first coat is dry, using an exterior filler compatible with the finishing specified and tinted to camouflage repairs.
3. Seal tops, edges, and bottoms, of unfinished wood doors immediately upon delivery. Seal cut-outs in similar manner prior to installation of butts, locks, and closers. If stained finish is required obtain alternate instructions from Architect. After being fitted by the carpenter, seal cut edges again, in similar manner, and then top and bottom edges shall be given an additional seal coat.
4. Seal wood glazing rabbets and sealant slots before glazing or sealant work begins.

G. Field-Welded Ferrous Metal: After installation, field-welding, and grinding, and immediately before painting, remove rust, loose mill scale, dirt, weld flux, weld spatter, weld smoke stains, burnt primer, and other foreign material with wire brushes and/or steel scrapers. Power tool clean in accordance with SSPC SP 3. Remove grease and oil by use of solvent recommended by paint manufacturer. Sand exposed surfaces, and between coats, as required to produce smooth, even finishes.

1. Sand smooth and spot prime welded areas, and areas where prime coat has been damaged or abraded, using rust inhibitive primer scheduled in this Section.

H. Other Ferrous Metal: Remove rust, mill scale, and foreign materials. Wire brush or sand damaged or rusted area to bright metal. Remove grease or dirt with solvents recommended by paint manufacturer just prior to applying paint.

1. Spot prime all areas where shop coat has been damaged or abraded, using same type paint as used for shop coat.

I. Field-Welded Galvanized Metal: After installation, field-welding, and grinding, and immediately before painting, remove rust, loose mill scale, dirt, weld flux, weld spatter, weld smoke stains, and other foreign material with wire brushes and/or steel scrapers. Power tool clean in accordance with SSPC SP 3. Remove grease and oil with solvents recommended by paint manufacturer. Sand exposed surfaces, and between coats, as required to produce smooth, even finishes.

1. Sand smooth welded areas, and areas where galvanized coating has been damaged or abraded. Spot prime using zinc primer scheduled in this Section.

J. Other Galvanized Metal: Prior to installation, remove corrosion and foreign materials by sanding or other appropriate method. Remove grease or dirt with solvent recommended by paint manufacturer just prior to applying primer.

K. Other Non-Ferrous Metal: Prepare shop primed non-ferrous metals similarly to ferrous metals, specified above.

1. Prepare unprimed non-ferrous metals by thoroughly cleaning of oil, grease, and temporary protective coatings using solvent recommended by primer manufacturer. Provide additional pretreatment recommended by primer manufacturer to assure permanent adhesion of paint coats.

L. Other Materials: Prepare other materials in strict accordance with recommendations of manufacturers of materials to be finished, and primers and finishes to be applied.

M. Materials Preparation: Mix and prepare paint materials in accordance with manufacturer's printed instructions. Use only thinners approved by paint manufacturer, and only within recommended limits.

3.3 APPLICATION

A. Painting Schedule in this Section lists minimum number of coats required. If specified minimum number of coats does not completely cover or hide base materials, provide additional coats required for coverage and uniform finish appearance, without additional cost to Owner.

B. Apply paint in strict accordance with manufacturer's instructions. Use applicators and techniques best suited for substrates and types of materials being applied. No material shall be thinned in any way except as directed by manufacturer.

C. Apply paints and coatings at coverage rates and dry film thicknesses scheduled at the end of this Section. Each coat applied must be inspected and approved by Architect prior to application of succeeding coat, otherwise no credit for the coat applied will be given and work in question shall be recoated without additional expense to Owner. Notify Architect when each coat is ready for inspection.

D. Additional Coats: Provide additional coats necessary to eliminate show through and bleed through conditions.

E. Drying Time: Allow manufacturer's recommended drying time between successive coats. However, allow each coat to thoroughly dry prior to application of subsequent coat.

F. Sanding: Lightly sand finishes between coats using #00 sandpaper.

G. Tinting: Tint prime coat on gypsum wallboard and plaster to approximate color of final shade.

H. Closets: Finish closets inside the same as adjoining rooms, unless otherwise specified or scheduled.

I. Doors and Panels: Paint all doors, panels, access panels, etc., in the "open" position. Paint all edges, tops, bottoms, and both faces. Paint back face of access panels and removable or hinged covers to match adjacent exposed surfaces.

J. Movable Equipment and Furnishings: Paint surfaces behind movable equipment and furnishings same as adjacent exposed surfaces.

K. Permanently Fixed Equipment: Paint surfaces behind permanently fixed equipment with prime coat only.

L. Duct Interiors: Paint interior surfaces of ducts where visible through registers, grilles, or louvers with flat black, non-specular paint.

M. Field-Finished Casework: Finish interior of wall and base cabinets and other field finished casework to match exterior.

N. Finished work shall be free from runs, sags, hairs, defective brushing, and clogging of lines and angles. Flaws visible in the completed work shall be removed and the area satisfactorily repaired.

O. Concrete Floor to Receive Sealer: Apply sealer at a rate not to exceed 200 sq. ft./gal.

1. Allow first coat to cure not less than 24 hours, but not more than 72 hours. Apply second coat at a rate not to exceed 400 sq. ft./gal.

P. Mechanical and Electrical Work: Painting of mechanical and electrical items is limited to items exposed to view in the mechanical rooms and in occupied areas.

1. Mechanical items to be painted include, but are not limited to:

a. Ductwork.
b. Heat exchangers.
c. Insulation
d. Motors and mechanical equipment.
e. Piping, hangers, and supports.
f. Tanks and equipment

2. Electrical items to be painted include but are not limited to:

   a. Conduit and fittings.
   b. Switchgear.

Q. Block Fillers: Apply block fillers to concrete masonry units at rates to ensure complete coverage with pores completely filled.

R. Completed Work: Provide finishes that match approved samples and mock-ups for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.

3.4 COMPLETION

A. Cleaning: At completion of work of this Section, remove paint and varnish spots, and oil, grease, and other stains caused by this work from exposed surfaces. Leave finishes in a satisfactory condition.

B. At completion of work of this Section, remove masking materials and other debris. Reinstall or replace fixtures, plates, etc., removed to facilitate application of paint.

C. Retouching: Touch-up and repair applied finishes which, for any reason have been damaged during construction work. All finished work applied under this Section shall have finished surfaces as approved by finish material manufacturer.

D. Final Inspection: Protect painted surfaces against damage until date of Substantial Completion. Architect will conduct final inspection of painting work. Areas that do not comply with requirements of these Specifications shall be repainted or retouched to satisfaction of Architect at no additional cost to Owner.

3.5 SURFACES NOT TO BE FINISHED

A. Finishes for the following items are either included under other appropriate Sections or require no painting, except as otherwise specifically scheduled with subsequent Exterior and Interior Schedules.

1. Chrome or nickel plating, stainless steel, bronze, brass, and aluminum other than mill finished, unless otherwise specified.
2. Factory finished mechanical and electrical equipment, pumps, and machinery, which occur in mechanical or equipment rooms or areas.
3. Galvanized ducts, pipes, conduits, etc., occurring within mechanical areas or spaces. Also all such items fully concealed from view in the finished work.
4. Factory finished materials, specialties, and accessories unless otherwise specified.
5. Ceramic and clay products, glass, plastic, and other surfaces with "integral" finishes, except as otherwise scheduled hereinbelow.
6. Exterior concrete.
7. Exterior masonry.
8. Architectural woodwork specified as shop finished.

3.6 PAINT SCHEDULE

A. Number of coats scheduled is minimum. Refer to Paragraph 3.03A., hereinbefore.

B. Painting of Interior Surfaces: Important Note: Notwithstanding anything in the following schedule to the contrary, interior painting and finishing shall conform to the applicable laws and building code regarding fire hazard classifications of finish materials.

1. Interior Gypsum Wallboard for Latex Eggshell, or Satin Finish:

One Coat

1. Benjamin Moore; Eco-Spec Interior Latex Primer: Applied at a dry film thickness of not less than 1.2 mils (0.030 mm).
2, Duron Equal
3. S-W Equal

Two Coats

1. Benjamin Moore; Eco-Spec Latex Eggshell Enamel: Applied at a dry film thickness of not less than 1.3 mils (0.033 mm).
2. Duron Equal
3. S-W Equal

2. Interior Gypsum Wallboard Ceilings for Latex Flat Finish:

One Coat

1. Benjamin Moore; Eco-Spec Interior Latex Primer: Applied at a dry film thickness of not less than 1.2 mils (0.030 mm).
2. Duron Equal
3. S-W Equal

Two Coats

1. Benjamin Moore; Eco-Spec Latex Flat: Applied at a dry film thickness of not less than 1.3 mils (0.033 mm).
2. Duron Equal
3. S-W Equal

3. Interior Metals not Specified to Receive other Coating Systems:

One Coat

1. Approved primer, in shop under other Sections (where specified)

One Coat

Field Primer (only where shop primer is not specified):

1. Benjamin Moore; Moore's IMC Acrylic Metal Primer: Applied at a dry film thickness of not less than 2.0 mils (0.051 mm).
2. Devoe Equal
3. S-W Equal
4. PPG Equal

Note: One prime coat only is required at interior metal work, except touch-up of areas which have become rusted or damaged prior to finish painting.

Two Coats

1. Benjamin Moore; Moorcraft Super Spec Acrylic Semi-Gloss Enamel: Applied at a dry film thickness of not less than 1.4 mils (0.036 mm).
2. Devoe Equal
3. S-W Equal
4. PPG Equal

4. Mechanical and Electrical Work (Paint all exposed items throughout the project except factory finished items with factory-applied baked enamel finishes which occur in mechanical rooms or areas, and excepting chrome or nickel plating, stainless steel, and aluminum other than mill finished. Paint all exposed ductwork and inner portion of all ductwork visible through grilles and registers):

   Same as specified for other interior metals, hereinabove.

5. Interior Concrete Masonry Units for Semi-Gloss Finish in Dry Areas:

One Coat

1. Benjamin Moore; Moorcraft Super Craft Latex Block Filler: Applied at a dry film thickness of not less than 8.1 mils (0.206 mm).
2. Devoe Equal
3. S-W Equal

One Primer Coat

1. Benjamin Moore; Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer: Applied at a dry film thickness of not less than 1.2 mils (0.030 mm).
2. Devoe Equal
3. S-W Equal

Two Coats

1. Benjamin Moore; Moorcraft Super Spec Latex Semi-Gloss Enamel: Applied at a dry film thickness of not less than 1.2 mils (0.031 mm).
2. Devoe Equal
3. S-W Equal

3.7 HIGH PERFORMANCE COATING SCHEDULE

A. High Performance Coating of Exterior Surfaces:

1. Exterior Galvanized Steel for Acrylic Polyurethane Finish (exterior steel doors and frames):

One Coat

1. Primer in shop, under Section 081113.

After Installation:

Barrier Coat:

1. As recommended by manufacturer for compatibility between shop coats and field coats.

First Field Coat	1.	Tnemec "No. N69 Hi-Build Epoxoline" Epoxy
	2.	Carboline Equal
	3.	DuPont Equal
Second Field Coat (dry film 1.5 to 2.0 mils)	1.	Tnemec "No. 1075U "
	2.	Carboline Equal
	3.	DuPont Equal

B. High Performance Coating of Interior Surfaces:

1. Interior Steel Doors and Frames:

One Coat	1.	Primer in shop, under Section 081113.

After Installation:

Barrier Coat:	1.	As recommended by field coat manufacturer for compatibility between shop and field coats.
First Field Coat	1.	Tnemec "No. 1029" at 2.0 – 2.5 mils DFT
	2.	Carboline Equal
	3.	DuPont Equal
Second Field Coat	1.	Tnemec "No. 1081" at 2.0 – 2.5 mils DFT
	2.	Carboline Equal
	3.	DuPont Equal

2. High Performance Coating for Interior Drywall Surfaces:

First Field Coat	1.	Tnemec Series “151” at 1.0 – 1.5 mils DFT
	2.	Carboline Equal
	3.	DuPont Equal
Second Field Coat	1.	Tnemec Series “280” at 4.0 – 6.0 mils DFT
	2.	Carboline Equal
	3.	DuPont Equal
Third Field Coat	1.	Tnemec Series “297” at 2.0 – 2.5 mils DFT
	2.	Carboline Equal
	3.	DuPont Equal

3. Exposed Overhead Structural Steel, Steel Decking, Ductwork, Conduit etc.:

One Coat (dry-film 3.0 mils) per coat)	1.	Tnemec Series 115 Unibond Rust Inhibitive Coating
	2.	Carboline Equal
	3.	DuPont Equal

END OF SECTION

SECTION 101423 SIGNAGE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fabricated channel dimensional characters.

B. Related Requirements:

1. Division 04, MASONRY; granite veneer base panels.

1.2 DEFINITIONS

A. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.3 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.4 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For illuminated information signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign.
4. Show locations of electrical service connections.
5. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each type of sign exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), as follows:

1. Exposed Metal: 12 in. long sample of each exposed metal and finish.

E. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

F. Maintenance Data: For signs to include in maintenance manuals.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices and electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 DIMENSIONAL CHARACTERS

A. Fabricated Channel Characters: Metal face and side returns, formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability and for securing fasteners; and as follows.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. APCO Graphics, Inc.
   b. ASI Sign Systems, Inc.
   c. Gemini Incorporated.
   d. Nelson-Harkins Industries.
   e. Poblocki Sign Company, LLC.

2. Character Material: Sheet or plate aluminum.
3. Material Thickness: Manufacturer's standard for size and design of character.
4. Character Height: As indicated.
5. Character Depth: 1 in.
6. Finishes:

   a. Integral Aluminum Finish: Clear anodized.

7. Mounting: Projecting studs.

   a. Hold characters at distance as indicated from wall surface.

2.2 DIMENSIONAL CHARACTER MATERIALS

A. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

2.3 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish **nonferrous-metal** devices unless otherwise indicated.
3. Sign Mounting Fasteners:

a. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

2.4 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.

2.5 GENERAL FINISH REQUIREMENTS

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. 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. Anodic Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

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 signage work.

B. Verify that anchor inserts are correctly sized and located to accommodate signs.

C. Verify that electrical service is correctly sized and located to accommodate signs.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.

2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

B. Mounting Methods:

1. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

   a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
   b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.

2. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

SECTION 102800 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install all toilet accessories as required to complete the work of the Contract, as indicated on the Drawings and as specified herein.

1.2 SUBMITTALS

A. Shop Drawings: Submit complete shop drawings of all work of this Section to Architect for approval, showing all pertinent details of construction and installation, including details of methods of attachment to supporting materials.

B. Product Data: Submit complete manufacturer's product data of all work of this Section to Architect for approval, consisting of complete product description and specifications, catalog cuts, and other descriptive data required for complete product and product use information.

C. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.

D. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.

1.3 QUALITY ASSURANCE

A. Source Limitations: For products listed, obtain products from single source from single manufacturer.

1.4 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.5 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Accessories shall be manufactured by Bobrick Washroom Equipment Company; American Specialties, Inc.; Bradley Corporation Washroom Specialties Division; or approved equal. Bobrick

catalog designations are specified to establish standards of quality for performance and materials and not to limit competition. Manufacturers' names shall not be visible on exposed surfaces when installed.

2.2 TOILET ACCESSORIES

A. Furnish and install all toilet accessories indicated on the Drawings.

B. The schedule of items is to establish type and quality. Carefully review the Drawings for types of toilet accessories and to establish quantities, locations, and mounting heights of the various accessories required. In the event that locations or mounting heights are not indicated, they shall be as directed by the Architect.

2.3 TOILET ACCESSORIES SCHEDULE

A. See drawings for Schedule.

2.4 LOCKS AND KEYS

A. Provide tumbler locks for all lockable access doors and panels. Locks shall be keyed alike for each room or for entire Project, in accordance with Owner's instructions.

2.5 FASTENINGS, PACKING, AND MARKING

A. Fastening devices shall be theft-proof, of appropriate type and of adequate capacity for each purpose intended. Exposed heads of fasteners shall be stainless steel with finish to match surrounding surfaces. All metal accessories shall have the required screws, bolts, and other fastenings necessary for proper installation, all of which shall be wrapped in the same package as the accessory item for which it is intended.

B. Each package shall be clearly labeled indicating the portion of the work for which it is intended.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Before installation of toilet accessories, check openings and recesses to receive recessed units to assure they are of proper size and location, and are plumb and square. Check substrate materials, blockings, and built-in anchor plates for structural adequacy to support the accessories.

B. Mount recessed accessories securely into wall openings and recesses, tightly anchored into place, and with trim fitted tightly and neatly against the wall surface. Mount surface mounted accessories plumb, level, and true, and securely anchored into place.

C. After installation, adjust all accessories for proper operation, and clean and polish all exposed surfaces. Protect accessories from damage from all sources whatever.

D. Deliver to Owner duplicate keys for each lockable accessory door or panel, properly tagged as to location.

END OF SECTION

SECTION 116510 - ATHLETIC FIELD SOUND SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Provide a performance grade, 2-way, multi-zone sound system, with loudspeakers permanently installed, setup and secure at the venue, and all head-end equipment housed in a wall rack with all equipment as described herein and as shown on associated drawings.

B. Systems to be capable of providing sound reinforcement of dynamic musical and vocal sources along with interfacing with other audio systems and ancillary audio equipment. The sound system shall consistently provide intelligible and natural sound reinforcement of voice throughout the entire complex, along with enhanced (full range) sound for the main field spectator and player areas. All sound shall be free of distortion or audio artifacts.

C. The sound system installation will be provided by a qualified Sound System Contractor. The Sound System Contractor will provide all equipment as listed herein along with all terminations, system setup, loudspeaker aiming, digital signal processor and wireless microphone programming, testing, calibration and user training.

D. Equipment to include wired (handheld) and wireless (handheld & headset) microphones, antennas, CD player with Bluetooth receiver, AM/FM receiver, auxillary input jack and USB input, amplifiers with integrated digital loudspeaker processing (equalization, compression, limiting, time alignment, feedback reduction filters, etc.), all weather loudspeaker systems, power distribution, equipment storage and all associated cabling and connectors as required or as needed for optimum performance and functionality.

E. Installation to include THREE pressbox mounted loudspeakers and associated mounting hardware. The speakers will be mounted per plans and in coordination with the Sound System Contractor and Electrical Engineer. The speaker wiring will be provided as TWO home runs as shown on the attached block diagram. All wiring to be protected per the NEC.

1.2 REFERENCE STANDARDS

A. All equipment to comply with the latest applicable requirements and standards of the National Electrical Code (NEC), the Electronics Industries Association (EIA), the Federal Communications Commission (FCC), and the Audio Engineering Society (AES).

1.3 PERFORMANCE SPECIFICATIONS

A. The sound system shall be designed and installed to produce a clear and undistorted SPL of 84dB throughout the full bandwidth between 500Hz and 5kHz without exceeding or being below 6dB of the reference level at all frequencies throughout the entire complex listening areas. The sound system shall be designed and installed to produce a clear and undistorted SPL of 84dB throughout the full bandwidth between 150Hz and 5kHz without exceeding or being below 6dB of the reference level at all frequencies throughout the home bleachers and adjoining listening areas.

B. Reproduction of sound will be controlled utilizing a CPU based digital signal processor (DSP). The DSP will be custom configured and programmed by the Sound System Contractor to provide the optimum fidelity and to insure system protection from excessive volume. Precise adjustments

will be made utilizing advanced acoustical analysis tools such as SIA SmartLive software and calibrated testing hardware.

C. The loudspeakers will be configured to provide articulate sound reproduction for the spectator and athlete areas only and will be positioned to provide a minimum amount of acoustical interaction with outside areas. All loudspeakers will be weather resistant and will not require removal for precipitation or extreme temperature or humidity conditions.

1.4 SOUND SYSTEM CONTRACTOR QUALIFICATION

A. The sound system equipment shall be furnished by and installed under the direction of a qualified professional Sound System Contractor experienced in the installation, testing and adjustment of sound systems similar to the systems specified herein.

B. Said Sound System Contractor is to have been a certified member of at least two of the following professional audio organizations:

Audio Engineering Association (AES)
InfoComm (formerly International Communications Industries Association)
National Academy of Recording Arts & Sciences (NARAS)
National Systems Contractor Association (NSCA)

C. Said Sound System Contractor is to have received factory authorized training for analog and digital audio signal processing from at least three of the following professional audio equipment manufacturer's:

Ashly Audio
Bose Professional
Digidesign
Peavey Electronics
QSC Audio
Sennheiser
Shure

D. Said Sound System Contractor shall employ a team of personnel highly trained and experienced in the fields of audio engineering. The team leader should have at least 10 (ten) years experience as an audio engineer and should, at a minimum, have earned a CTS (Certified Technology Specialist) certification from InfoComm.

E. Safety in the workplace is the highest priority. All contracted personnel at the work site shall be regularly trained and certified for safe work practices. At a minimum, each worker should posses an OSHA 10 card.

F. Said Sound System Contractor may be required to provide references from previous customers and authorization from equipment manufacturers.

G. Pre-approved Sound System Contractor to include:

Pro Sound Associates
www.ProSoundAssociates.com
888.715.1176

1.5 WARRANTY & SERVICE

A. To maintain certain manufacturer's warranties, equipment must be installed, aligned and serviced by those installers authorized by said manufacturer to perform those duties. The Sound System Contractor will include a statement of warranty on the entire system and on the individual pieces of equipment. The system warranty will be one year from the date of system acceptance by the Owner. This warranty shall obligate the Sound System Contractor to provide equipment, material, and labor if required, at no charge to the Owner, during the warranty period, in the event of system or equipment malfunction due to defect.

B. Sound System Contractor to maintain a dedicated service representative and point of contact for future support, and maintain an inventory of spare parts capable of providing future service.

C. Response for service and/or operational assistance shall be within 24 hours of receiving such service call and will be provided during normal working hours Monday through Friday.

1.6 SUBMITTALS & CLOSE OUT DOCUMENTATION

The Sound System Contractor shall provide electronic copies of the following submittals:

A. Product Data: Manufacturer's descriptive literature for each type of device or piece of equipment, and wire/cable to be used on the project, indicating compliance with specified requirements.

B. Shop Drawings: Complete description and wiring riser diagram layout of sound system, clearly indicating all devices, equipment, etc.

C. Operations / Maintenance Manual (Users Guides): Manufacturer's operational manuals for each type of device or piece of equipment requiring manual operation along with an as-built drawing accounting for any system configuration changes if such exist.

D. Statement of Guarantee and Warranty: Contractor’s letter of completion, including equipment warranty (minimum one year) and labor guarantee (minimum two years) dates.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Equipment listed herein is not intended to be restricted to specific manufacturers but provide a technical feature set and performance specifications on which the entire systems design is based. Each manufacturer and model listed has been carefully chosen based on technical performance requirements, specific feature sets, quality of manufacturing, and overall subjective experience with the success of such equipment in previous system installations. All performance equivalent substitutions must be authorized by the Electrical Engineer prior to system acceptance, purchase, and installation.

B. Acceptable manufacturers may include:
- Community, Adaptive Technologies and Polar Focus for rigging hardware
- Ashly Audio, Symetrix, and QSC Audio for digital signal processors
- K&M, FrameWorks and Atlas-Soundolier for microphone hardware
- Community, One Systems and Technomad for all weather loudspeakers
- Furman Sound, Surge-Ex and Middle Atlantic products for power distribution
- Listen Technologies, Telex and Williams Sound for assistive listening systems
- Middle Atlantic Products, Lowell and Gator for racks and hardware

- QSC Audio, LabGruppen and Ashly Audio for amplifiers
- Sennheiser, Shure and Audix for wired and wireless mics and accessories
- Tascam, Denon and Marantz for CD players and Bluetooth receivers
- Whirlwind, ProCo and Canare for portable wiring and accessories

C. Bill-Of-Materials:

LINE	QTY	MANUFACTURER	MODEL / PART #	DESCRIPTION
1	1	Community	R.5-66MAX	long throw, all weather loudspeaker
2	2	Community	R.35COAX	full range, all weather loudspeaker
3	3	Community	R-VTY35	pan/tilt bracket for R.35COAX
4	1	Denon	DN-300Z	CD player w/ Bluetooth receiver, AM/FM tuner, Aux input and USB input jacks
5	1	Frameworks	GFW-MIC-0601	portable desktop mic stand
6	1	Frameworks	GFW-MIC-2020	portable mic stand w/ boom
7	1	Gator	GRR-10L	portable equipment rack
8	1	Listen	LA-125	assistive listening antenna kit
9	9	Listen	LA-402	assistive listening headphones
10	3	Listen	LA-166	assistive listening induction loop
11	2	Listen	LA-304	assistive listening signage
12	1	Listen	LA-311-01	assistive charging/storage case
13	1	Listen	LA-326	assistive listening rack kit
14	12	Listen	LA-362	assistive listening rechargeable batteries
15	12	Listen	LR-300-072	assistive listening receiver
16	1	Listen	LT-800-072	assistive listening transmitter
17	1	Middle Atlantic	D2LK	locking storage drawer
18	1	Middle Atlantic	PDLT-815RV-RN	15 amp power distro w/ work light
19	1	QSC	GXD8	2 x 1,200w amplifier with 2x2 DSP
20	2	Shure	SB900	lithium-ion rechargeable battery
21	1	Shure	SBC200-US	dual recharging dock
22	1	Shure	SCM-268	5 X 2 rackmount mixer
23	1	Shure	SM31FH-TQG	Shure earset microphone
24	1	Shure	ULXD1	beltpack digital wireless transmitter
25	1	Shure	ULXD2/SM58	handheld digital wireless microphone/transmitter
26	1	Shure	ULXD4D	2x digital wireless microphone receiver w/ antenna
27	1	Shure	WA360	Shure earset mic mute switch
28	2	Whirlwind	M3503	dual RCA patch cable
29	3	Whirlwind	MK402	XLR patch cable
30	1	Whirlwind	MK420	XLR microphone cable
31	1	Whirlwind	MST10	portable audio cable
32	1	Whirlwind	NL4-015	12/4 portable speaker cable
33	1	Whirlwind	ST02	1/4" TRS patch cable
34	50	Whirlwind	W12GA (foot)	12/2 speaker wire

35	1	Whirlwind	WPX2B/1NL4	speaker jack wall plate
36	2	Hosa	YRA-104	RCA adapter cable
37	1	various	LOT	misc. hardware for complete installation

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall include delivery, unloading, setting in place, inter-connecting wiring of system components, equipment alignment, adjustments, programming, and all other work whether or not expressly required herein which is necessary to result in a complete, operational and optimum performing system.

B. All installation practices shall be in accordance with, but not limited to, this specification. Installation shall be performed in accordance with the applicable standards, requirements, and recommendations of National, State, and Local authorities having jurisdiction.

C. During installation, and up to the date of System Acceptance, the Electrical Contractor shall be under obligation to protect the Sound System Contractor's finished and unfinished work against damage and loss. In the event of such damage or loss, the Electrical Contractor shall replace or repair such work at no cost to the Sound System Contractor.

3.2 SYSTEM ACCEPTANCE

A. A physical inventory will be taken of all equipment on site and will be compared to equipment lists in the contract documents.

B. Proof of performance shall be demonstrated with written verification of SPL and frequency response measurements plotted on a site map. Only actual readings are accepted. Computer simulation models are not acceptable. All test documentation shall be submitted at close out along with all final "as built" drawings, cut sheets, manuals, and other required documentation.

C. The operation of all system equipment shall be demonstrated by the Sound System Contractor. A Training Sign-Off sheet with signatures of all training attendees will be recorded and distributed at close out.

3.3 TRAINING

A. The Sound System Contractor will provide on-the-job training by a qualified instructor, to instruct the Owner in the operation and maintenance of the system. Owner is advised to provide system operators with basic sound system knowledge to be present at time of training. There shall be a minimum of two hours total training provided. This training may take place before, during and/or after System Acceptance.

END OF SECTION

SECTION 116833 – OUTDOOR SPORTS EQUIPMENT

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Provide equipment and materials, and do work necessary and construct or provide the following, as indicated on the Drawings and as specified. Work shall include but shall not be limited to:Soccer Equipment:
   1. Miscellaneous Barrier / Impact Netting.
   2. Soccer – Covered Team Benches.
   3. Field Corner Flags / Markers.

1.2 SUBMITTALS

A. Shop Drawings:
   1. Show application to project.
   2. Show fabrication and installation of netting system assembly. Include plans, elevations, component details, and attachments to other Work.

B. Product Data: Submit manufacturer's product data and samples as noted for the following:
   1. Net Fabric and appurtenances:
      a. 3 samples of netting one square foot each.
   2. Soccer Goal(s).
   3. Field Corner Markers.

1.3 PERFORMANCE REQUIREMENTS

A. Ball Net and Barrier Systems– Contractor to submit sealed shop drawings by a State Licensed Engineer for the upright post diameter and footing design.

1.4 QUALITY ASSURANCE

A. Installer of outdoor sports equipment the playing field shall be the same Contractor. All installed equipment shall be under the supervision of Owner's groundskeeper.

B. Ball Net System Installer – Contractor to restretch/tighten netting if necessary 60 days after substantial completion.

C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-Steel," and AWS D1.3, "Structural Welding Code – Sheet Steel."

1.5 WARRANTY

A. General Warranty: Special warranties specified in this Section shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranties:

1. Equipment: Written warranties, executed by the manufacturer of each piece of equipment specified agreeing to repair or replace equipment or components that fail in materials or workmanship with specified warranty period.
2. Impact and Barrier Netting: Installed netting shall prevent passage of kicked, struck or thrown balls or implements per designed sport use. If netting fails to do so, installer shall adjust netting to appropriate tension.
    a. Warranty Period: Per the manufacturer.

PART 2 – PRODUCTS

A. Wall Padding:

1. Option A:
    a. Vinyl Covering: 18 oz. High UV Laminated Vinyl.
    b. Padding: 3 inch high density polyurethane foam.
    c. Backer Board: 5/8 inch Moisture resistant Plywood or Composite Wood.
    d. Warranty: 1 year.
    e. Attachment: Stainless Steel Z clips.
    f. Hardware: Stainless Steel.
    g. Products:
        1) Basezone, Sportsfield Specialties.
        2) Approved equal.
    h. Suppliers:
        1) Sportsfield Specialties, Inc. (www.sportsfieldspecialties.com).
        2) C and H Baseball (941) 727-1533, (www.chbaseball.com).
        3) Burbank Sports Nets, (866) 349-0057, www.burbanksportsnets.com.
        4) Approved equal.

2.2 SOCCER EQUIPMENT

A. Fabricated Ball Net System:

1. General:
    a. Framing System:
        1) Refer to Specification Section Chain Link Fence and Gates and Contract Drawings for lower fencing, upright posts and footings.
        2) Contractor to submit sealed engineering drawings verifying footing and upright post diameters / sizes.
    b. Height:
        1) Total height of netting system as shown on drawings complete with pulleys, pull strings, connectors, cleats, etc. per recommendations of the manufacturer.
    c. Netting System:
        1) Netting system shall be “Stormguard 150# Breakway pin” or equal.
            a) Design wind speed at failure shall be 75 mph (max).
            b) Design wind speed for bare pole shall be 105 mph (min).
            c) Sag shall be 12” max w/20 o.c. pole spacing.
        2) Provide:
            a) Four inch square mesh - #36.

b) Twisted, knotted nylon netting.
c) Minimum Strength – 350 lbs.
d) Edge treatment: Hemmed with a 5/16 inch three strand twisted polyethylene rope spliced to the edge.
e) Weather treatment – UV and weather Treated black netting and cord.
f) Cables, pulleys, accessories, etc., per drawing and manufacturers recommendations.

3) Netting shall be sized so that when installed it shall be fastened tight, with no slack at top of chain link fence rail. Contractor shall retighten after 60 days.

2. Netting and hardware Suppliers:
   a. Sportsfield Specialties.
   b. Keeper Goals, (800) 594-5126, keepergoals.com (preference).
   c. Burbank Sports Nets, (866) 349-0057.
   d. West Coast Netting, Inc., www.westcoastnetting.com (888) 631-6387.
   e. US Netting (www.usnetting.com).
   f. Carron Net, (800) 558-7768, www.carronnet.com.
   g. Approved equal.

B. Field Corner Flags:
   1. International Corner Flags:
      a. General:
         1) 60"H x 1.5" O.D. white, high impact PVC uprights. Steel spring base and concrete ground sleeve.
      b. Suppliers:
         1) KwikGoal #6B701.
         2) Approved equal.

C. Field Corner Markers (In ground footings/sleeve):
   1. General:
      a. Concrete Footing and ½ inch diameter stainless steel sleeve.

D. Field Corner Marker Stakes (In ground staking system)[As applicable]:
   1. General:
      a. Plastic staking package system.
   2. Suppliers:
      a. Missouri Paint.
      b. Approved equal.

2.3 SOCCER – COVERED TEAM BENCHES (Add Alternate item No. 6)

A. General:
   1. Provide, assemble and install 2 team benches.
      a. Benches shall be Kwik Goal Model 9B5126 Elite Shelters
      b. Benches shall be 18’long.
      c. Benches shall have molded seats
      d. Frame shall be 4” round aluminum, painted black
      e. Top shall be 6.5’ high
      f. Poly carbonate panels shall be smoke colored

g. Benches shall include an equipment shelf
h. Approved equal.

2. Supplier:
a. Keeper Goals, (800) 594-5126, keepergoals.com.
b. Or Approved Equal.

3. Quantity:
a. 1 Pair (2 goals)

B. Soccer Goal Anchor:
1. Product: A (Synthetic Turf or grass fields):
a. #4KGDB68 Duckbill Anchor and Accessories:
1) 3 ft. cable, 2 ft. chain.
2) Plastic insert and cover kit for below ground storage.
b. Approved equal.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General: Install in accordance with manufacturers recommendations and approved shop drawings.

B. Soccer Equipment:
1. Fabricated Ball Net System [As applicable]:
a. Install netting, pulleys, quick-clip net connects, nets and other appurtenances per manufacturer's recommendations.
b. Use nylon ties to fasten netting to top of lower fence. Space per recommendation of manufacturer or no less than 18 inches on center.
c. Contractor to return after 60 days to retighten netting as required.

2. Field Corner Marker Footings/Sleeves:
a. Locate and install concrete footings and sleeves at the corners and midpoints of the field.

3. Field Corner Marker Stakes:
a. Provide to Owner.
b. The Contractor shall locate and install field markers at the corners, midpoint and other locations as indicated on the drawings.

4. Field Corner Flags:
a. The Contractor shall locate and install field flags and concrete sleeves/footings as per the manufacturer's instructions at the four corners of field.
b. Provide to Flags to Owner.

END OF SECTION

SECTION 131250 – GRANDSTAND SEATING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. This section includes complete services to provide a permanent grandstand seating system of size and capacity, and with features indicated on the drawings.

B. Complete Scope of Work in this bid package includes the following:
1. AISC certified steel fabrication
2. Steel Understructure Designed with an L/200 Serviceability Criteria
3. Galvanized structural steel finish
4. Fully Closed Aluminum T&G Deck System
5. Enhanced slip resistant deck with anodized finish
6. NJ certified modular press box
7. Powder Coated Aluminum Risers

1.3 REFERENCES

A. NJ State Building Code

B. AISC Steel Manual Thirteenth Edition

C. ACI 318-05

D. Aluminum Association Design Manual 2010

E. ASTM E985

F. AWS D1.2

1.4 PERFORMANCE REQUIREMENTS

A. Design Loads

Dead Load 10 psf
Live Load 100 psf
Wind Speed Design per local wind speeds & building codes
Sway Load 24 plf per row parallel to seatboards
Sway Load 10 plf per row perpendicular to seatboards
Seismic Load Design per local seismic conditions
Guardrail Loads 50 plf distributed or 200 lb concentrated load applied in any direction

B. Serviceability Requirements

C. Deflection shall be limited to 1/200 of the span for all structural members.

D. Foundation Design

Foundations shall be designed for bearing, overturning, and sliding for the following load cases as well as all applicable load cases in the building code using an allowable stress design.

1. 1.0 DL + 1.0 LL + SWAY
2. 0.6 DL + 1.0 WL
3. 1.0 DL + 0.75 WL + 0.75 LL

Soil bearing capacity to be verified by owner prior to placement of footings. Foundation sizes if shown on drawings will not be reduced under any circumstances.

1.5 SUBMITTALS

A. Post-Bid Submittals
1. Full drawings including foundation plan, seating plan, section drawing, and details
2. Structural Calculations
3. Product Samples Upon Request

NOTE: Delays caused by required resubmittals due to noncompliance with the specification shall not extend any milestone date in the contract. The contractor is responsible for complying with all aspects of this specification.

B. Fabricator AISC Certificate of compliance with the Standard for Steel Building Structures

C. Product Certificate: Prepare written statement on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

D. Shop Drawings: Complete detailed drawings prepared, signed and sealed by a Registered Professional Engineer (P.E.) licensed in the State of New Jersey. Include:

1. Detailed and dimensioned plans.
2. Seating plan indicating aisles, walkways, seating sections and exits and showing exit calculations using appropriate tables and requirements of the New Jersey State Building Code.
3. Sections and details showing complete methods of assembly and anchorage.
4. Footings and foundation sizes and types and relationships to finish grade in compliance with construction documents. Exposed portions of foundations, pier height and top elevations shall be subject to customer approval.
5. Engineering calculations.
6. Minimum sizes for structural steel and foundations are shown on bid document drawings, in order to establish an equal bidding opportunity for all participants. Reduction in minimum sizes of concrete foundation and structural steel will not be allowed.

E. Qualifications of Professional Engineer who seals the shop drawings and calculations.

F. Samples for verification to include 3' section of deck assembly with interlocking riser in specified dimensions and finishes and 3' long seat board with mounting bracket.

1.6 SITE REPRESENTATION

A. A qualified representative of the grandstand manufacturer must be onsite at all times during installation of the grandstand.

1.7 QUALITY ASSURANCE

A. AISC Certification: All structural steel shall be fabricated in an American Institute of Steel Construction (AISC) certified plant that is certified "STD" at the time of the bid. The manufacturer shall be listed on AISC's website as a certified fabricator.

B. Experience: Manufacturer of grandstand system shall have a minimum of (5) years experience in fabrication of grandstand structures and shall, upon request, provide references to successful projects of similar size and project specific requirements.

C. Installation: Installation shall be performed by factory trained and certified representatives of the grandstand manufacturer. Installer shall have completed at least three installations of similar size. Documentation shall be provided upon request.

1.8 WARRANTY

Product shall be guaranteed for (5) years on the structure and (3) years on the finishes together with labor. Damage resulting from abnormal use or vandalism is not covered.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. The basis of design is Dant Clayton Corporation, 1500 Bernheim Lane, Louisville, Kentucky 40210; (800) 626-2177.

B. Southern Bleacher Company, Graham, TX. (800)-433-0912.

C. Approved equivalent

2.2 PRODUCT COMPONENTS

A. Fully Closed Welded Deck System

1. Footboards and toeboards shall be 6063-T6 extruded aluminum with a fluted surface with a minimum wall thickness of 0.078" between flutes. The minimum acceptable vertical height is 1.750". Individual planks shall be T&G interlocking design, nesting with adjacent planks.
2. The second component is a one-piece aluminum riser extension that has a male-female connection at the top with the deck panel and a shingled overlap connection at the bottom with the deck panel.
3. The decking system will run from raker beam to raker beam. There will be a ½” gap at joint of the welded deck panels to allow for expansion and contraction of the aluminum due to temperature variations.

4. The joint of the welded deck panel is covered with a 4” wide aluminum extrusion joint cover.
5. Riser height per row and tread depth per row is indicated on design drawings.
6. The ends of decking system will be finished with a one-piece aluminum angle end cap.

B. Seating
1. Seat Brackets shall bolt directly to the steel understructure. Supporting seat brackets in the aluminum channels of the deck will not be permitted.
2. Seats shall be 6063-T6 extruded aluminum with a fluted surface and a minimum of 4 vertical legs. The exact size of seatboard is 2” x 10” x .080” wall thickened at the joints and weighing 1.9 lbs. per foot with 1” radius comfort curve front edge.
3. Mounting brackets: 3/16” thick A36 steel plate, plasma cut, bent and galvanized.

C. Understructure shall consist of an open span I-Beam understructure.
1. Longitudinal bays may include angle cross bracing provided that it does not interfere with building entrances or vomitories.
2. All beams and columns may be made of either wide flange or tube shapes.
3. All steel shall be sized to support the most conservative of the loads in the table above, and the loads in the local building code. If sizes are shown in the drawing, they shall not be reduced for any reason.

D. Guard Railing
1. Materials:
   a. Top and bottom rail shall be 1 1/2” ASTM.A36 hot rolled steel channel.
   b. Vertical ballasters shall be 1/2” ASTM A36 bar stock
   c. Vertical support posts shall be ASTM A-53 steel 3”x3”x1/4” square tube with a seal welded top and bottom cap
2. Fabrication:
   a. Welds to be full seal welds around all joints in materials. No partial welding.
   b. All welds shall be shop welded to top and bottom channel.
3. Finish:
   Vertical Picket rail shall consist of a multiple stage E-coat and Powder Coat finish
   a. Steel shall be shot blasted to a near white metal to enhance adhesion of coating.
   b. Once cleaned the steel shall be immersed in a phosphate coating tank.
   c. Once the part has been given a phosphate coating, the steel shall be immersed in a liquid epoxy and coated to a uniform 0.7 - 1 mils.
   d. Once the part has been E-coated it shall be powder coated to achieve the desired color. Total film thickness shall be no less than 5 mils.
   e. Substituted finishes will not be accepted unless submitted for approval and approved prior to the bid in accordance with the bid documents.

E. Hand & Grab Rails
1. Hand and Grab Rails shall be located in all areas required by building code.
2. Hand and Grab Rails shall be 1-15/16" O.D. extruded aluminum pipe.
3. Two-Line mid-aisle handrails shall be located in all interior aisles. All mid-aisle rails shall feature internal fittings for both lines of rail. External fittings are not permitted.

2.3 MATERIALS

A. Structural Steel

1. All detailing, fabrication, and erection shall be completed in accordance with the AISC Steel Construction Manual 13th Edition. All fabrication shall be completed in an AISC certified facility as described in Para. 1.8 A.
2. Structural Steel shall be ASTM A572 multi-certified grade 50. Miscellaneous steel shall be ASTM A36.
3. Bolts & Nuts: All bolts 5/8" diameter and larger shall meet ASTM A325. All bolts 1/2" and small shall meet ASTM A307.
4. All welds shall conform to ANSI/AWS D1.1. Electrodes shall be E70xx

B. Aluminum

1. All footboards & seatboards shall consist of 6063-T6 aluminum alloy with minimum yield strength of 25 ksi.
2. All straight grab & hand rails shall consist of 6061-T6 aluminum alloy with minimum yield strength of 35 ksi.
3. All bent grab & hand rails shall consist of 6061-T4 aluminum alloy with minimum yield strength of 21 ksi.

2.4 FINISHES

A. Structural Steel

1. Structural steel shall be coated with a minimum of 2 oz. hot dipped galvanized in accordance with ASTM 123-A with a minimum galvanized film thickness of 3.3 mils. Zinc shall be 98% purity, certified with written test results based on samples taken from the tank.
2. All structural steel fasteners shall be galvanized.

B. Aluminum

1. All footboards shall have a Clear Anodized and Shop Blasted Slip Resistant finish.
   a. All footboards shall have a clear anodized finish to resist oxidation.
   b. All aluminum decking intended for use as a walking surface, including walkways, aisles, walking surfaces in seating sections, stairs, ramps, platforms, handicap areas, and landings, will exhibit a factory blasted slip resistant surface treatment intended to minimize the effects of wet conditions on pedestrian safety. The surface treatment shall be achieved through a metallic media blasting process in a controlled factory environment to ensure consistency.
   c. Hand processes or sand blasting is strictly prohibited as they produce an inconsistent finish that is not uniform in appearance.
   d. Untreated mill finish aluminum with raised “flutes” or “ribs” does not meet this requirement.
   e. This surface finish shall exhibit enhanced slip resistance beyond the mill extrusion process, resulting in an improved coefficient of friction under wet conditions in all directions of travel.
   f. This surface treatment requirement shall not alter the requirement for all footboards to be provided with an anodized finish. In this case, both an anodized and factory blasted finish is required.
2. All seat boards shall have a clear anodized finish.

3. All Riser boards shall have a color powder coated finish in a color selected by the architect from the manufacturer's standard selection set.
4. Powder coat system shall meet or exceed the following test requirements:
   a. Direct Impact Resistance: ASTM D 2794-93, up to 140 in.-lbs.
   b. Flexibility: ASTM D 522-93, Method B, 100% Pass
   c. Pencil Hardness: ASTM D 3363-93a, 3H-4H
   d. Crosshatch Adhesion: ASTM D 3359-97, Method B, 5B, 100% Pass
   e. Salt Spray Resistance: ASTM B 117, plus 1,000 hours
   f. Humidity Resistance: ASTM D 2247, plus 1,000 hours
5. All hand and Grab Rails shall be clear anodized

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be handled directly by the manufacturer or by a factory-certified installation subcontractor. Factory certification shall require three installations within the last two years within the state.

B. Structure shall be erected in accordance with plans, shop drawings, and specifications.

C. Site preparation is not included in this specification.

3.2 CLEANING

A. Clean all surfaces after erection, in accordance with manufacturer's recommendations.

B. Remove and properly dispose of all packaging and construction debris.

C. Do not use acid solution, steel wool or other harsh abrasives.

END OF SECTION

SECTION 13126 - PRESSBOX

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Furnish a prefabricated, modular press box equal to that as provided by Dant Clayton Corporation, Louisville Kentucky or Southern Bleacher Company, Graham Texas.

1.2 RELATED WORK/RELATED SECTION

A. Grandstand / Section 13125.

1.3 SUBMITTALS

A. Bidders with any deviation from the specifications must comply with the following requirements seven (7) days prior to the bid opening.

1. Plan view and wall section showing complete detail of layout, connection and trim detail.
2. Schedule of Work Experience, including names of contacts and phone numbers; 10 jobs minimum within the last five (5) years.
3. List of three (3) similar jobs within the past two (2) years – should owners (3 persons maximum) request a site visitation to these jobs, it will be at the bidder's expense.
4. Resume including Corporate Officers, Sales Representatives, Technical Advisor, Project Manager, and Job site Superintendent.
5. Project schedule, including phasing with other trades and designation for all tasks, milestone dates for drawing submittal, fabrication time, key material delivery dates and designated dates of installation.
6. Shop drawings stamped and signed by a Professional Engineer licensed in the state of installation.

1.4 DESIGN CRITERIA

A. All material and workmanship shall be in accordance with the applicable state building code/ IBC current edition and NFPA.

B. All electric components shall be UL listed.

C. Design Loads:

1.	Live Load	100 psf	floor
		50 psf	roof (w/ filming platform)
	Wind	20 psf	on vertical surfaces

D. Design Classification

1. Use Group: B, Construction Type: V-B

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in modular building construction with experience in manufacturing press boxes.

B. Engineer qualifications: The press box shall be approved by a registered professional engineer in the state the Press Box will exist in in.

C. Warranty: Press box shall be guaranteed for one (1) year against defective material or workmanship. Damage resulting from abnormal use or vandalism is not applicable.

PART 2 - PRODUCTS

2.1 FLOOR CONSTRUCTION

A. Bottom Board: 1/2” CCX foundation grade treated plywood. Industrial grade asphalt-based pint. Continuous aluminum vents on 8’ centers.

B. Insulation: 6” R-19 fiberglass batts, with vapor barrier.

C. Joists: 2” x 6” #2 SYP, on 16” centers, longitudinal framing.

D. Decking: 3/4” Sturdifloor, underlayment grade, tongue and groove fir plywood, (Index24 in O.C.).

E. Covering: 1/8” Armstrong Excelon vinyl composition tile.

F. Molding: 4” Thermoplastic rubber base molding by Roppe.

2.2 WALL CONSTRUCTION

A. Studs: 2” x 4”, #2 or better SPF, on 16” centers, BOCA framing.

B. Bottom Plate: 2” x 4” #2 or better SPF.

C. Top Plates: (2) 2” x 4” #2 or better SPF.

D. Headers: As span and design load requires.

E. Ceiling Height: 8’-2” x 8’-0”, front to back.

F. Covering: 5/8” vinyl-faced gypsum panels, Class A, F.S.R.

G. Insulation: 3-1/2” R-13 fiberglass batts with vapor barrier.

H. Sheathing: 1/2” CDX plywood.

I. Siding: Metal Sales “U-Panel” .026 gauge ribbed steel panels with Kynar 500 finish color by owner.

2.3 ROOF CONSTRUCTION

A. Joists: 2” x 8”, #2 SYP, 16” O.C. spacing.

B. Overhang: 15-1/2” over front wall; 6” over rear wall. .019 Steel fascia with perforated vinyl soffit panels.

C. Ceiling: 5/8” type-x fire-rated gypsum board, taped and bedded with spray textured finish,

Class A F.S.R.

D. Insulation: 6” R-19 fiberglass batts with vapor barrier.

E. Decking: 3/4” tongue & groove oriented strand board (Index 24” O.C.).

F. Covering: .060 single-ply EPDM rubber membrane, fully adhered. (Unless camera deck is added see below).

2.4 WINDOWS

A. THV #7000 series "paragon", double horizontal slider windows w/ extruded vinyl frames, AAMA LC-25 structural rating, w/ 3/4" insulated low-e, argon filled tempered glass and removable insect screens.

B. Interior windows to be 1/4” tempered safety glass fixed with stained jambs and casing.

2.5 DOORS

A. 36” x 80” Insulated vinyl-faced steel clad with wood jambs; 16” insulated/tempered lite, aluminum threshold, vinyl weather stops, stainless steel hinges and heavy-duty retention chains. Doors equipped with commercial lever-handled keyed locksets.

2.6 ELECTRICAL

A. Service Entrance Panel: Square D Q0124M100 with Main Disconnect; rated at 120/240V, single phase, 100 amp capacity.

B. Receptacles: Pass & Seymour 125 volt/15 amp duplex, spec-grade, along the rear wall. Wiremold 5400 Series two-piece multi-channel, dual voltage, non-metallic surface raceway along front wall below scorer’s counter, outlets on 48" centers.

C. Lighting: Lithonia M232PC1S 4-ft. 2-tube fluorescent strips with low-glare parabolic diffusers.

D. Circuits: All branch circuit wiring is minimum #12 THHN encased in EMT thinwall conduit or MC Cable.

E. HVAC: (1) Berko BKOC2544W 4’-0” Electric baseboard heater with integral thermostat.

2.7. SCORERS' COUNTER

A. 20” deep x 1 ½” Clear Anodized finish aluminum countertop with rounded front nose. Mounted on brackets spaced a minimum of 32”.

2.8. CAMERA DECKS

A. Hatch: Bilco Model #NB-50 2’6” x 4’6” aluminum roof hatch.

B. Ladder (Aluminum): Alaco #370 70 degree ships ladder.

C. Upgraded Roof Surface: .060 polyester reinforced skid and spike resistant PVC membrane, fully adhered.

D. Railing Mounts: 1/2” galvanized threaded bolts & nuts through roof fascia on 48” centers along perimeter edge of roof. Railing mounts cannot be placed on the roof surface.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Installation: Shall be handled directly by the manufacturer or by a factory certified installation subcontractor.

B. Erect per plans, shop drawings, and specifications.

3.2 CLEANING

A. Clean all surfaces according to manufacturer’s recommendations.

B. Remove all packaging and construction debris.

3.3 OWNER RESPONSIBILITY

A. Site Access.

B. Final electrical hook up.

END OF SECTION

SECTION 220000 - GENERAL REQUIREMENTS FOR PLUMBING SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes general administrative and procedural requirements for all work. The administrative and procedural requirements included in this Section are to expand the requirements specified in Division 1.

1.2 SCOPE OF WORK

A. Provide all labor, material, equipment, and services necessary for and incidental to completion of all work as indicated on the Drawings and/or as specified herein. This includes all incidentals, equipment, appliances, services, hoisting, scaffolding, supports, sleeves, inserts, anchor bolts, tools, supervision, labor, consumable items, fees, licenses, etc., necessary to provide complete and workable systems.

1.3 DRAWING USE AND INTERPRETATION

A. Unless indicated by specific dimensions, drawings are meant to be diagrammatic. Exact equipment locations and routing of utilities shall be governed by field conditions and/or Owner's Representative's instructions.

B. All dimensions which relate to the building shall be taken as construction progresses. All errors incurred as result of the failure to check or verify dimensions, measurements, etc., shall be corrected.

C. The drawings show the general arrangement of utilities, equipment, and accessories. Drawings do not indicate all offsets, fittings, accessories, and changes in elevation, which may be necessary. Make all changes in equipment, locations, etc., to accommodate the work and to avoid obstacles at no increase in contract price. Provide offsets, fittings, and accessories as may be required to meet such conditions.

1.4 SPECIFICATION FORMAT AND CONTENT EXPLANATION

A. 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 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. Streamlined Language: The Specifications generally use the imperative mood and streamlined language. 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 where a colon (:) is used within a sentence or phrase.

1.5 DEFINITIONS

A. General: Basic Contract definitions are included in the conditions of the Contract.

B. Indicated: The term “indicated” refers to graphic representations, notes or schedules on the Drawings, or other Paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as “shown,” “noted,” “scheduled,” and “specified” are used, it is to help the reader locate the reference; no limitation on location is intended.

C. Directed: Terms such as “directed,” “requested,” “authorized,” “selected,” “approved,” “required,” and “permitted” mean “directed by the Engineer,” “requested by the Engineer,” and similar phrases.

D. Approved: The term “approved,” where used in conjunction with the Engineer’s action on the Contractor’s submittals, applications, and requests, is limited to the Engineer’s duties and responsibilities as stated in the Conditions of the Contract.

E. Regulations: The term “Regulations” includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

F. Furnish: The term “furnish” is used to mean “supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.”

G. Install: The term “install” is used to describe operations at project site including the actual “unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.”

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

I. Installer: An “installer” is the Contractor or an entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

1. The term “experienced,” when used with the term “installer,” means having a minimum of five previous projects similar in size and scope to this Project, being familiar with the special requirements indicated, and having complied with requirements of the authority having jurisdiction.
2. Trades: Use of titles such as “carpentry” is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as “carpenter.” It also does not imply that requirements specified apply exclusively to trades persons of the corresponding generic name.
3. Assignment of Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in the operations to be performed. The specialists must be engaged for those activities, and assignments are requirements over which the Contractor has no choice or option. Nevertheless, the ultimate responsibility of fulfilling Contract requirement remains with the Contractor.
    a. This requirement shall not be interpreted to conflict with enforcement of building codes and similar regulations governing the Work. It is also not intended to interfere with local trade union jurisdictional settlements and similar conventions.

J. The term “concealed”: embedded in masonry or other construction, installed behind wall furring, within partitions or hung ceilings (permanent or removable), in trenches, or in crawl spaces.

K. The term “exposed”: not installed underground or concealed. Equipment in rooms with exposed construction (i.e. mechanical rooms, electrical rooms, janitor’s closets, etc.) are classified as exposed.

L. The term “piping”: piping fittings, flanges, valves, controls, hangers, traps, drains, insulation and items necessary or required in connection with or relating thereto.

M. The “Project Site” is the space available to the contractor for performance of construction activities, either exclusively or in conjunction with other performing other work as part of the Project.

N. Testing Laboratories: A “testing laboratory” is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.6 COMPLETE SYSTEMS

A. General: Provide all materials as required for complete systems, including all parts obviously or reasonably incidental to a complete installation, whether specifically indicated or not. All systems shall be completely assembled, tested, adjusted and demonstrated to be ready for operation prior to Owner’s acceptance.

B. Systems: The systems specified and/or shown on the Drawings are for complete and workable systems. Any deviation from these systems due to a particular manufacturer’s requirements shall be made at no additional cost to the Owner.

1.7 CODES AND REGULATIONS

A. General: Comply with all governing federal, state, and local laws, ordinances, codes, rules, and regulations. Where the Contract Documents exceed these requirements, the Contract Documents shall govern. In no case shall work be installed contrary to or below minimum legal standards.

B. Utilities: Comply with all applicable rules, restrictions, and requirements of the utility companies serving the project site/facilities. Contractor shall be required to contact state regulated “call before you dig” service prior to any excavation work.

C. Non-Compliance: Should any work be performed which is found not to comply with any of the above codes and regulations, provide all work and pay all costs necessary to correct the deficiencies.

1.8 REFERENCE STANDARDS

A. All published standards of the following associations/organizations, as mandated by specific state standards, shall be followed and applied as a minimum.
   1. AABC, Associated Air Balance Council
   2. ACI, American Concrete Institute
   3. AGA, American Gas Assoc.
   4. AIA, The American Institute of Architects
   5. AISC, American Institute of Steel Construction
   6. ANSI, American National Standards Institute
   7. API, American Petroleum Institute
   8. ASME, American Society of Mechanical Engineers
   9. ASPE, American Society of Plumbing Engineers
   10. ASSE, American Society of Sanitary Engineering
   11. ASTM, American Society for Testing and Materials
   12. AWS, American Welding Society
   13. AWWA, American Water Works Assoc.

14. CAGI, Compressed Air and Gas Institute
15. CGA, Compressed Gas Assoc.
16. CISPI, Cast Iron Soil Pipe Institute
17. DIPRA, Ductile Iron Pipe Research Assoc.
18. ETL, ETL SEMKO a Division of Intertek Group
19. FMG, Factory Mutual Global
20. HEI, Heat Exchange Institute
21. HI, Hydronics Institute
22. ISA, Instrument Society of America
23. MSS, Manufacturers Standardization Society
24. NACE, National Association of Corrosion Engineers International
25. NEC, National Electrical Code (from NFPA)
26. NEMA, National Electrical Manufacturers Assoc.
27. NFPA, National Fire Protection Assoc.
28. NSF, National Sanitation Foundation
29. PDI, Plumbing and Drainage Institute
30. SSPMA, Sump and Sewage Pump Manufacturers Assoc.
31. STI, Steel Tank Institute
32. SWPA, Submersible Wastewater Pump Assoc.
33. UL, Underwriters Laboratories Inc.
34. WSC, Water Systems Council

B. 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 are subject to change and are believed, but are not assured, to be accurate and up-to-date as of the date of the Contract Documents.
1. CE, Corps of Engineers (U.S. Department of the Army)
2. EPA, Environmental Protection Agency
3. UFC, United Facilities Criteria
4. MIL, Military Standardization Documents (U.S. Department of Defense)
5. NIST, National Institute of Standards and Technology (U.S. Department of Commerce)
6. OSHA, Occupational Safety and Health Administration (U.S. Department of Labor)

C. 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. Such standards are made a part of the Contract Documents by reference.

D. Copies of Standards: Each entity engaged in construction on the project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents. Where copies of standards are needed for performance of a required construction activity, the contractor shall obtain copies directly from the publication source.

1.9 QUALITY ASSURANCE

A. Manufacturers' Qualifications: Not less than five years' experience in the actual production of the specified products.

B. Installers' Qualifications:

1. Firm with not less than five years' experience in the installation of mechanical systems and equipment similar in scope and complexity to those required for this Project, and having successfully completed at least ten comparable scale projects.
2. Painting, patching, carpentry and the like related to or required for Division 22 work shall be performed by craftsman skilled in the appropriate trade.
3. All welding shall be performed by ASME certified welders.

1.10 INSPECTIONS

A. General: During and upon completion of the work, arrange and pay all associated costs for inspections of all work installed under this Contract, in accordance with the Conditions of the Contract.

B. Inspections Required: As per the laws and regulations of the local and/or state agencies having jurisdiction at the project site.

C. Inspection Agency: Approved by the local and/or state agencies having jurisdiction at the project site.

PART 2 – PRODUCTS

2.1 GENERAL

A. Where Specified: Materials and equipment shall be as specified in subsequent sections of the Project Manual and/or as indicated on the Drawings.

B. General: All materials and equipment to be new, clean, undamaged, and free of defects and corrosion.

C. Acceptable Products: The product will be acceptable only when that product complies with all requirements of the Contract Documents as determined by the Engineer.

D. Common Items: Where more than one of any specific item is required, all shall be of the same type and manufacturer.

E. Listing: All materials and equipment shall be Underwriters' Laboratories (UL) or ETL SEMKO (ETL) listed and labeled, where UL or ETL standards and listings exist for the specified materials or equipment.

F. Special Tools: Provide all special tools needed for proper operation, adjustment and maintenance of equipment.

PART 3 – EXECUTION

3.1 GENERAL

A. The installation of all mechanical work shall be in accordance with the letter and intent of the Contract Documents, as determined by the Engineer.

B. Installation Requirements: All materials and equipment shall be installed as recommended by the respective manufacturers, by mechanics experienced and skilled in their particular trade, in a neat and workmanlike manner, in accordance with the standards of the trade, and so as not to void any warranty, UL or ETL listing.

3.2 DELIVERY STORAGE AND HANDLING

A. Packing and Shipping: Deliver products in original, unopened packaging, properly identified with manufacturer's identification, and compliance labels.

B. Storage and Protection: Comply with all manufacturer's written recommendations. Protect all equipment, materials and work from the weather elements, paint, mortar, construction debris and damage throughout duration of project.

C. Damaged Products: Do not install damaged products. Arrange for prompt replacement.

3.3 EXAMINATION

A. Conditions Verification: Examine the areas and conditions under which the work is to be performed. Identify and report any conditions detrimental to the proper and timely completion of the work to the Owner's Representative.

3.4 DIMENSIONS

A. Building Dimensions: Exact locations of building elements shall be based on contractor's field measurements.

B. Limiting Dimensions: Where equipment dimension and clearances are indicated on the Drawings, do not provide equipment larger than equipment dimensions or clearances specified.

C. Verify all dimensions by field measurements.

3.5 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

3.6 CUTTING AND PATCHING

A. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting and patching of mechanical equipment and materials required to:
   1. Uncover Work to provide for installation of non-coordinated and/or improperly installed work.
   2. Remove and replace defective Work.
   3. Remove and replace Work not conforming to requirements of the Contract Documents.
   4. Remove samples of installed Work as specified for testing.
   5. Install equipment and materials in existing structures.
   6. Uncover and restore Work to provide for Engineer observation of concealed Work.

C. Cut, remove and legally dispose of equipment, components, and materials as indicated. Removal shall include all ancillary items associated with items removed. Remove all items made obsolete by the new work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated to be removed.

E. Provide and maintain temporary dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

F. Patch surfaces and building components using new materials matching existing adjacent materials.

3.7 ADMINISTRATION AND SUPERVISION

A. The Contractor shall supervise the work and shall have at all times some competent person, approved by the Owner, following the work to receive instructions and to act with authority.

3.8 TESTING AND ADJUSTING

A. General: Provide testing equipment, materials, instruments, and personnel to perform all test procedures and adjustments required by other Division 22 Sections and/or deemed necessary by the Engineer to establish proper performance and installation of systems and equipment. All test instruments to be accurately calibrated and in good working order.

B. Scheduling: Schedule tests at least three days in advance, and so as to allow Engineer and Owner representative(s) to witness the test, unless directed otherwise. Do not schedule tests until the system installation is complete and fully operational, unless indicated or directed otherwise.

C. Correction/Replacement: After testing, correct any deficiencies, and replace materials and equipment shown to be defective or unable to perform at design or rated capacity. Retest without additional cost to the Owner or Contract. Submit finalization report indicating corrective measures taken, and satisfactory results of retest.

3.9 SYSTEMS DEMONSTRATION

A. Instruct the Owner's representative(s) in the start-up, operation and maintenance of all systems and equipment in accordance with the Contract Documents.

3.10 CLEANING

A. General: Remove from the project site, all waste, rubbish, and construction debris weekly unless indicated otherwise. The premises shall be left clean and free of any debris and unused construction materials, prior to final acceptance.

B. Equipment: Remove all dust, dirt, debris, mortar, rust, and other foreign materials from the interior and exterior of all equipment and enclosures, and wipe down.

C. Utilities: Thoroughly clean all utilities, just prior to final inspection.

3.11 TOUCH-UP PAINTING

A. Touch-Up Painting: Restore and refinish to original condition, all surfaces of equipment scratched, marred and/or dented during shipping, handling, or installation. Remove all rust, and prime and paint as recommended by the manufacturer.

END OF SECTION

SECTION 220004 – COORDINATION WITH OTHER TRADES

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. This section describes the coordination and procedural requirements for Contractors.

B. Definitions:
1. Owners Representative - Architect, Engineer, Construction Manager, General Contractor, Clerk of the works or any stipulated Agent or Representative of the Owner.
2. GC - General Contractor
3. MC - Mechanical Contractor/Subcontractor
4. PC - Plumbing Contractor/Subcontractor
5. EC - Electrical Contractor/Subcontractor
6. SM - Sheet Metal Subcontractor
7. SC - Sprinkler Contractor/Subcontractor

1.2 COMPLIANCE

A. Cost incurred including those of other contractors and/or Owner, due to non-compliance with this Section shall be the responsibility of the non-compliant contractor.

1.3 SUBMITTALS

A. Complete coordinated shop drawing shall be submitted in PDF format to the Engineer for their record by the MC. Submitted coordinated shop drawing shall include all signatures required by sign off procedure.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.1 COORDINATION

A. General: Sequence, coordinate and integrate the installation of all materials and equipment for efficient flow of work, in conjunction with the other trades. Review and become familiar with all of the Drawings and work of all the other trades. Report and resolve any discovered discrepancies and/or interferences prior to commencing work.

B. Cooperation: Cooperate with the other Contractors and individual disciplines for placement, anchorage and accomplishment of the work.

C. Chases, Slots, and Openings: Arrange for chases, slots, and openings during the progress of construction, as required to allow for installation of the work.

D. Supports and Sleeves: Coordinate the location installation of required supporting devices and sleeves to be set in concrete and other structural components, as they are constructed.

E. Right-Of-Way:

1. Adjust location of utilities, equipment, etc., to accommodate the work to prevent interferences, both anticipated and encountered.
2. Determine the exact route and location prior to fabrication.
3. Pitched piping has the right-of-way over utilities which do not pitch.
4. Furnish and install ancillary materials & equipment including but not limited to traps, air vents, drains, etc., as required to accommodate offsets, transitions and changes in direction.

F. Headroom: Install systems, materials, and equipment to maximize headroom unless noted otherwise.

G. Utility Connections: Coordinate connection with underground and overhead utility services. Comply with requirements of governing regulations, utility providers, and controlling agencies. Provide required connection for each service.

3.2 COORDINATED SHOP DRAWINGS

A. The coordination shop drawing process shall occur in the following manner:

1. The MC shall create 3/8" scale AutoCAD (2002 or newer) base plans which shall incorporate and coordinate with structural steel and ceiling system framing supports and show framing members on the shop drawings. This shall include existing building components not shown on Contract Documents.
2. The MC shall require the Sheet Metal Subcontractor to submit AutoCAD shop drawings, as expeditiously as possible, to the Engineer (through normal channels) for review and approval. The shop drawings shall incorporate all ductwork (including top and bottom of duct elevations at a maximum interval of 25 linear feet and at each elevation change), structural steel (building and misc. support steel), equipment and accessories as shown and/or specified in the contract documents.
3. All roof penetrations, wall and floor openings shall be coordinated with the structural steel Subcontractor, Supplier and/or Erector, through the Owner's Representative. All conflicts with structural steel members shall be resolved through the Owner's Representative.
4. After review and final approval of the sheet metal shop drawing by the Engineer, the sheet metal Subcontractor shall incorporate all required corrections, additions and modifications on the AutoCAD ductwork shop drawings.
5. The approved AutoCAD ductwork shop drawings shall be utilized for coordination with all other Contractors or Subcontractors whose involvement is mandated. The SM shall submit the AutoCAD ductwork shop drawings (hard copy and electronic files) to the MC to initiate the "coordination" process. The MC shall review the drawings for accuracy and completeness prior to distribution.
6. The MC shall forward, with transmittal, the ductwork shop drawings (hard copy and electronic files) to the PC for coordination of the plumbing work. The MC shall forward a copy of the transmittal to the Owner's Representative.
7. The PC shall (upon receipt of drawings from the MC) superimpose his scope of work on the AutoCAD ductwork shop drawings illustrating all plumbing equipment, piping and hangers.
8. The PC shall include invert of pipes; elevations (top and bottom) and pipe sizes including insulation at a maximum of 25 foot intervals and at each elevation change.
9. Any conflicts between the plumbing and ductwork shall be clouded by the PC on the AutoCAD ductwork shop drawing file.
10. PC shall request coordination meeting to resolve the conflicts as clouded on the coordinated shop drawings. PC shall provide clouded shop drawing at the coordination meeting. All conflicts that arise between the plumbing and ductwork shall be resolved through and by the Owner's Representative.

11. The PC and/or the SM shall correct and shall complete the AutoCAD drawings depicting all resolutions.
12. When it is ascertained that no conflicts exist between the ductwork and plumbing work, the PC shall forward the final ductwork/plumbing coordinated drawings (hard copy and electronic files) to the MC with transmittal, and provide the Owner's Representative with a copy of the transmittal.
13. The MC shall (upon receipt of drawings from the PC) superimpose all heating and air conditioning piping, equipment, hangers, and insulation, including elevations (top and bottom) and pipe sizes (including insulation), on the AutoCAD drawings.
14. Any conflicts between the ductwork/plumbing/mechanical work shall be clouded by the MC on the AutoCAD shop drawing file.
15. MC shall request coordination meeting to resolve the conflicts as clouded on the coordinated shop drawings. MC shall provide clouded shop drawing at the coordination meeting. All conflicts that arise between the MC, SM and PC shall be resolved through and by the Owner's Representative.
16. The MC, PC and SM shall correct and complete the AutoCAD drawings depicting all resolutions.
17. When it is ascertained that no conflicts exist between the MC, SM and PC, the MC shall forward the final ductwork/plumbing/mechanical coordinated drawings (hard copy and electronic files) to the EC with transmittal, and provide the Owner's Representative with a copy of the transmittal.
18. The EC shall (upon receipt of drawings from the MC) superimpose all electrical equipment including but not limited to light fixtures, conduit and hangers on the AutoCAD drawings.
19. The EC shall include elevations of light fixtures, electrical conduit and conduit sizes.
20. Any conflicts with the ductwork/plumbing/mechanical/electrical work shall be clouded by the EC on the AutoCAD shop drawing file.
21. EC shall request coordination meeting to resolve any conflicts as clouded on the coordinated shop drawings. EC shall provide clouded coordinated shop drawing at the coordination meeting. All conflicts that arise between the EC, MC, PC and SM shall be resolved through and by the Owner's Representative.
22. The EC and/or the SM, PC, MC shall correct and complete the AutoCAD drawings depicting all resolutions.
23. When it is ascertained that no conflicts exist between the EC, MC, PC and SM, the EC shall forward the final ductwork/plumbing/mechanical/electrical coordinated drawings (hard copy and electronic file) to the SC with transmittal, and provide the Owner's Representative with a copy of the transmittal.
24. The SC shall (upon receipt of drawings from the EC) superimpose all sprinkler equipment, piping, hangers and sprinkler heads as required by the contract documents and the appropriate codes.
25. The SC shall include elevations of piping and piping sizes.
26. Any conflicts with the ductwork/plumbing/mechanical/electrical/sprinkler work shall be clouded by the SC on the AutoCAD shop drawings.
27. The SC shall request coordination meeting to resolve any conflicts as clouded on the coordinated shop drawings. SC shall provide clouded coordinated shop drawing at the coordination meeting. All conflicts that arise between the SC, EC, MC, PC, and/or SM shall be resolved through and by the Owner's Representative.
28. The SC and/or EC, MC, PC, SM shall complete the AutoCAD drawings depicting all resolutions.
29. When it is ascertained that no conflicts exist between the SC, EC, MC, PC, and SM, the SC shall forward the final ductwork/plumbing/mechanical/electrical/sprinkler coordination

drawing to the MC with transmittal, and provide the Owner's Representative with a copy of the transmittal.

30. Sign Off:
    a. The MC shall provide the final coordinated shop drawing to the Engineer and the Owner's Representative. The final coordinated shop drawing shall contain signatures from SM, PC, MC, EC, and SC on each sheet.
    b. Upon completion of the coordination process by all Contractors and Subcontractors as described above, they shall sign off on all drawings in ink indicating company, name, date of sign-off and signature of company representative.
    c. Each contractor signature shall certify that each Contractor has shown their respective work on the drawings and have resolved all points of conflict and interference with other Contractors and Subcontractors.

3.3 COORDINATION MEETINGS

A. During the coordination process, separate meetings apart from project meetings concerning the progress and schedules may be called by the Owner’s Representative when required or at the request of one or more of the coordinating Contractors.
   1. The Owner’s Representative shall contact the Contractors and make all required arrangements, e.g. time, place, etc.
   2. All Contractors shall place emphasis and importance on equipment purchases, so as to not delay approvals, shop drawings and the coordinated drawings.

3.4 SCHEDULE OF COORDINATED SHOP DRAWINGS

A. The MC and SM shall complete the ductwork shop drawings within two (2) weeks after award of contract (or authorization to proceed).

B. Turn-around time for each Contractor shall be two (2) weeks maximum.

3.5 "AS BUILT" DRAWINGS

A. At the completion of the project, “As Built” corrections shall be made to each AutoCAD drawing by each of the aforementioned Contractors and returned to the Owner’s Representative for the Owner’s permanent files and records. These “As Builts” do <u>not</u> remove the obligation of “As Builts” and record drawings as outlined under other sections of the specifications <u>unless</u> the Owner’s Representative elects to do so.

END OF SECTION

SECTION 220500 – BASIC PLUMBING MATERIALS AND METHODS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following basic materials and methods to complement other Division 22 Sections.
   1. Piping installation instructions common to most piping systems
   2. Dielectric fittings
   3. Flexible connectors
   4. Mechanical sleeve seals
   5. Sleeves
   6. Escutcheons
   7. Fire Stopping
   8. Identifying devices and labels
   9. Grout
   10. Interior concrete housekeeping pads
   11. Installation requirements common to equipment specification sections
   12. Touch-up painting
   13. Removals
   14. Repairs

B. Pipe, pipe fittings and joining materials and methods are specified in Division 22 piping system sections.

1.2 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, crawl spaces, 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. NP: Nylon plastic.
   4. HDPE: High Density Polyethylene plastic.

5. PVC: Polyvinyl chloride plastic.

G. Existing: Condition present prior to award of this contract.

1.3 SUBMITTALS

A. Product Data: For all materials specified within this section

B. Fire Rated Penetration Listing Details: Submit Underwriters Laboratory penetration listing details specific to the penetrations required by the project along with fire stopping material data.

C. Quality Control Submittals: Fire stopping certificates specified in Quality Assurance below.

1.4 QUALITY ASSURANCE

A. Fire Stopping: Fire stopping installer shall be certified by the fire stopping manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Protect piping, flanges, fittings, and piping specialties to prevent pipe end damage. Maintain end caps through shipping, storage, and handling.

B. Store plastic pipes in locations not subject to direct sunlight.

C. Protect all stored materials from moisture and dirt. Elevate above grade and support to prevent sagging and bending. Do not exceed structural capacity of floor, if stored inside.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where identifying devices are to be applied.

B. Install identifying devices before concealment.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Dielectric Components:
      a. Watts Water Technologies, Inc.
      b. Grinnell Corp.; Grinnell Supply Sales Co.
      c. Victaulic Co. of America.
   2. Metal, Flexible Connectors:
      a. Engineered Flexible Products
      b. Flexicraft Industries.
      c. Grinnell Corp.; Grinnell Supply Sales Co.
      d. Mercer Rubber Co.
      e. Metraflex Co.

3. Mechanical Sleeve Seals:
    a. Calpico, Inc.
    b. Metraflex Co.
    c. Proco Products, Inc.
    d. Thunderline/Link-Seal.
4. Fire-Stopping Sealant:
    a. Dow Corning Corp.
    b. 3M Corp.
    c. Hilti Corp.
5. Pipe Escutcheons:
    a. Chicago Specialty Mfg. Co.
    b. Sanitary-Dash Mfg. Co.
    c. Grinnell
6. Identifying Devices:
    a. Craftsmark Identification Systems
    b. Seton Identification Products
    c. W.H. Brady Company

2.1 DIELECTRIC FITTINGS

A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.

B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.

C. Insulating Material: Suitable for system fluid, pressure, and temperature.

D. Dielectric-Flange Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers. Dielectric flange kit materials shall be compatible with system fluid, temperature and pressure.

E. Dielectric Couplings: ARE NOT ALLOWED

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; and 300-psig (2070-kPa) minimum working pressure at 225° F (107° C). Coordinate end selection with piping system specifications.

2.2 FLEXIBLE CONNECTORS

A. General: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections. Include 125-psig (860-kPa) minimum working-pressure rating at 220°F, unless higher working pressure or temperature is indicated. Coordinate end selection with piping system specifications.

B. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

2.3 MECHANICAL SLEEVE SEALS

A. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with stainless steel bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical isolation.

2.4 SLEEVES

A. General: The following materials are for wall, floor, slab and roof penetrations.

B. Pipe:
   1. Steel Sheet Metal: 0.0359-inch (0.9-mm) minimum thickness, galvanized, round tube closed with welded longitudinal joint.
   2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, and plain ends. Provide integral waterstop where indicated.
   3. Cast Iron: Cast or fabricated pipe equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.
   4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
      a. Underdeck Clamp: Clamping ring with set screws.

C. Ductwork
   1. All sleeves shall be per SMACNA.

2.5 ESCUTCHEONS

A. General: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
   1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
   2. OD: Completely cover opening.
   3. Stamped Steel: One piece, with set screw and chrome-plated finish.
   4. Stamped Steel: Split plate, with concealed hinge, set screw, and chrome-plated finish.

2.6 FIRE STOPPING

A. UL listed material specific to the UL penetration listing detail.

2.7 IDENTIFYING DEVICES AND LABELS

A. Equipment Nameplates: Metal nameplate with operational data engraved or die-stamped; permanently fastened to equipment.
   1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.

B. Stick-on Pipe Markers: Manufacturer’s standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl, complying with ASME A13.1.

C. Stick-on Duct Markers: Manufacturer’s standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl, complying with ASME A13.1.

D. Stick-on Flow Marker: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl, two inch (2") wide band, color coded complying with ASME A13.1.

E. Rigid Pipe Markers: Manufacturer's standard preprinted, color coded, rigid plastic with flow arrows and fluid medium designed to be applied to piping systems without the need of adhesives. For markers up to 6 inch, markers shall wrap completely around the pipe, and their own tension shall secure them in place. For markers over 6 inch, markers shall be provided with nylon ties to secure marker to piping system Markers comply with ANSI/ASME A13.1.

F. Valve Tags: Stamped or engraved 0.032-inch- (0.8-mm-) thick, polished brass, 1-1/2-inches (40-mm) diameter, with 1/4-inch (6-mm) piping system abbreviation letters and 1/2-inch (13-mm) sequenced numbers. Include 5/32-inch (4-mm) hole and brass, wire-link or beaded chain; or brass S-hook fastener.

G. Framed Valve Schedule: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include appropriate mounting hardware. Valve schedule shall be 8-1/2" x 11" with a minimum font height of 12 pt. Frame shall be extruded aluminum with ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass. Schedule shall include valve number, piping system, system abbreviation as shown on valve tag, location of valve (room or space), normal operating position (open, closed or modulating). Indicate valves utilized for emergency shut off or other special purposes.

H. Access Panel Markers: 1/16-inch- (2-mm-) thick, engraved plastic-laminate markers, with abbreviated terms and numbers corresponding to concealed valve. Provide 1/8-inch (3-mm) center hole for attachment

I. Plastic Equipment Markers: ASME A13.1, color-coded, laminated plastic. Include lettering identifying name, equipment service, design capacity, pressure drop, entering and leaving conditions and RPM indicated on the contract documents. Size shall be 2-1/2 by 4 inches (65 by 100 mm) for control devices, dampers, and valves; and 4-1/2 by 6 inches (115 by 150 mm) for equipment. Identifying names and/or abbreviations shall match those indicated on the contract documents.

2.8 GROUT

A. Non-shrink, Non-metallic Grout: ASTM C 1107, Grade B, post-hardening, volume-adjusting, dry, non-staining, non-corrosive, non-gaseous, hydraulic-cement grout recommended for interior and exterior applications. Design mix shall be 5000-psig (34.5-MPa), 28-day compressive strength.

2.9 INTERIOR CONCRETE HOUSEKEEPING PADS

A. Concrete: 3000-psig (20.7-MPa), 28-day compressive-strength concrete.

B. Form work: 14 gauge galvanized steel frame

C. Dowels: #4 rebar

D. Reinforcement: 6 X 6 –W2.9 X W 2.9 wire metal mesh at center

PART 3 – EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. General: Install piping as described below, unless piping sections specify otherwise.

B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.

C. Install components with pressure and temperature ratings equal to or greater than system operating pressure and temperature.

D. Install piping free of sags and bends. Install fittings for changes in direction and branch connections. Install fittings, couplings, and accessories according to manufacturer's written instructions.

E. Install piping at parallel and perpendicular to building walls. Diagonal runs are prohibited, unless otherwise indicated. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

F. In areas of exposed piping, install piping to maximize headroom. In areas with ceilings, install piping to maximize clearance between ceiling and pipe. Allow sufficient space for ceiling panel removal.

G. Install piping to allow application of insulation plus 1-inch (25-mm) clearance around insulation.

H. Install pipe escutcheons for pipe penetrations of walls, partitions, floors and ceilings.

I. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, ¾" ball valve, threaded nipple and chained cap.

J. Install line size manual shutoff valve at each connection to each piece of equipment.

K. Install piping so that accessories are accessible for operation, maintenance, repair and replacement.

L. Install piping with sufficient clearance to allow for expansion and contraction.

M. Sleeves are not required for core drilled holes through interior solid concrete walls and floors, above grade exterior solid concrete walls and existing underground solid concrete walls. Floors in mechanical equipment areas or other wet areas shall be provided with a sleeve with waterstop.

N. Install sleeves for pipes passing through walls, partitions, and 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 (50 mm) above finished floor level. In floors with water stop extend cast-iron sleeve fittings below floor slab as required to secure clamping ring.
   2. Build sleeves into new walls and slabs as walls and slabs are being constructed.
   3. Install sleeves in non-fired rated assemblies large enough to provide 1/2-inch (12.7-mm) annular clear space between sleeve and pipe or pipe insulation.
   4. Install sleeves in fire rated assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

O. Interior Wall and Floor Pipe Penetrations: Sleeves shall be steel pipe except steel sheet metal shall be used for gypsum wall penetrations.

P. Water Proof Floor and Roof Pipe Penetrations: For pipes penetrating floors and roofs with membrane waterproofing install stack sleeve fitting. Secure flashing between clamping flanges. Seal space outside of sleeve fittings with non-shrink, non-metallic grout. Provide Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant between sleeve and pipe.

Q. Aboveground, Exterior-Wall, Pipe Penetrations:

1. Masonry Wall: Provide steel pipe wall sleeve. Seal space outside of sleeve with non-shrink, non-metallic grout. Provide Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant between sleeve and pipe.
2. Non-Masonry or Non-Concrete Walls: Provide wall plate matching surrounding construction. Fill gap between wall opening and pipe with mineral wool. Provide Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant between wall plate and wall.

R. Underground, Exterior-Wall, Pipe Penetrations: Provide cast-iron or galvanized steel sleeves with integral waterstop, except for existing walls. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for annular clear space between pipe and sleeve for installing mechanical sleeve seals. Annular clear space shall be per mechanical sleeve seal manufacturer's written recommendation. Assemble and install mechanical sleeve seals according to manufacturer's written instructions.

S. Verify final equipment locations for roughing-in.

T. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:

1. Threaded Steel Pipe Joints: Thread pipe with tapered pipe threads in accordance with ANSI B2.1 and ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than 3 threads exposed. 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
2. Welded Steel Pipe Joints: Weld pipe joints in accordance with applicable ASME Codes and AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe".
3. Flanged Steel Pipe Joints: Clean flange faces and install gaskets. Align flange surfaces parallel. Use suitable lubricants on bolt threads. Tighten bolts to torque specified by manufacturer of flange and flange bolts, to provide uniform compression of gaskets.
4. Grooved Steel Pipe Joints: Install per grooved piping manufacturer's written installation instructions.
5. Copper Pipe Joints: Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
6. Gasket Materials: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.
7. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
8. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
9. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. 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. ABS Piping: ASTM D 2235 and ASTM D 2661.
    c. CPVC Piping: ASTM D 2846 and ASTM F 493.
    d. PVC Pressure Piping: ASTM D 2672.
    e. PVC Nonpressure Piping: ASTM D 2855.
    f. PVC to ABS Nonpressure Transition Fittings: Procedure and solvent cement according to ASTM D 3138.

10. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 procedures and manufacturer's written instructions.
    a. Plain-End Pipe and Fittings: Use butt fusion.
    b. Plain-End Pipe and Socket Fittings: Use socket fusion.

U. Piping Connections: Make connections according to the following, unless otherwise indicated:
1. Remake leaking joints using new materials.
2. Install unions, in piping 2-inch NPS (DN50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
3. Install flanges, in piping 2-1/2-inch NPS (DN65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
4. Piping Systems: Install dielectric fittings to connect piping materials of dissimilar metals.

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting and without interference(s) to other installations.

D. Extend grease fittings to accessible locations.

3.3 FIRE STOPPING

A. Fire Stopping: At penetrations through fire rated walls, partitions, barriers, ceilings, roofs or floors, the fire rated integrity shall be maintained. Provide manufacturer's standard fire-stopping sealant, with accessory materials, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

3.4 LABELING AND IDENTIFYING

A. Piping Systems: Install pipe markers on all piping of each system (insulated and un-insulated), including pipe sizes, fluid medium and direction of flow arrows. Interior, non-metal jacketed piping systems: Provide stick-on markers. Install flow marker 360 degrees at each end of each pipe marker.
2. Interior metal jacketed and exterior piping systems: Provide rigid markers (for markers on piping over 6 inches provide nylon ties). Provide stick-on size marker attached to rigid marker.
3. Markers shall be spaced at a maximum of 25-foot (7.5-m) intervals along each run. In addition to the 25 foot intervals, provide markers at the following locations:
    a. Near each valve and control device.
    b. Near each branch, excluding short takeoffs for fixtures and terminal units.
    c. Near locations where pipes pass through walls, floors, ceilings, or enter non-accessible enclosures.
    d. At access doors, manholes, and similar access points that permit view of concealed piping.
    e. Near major equipment items and other points of origination and termination.

B. Valve Tags:

1. Install on all valves and control devices (factory and field installed), except check valves, plumbing fixture supply stops, faucets, and hose connections. List tagged valves in valve schedule.
2. Provide framed valve schedule(s) where directed by owners representative.

C. Install plastic equipment marker on all equipment provided under this contract.

D. Provide additional mechanical identification materials and devices to supplement field or factory supplied nameplates that have become visually blocked by work of this or other Divisions.

E. Clean faces of identification devices and glass frames of valve charts.

3.5 TOUCH-UP PAINTING

A. Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 GROUTING

A. Install nonmetallic, non-shrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix and cure grout according to manufacturer's written instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placing of grout.

E. Place grout to provide smooth bearing surface for equipment base.

F. Place grout, completely filling equipment bases.

G. Place grout around anchors.

3.7 INTERIOR CONCRETE HOUSEKEEPING PADS

A. Provide concrete housekeeping pads for all floor mounted equipment. Provide 6" tall 3000 psi concrete pad having 6 X 6 –W2.9 X W 2.9 wire metal mesh at center. Extend pad a minimum of 4" greater than equipment footprint in all directions. Provide a smooth trowel finish on top surface of pad.

B. Provide 14 gauge galvanized steel frame around entire perimeter of pad having a ¾" chamfer at all corners and at all edges. Frame to extend ½" over top of pad and 1" beneath bottom surface of pad. All corners to be welded.

C. Anchor pad to existing or new concrete floor with #4 rebar dowels set at a minimum 12" on center in each direction, having the last 2" of dowel bent at a 90 degree angle.

1. Existing floors: Drill 1" diameter bores into the existing concrete floor at a minimum depth of 2" to accept dowels. Fasten dowels within bores with epoxy grout.
2. Newly poured floors: Provide rebar dowels embedded to a depth of 2" below floor surface, having the last 2" of dowel bent at a 90 degree angle.

D. Prior to pouring concrete pad, place manufacture's recommended galvanized steel anchor bolts into pad using the equipment template provided.

E. Provide 5000 psi level grout bedding beneath equipment prior to setting and final tightening of fasteners.

3.8 REMOVALS

A. Disconnect and remove work where indicated on the contract documents in its entirety.

B. Removal: Remove indicated equipment, piping, ductwork, insulation and associated components from Project site and dispose of in a legal manner. Provide owner's right of first refusal for all equipment removed.

C. Where work is indicated to be abandoned in place, cut and remove pipe or ductwork a minimum of 2 inches (50 mm) beyond the wall, floor, ceiling or roof. Patch surface to match existing finish of adjacent construction.

D. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

3.9 REPAIRS

A. If existing or new work is damaged or disturbed, remove damaged sections and install new products of equal capacity and quality.

END OF SECTION

220503-PIPES AND TUBES FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Pipe and pipe fittings for the following systems:
   1. Domestic water piping.
   2. Sanitary sewer piping.
   3. Storm drain piping.
   4. Equipment drains and over flows.
   5. Unions and flanges.

B. Related Sections:
   1. Section 07 92 00 - Firestopping: Product requirements for firestopping for placement by this section.
   2. Section 09 21 16 - Access Doors and Frames: Product requirements for access doors for placement by this section.
   3. Section 09 91 00 - Painting and Coating: Product and execution requirements for painting specified by this section.
   4. Section 22 05 23 - General-Duty Valves for Plumbing Piping: Product requirements for valves for placement by this section.
   5. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports and firestopping for placement by this section.
   6. Section 22 07 00 - Plumbing Insulation: Product requirements for piping insulation for placement by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:
   1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
   2. ASME B16.3 - Malleable Iron Threaded Fittings.
   3. ASME B16.4 - Gray Iron Threaded Fittings.
   4. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
   5. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
   6. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV).
   7. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
   8. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
   9. ASME B31.9 - Building Services Piping.
   10. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.
   11. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. ASTM International:
   1. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.

2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
4. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
5. ASTM A536 - Standard Specification for Ductile Iron Castings.
6. ASTM B32 - Standard Specification for Solder Metal.
7. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
8. ASTM B75 - Standard Specification for Seamless Copper Tube.
9. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
10. ASTM B251 - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
11. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
12. ASTM B302 - Standard Specification for Threadless Copper Pipe, Standard Sizes.
13. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
14. ASTM D2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameters.
15. ASTM D2241 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
16. ASTM D2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter.
17. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.
18. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
19. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
20. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
2. AWS D1.1 - Structural Welding Code - Steel.

D. Cast Iron Soil Pipe Institute:
1. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
2. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

E. National Fire Protection Association:
1. NFPA 99 - Standard for Health Care Facilities.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, and sizes.

C. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.

D. Design Data: Indicate pipe sizes. Indicate pipe sizing methods. Indicate calculations used.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years' experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Do not install underground piping when bedding is wet or frozen.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 COORDINATION

A. Section 01 31 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate installation of buried piping with trenching.

PART 2 PRODUCTS

2.1 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tubing: ASTM B88, Type L, drawn.
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
   2.
   3. Joints: ASTM B32, Alloy Grade Sb5 tin-antimony, or Alloy Grade Sn95 tin-silver, lead free solder

B. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized, rolled grooved ends.
   1. Fittings: ASTM A395/A395M and ASTM A536 ductile iron, grooved ends.
   2. Joints: Grooved mechanical couplings meeting ASTM F1476.
      a. Housing Clamps: ASTM A395 and ASTM A536 ductile iron, enamel coated, compatible with steel piping sizes, rigid type.
      b. Accessories: Stainless steel bolts, nuts, and washers.

2.2 SANITARY SEWER PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74, service weight.
   1. Fittings: Cast iron, ASTM A74.
   2. Joints: ASTM C564, rubber gasket joint devices or lead and oakum.

2.3 STORM WATER PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74 service weight, bell and spigot plain ends.
   1. Fittings: Cast iron, ASTM A74.
   2. Joints: ASTM C564, neoprene gasket system or lead and oakum.

2.4 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized.
   1. Fittings: ASME B16.3, malleable iron or ASME B16.4, cast iron.
   2. Joints: Threaded for pipe 2 inch and smaller; flanged for pipe 2-1/2 inches and larger.

2.5 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:
   1. Ferrous Piping: Class 250, malleable iron, threaded.
   2. Copper Piping: Class 150, bronze unions with brazed joints.
   3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

B. Flanges for Pipe 2-1/2 inches (65 mm) and Larger:
   1. Ferrous Piping: Class 250, forged steel, slip-on flanges.
   2. Copper Piping: Class 150, slip-on bronze flanges.
   3. Gaskets: 1/16 inch (1.6 mm) thick preformed neoprene gaskets.

2.6 UNDERGROUND PIPE MARKERS

A. Plastic Ribbon Tape: Bright colored, continuously printed, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.

B. Trace Wire: Magnetic detectable conductor, clear brightly colored plastic covering, imprinted with "Natural Gas Piping" in large letters.

2.7 BEDDING AND COVER MATERIALS

A. Soil Backfill from Above Pipe to Finish Grade: Soil Type S2.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 76 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify excavations are to required grade, dry, and not over-excavated.

C. Verify trenches are ready to receive piping.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

A. Verify connection to existing piping system size, location, and invert are as indicated on Drawings.

B. Establish elevations of buried piping with not less than 2 ft of cover.

C. Excavate pipe trench.

D. Install pipe to elevation as indicated on Drawings.

E. Install pipe on prepared bedding.

F. Route pipe in straight line.

G. Install pipe to allow for expansion and contraction without stressing pipe or joints.

H. Install shutoff and drain valves at locations indicated on Drawings.

I. Install plastic ribbon tape continuous over top of pipe.

3.4 INSTALLATION - ABOVE GROUND PIPING

A. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

B. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.

C. Group piping whenever practical at common elevations.

D. Sleeve pipe passing through partitions, walls and floors. Refer to Section 22 05 29.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 00.

G. Provide access where valves and fittings are not accessible.

H. Install non-conducting dielectric connections wherever jointing dissimilar metals.

I. Slope piping and arrange systems to drain at low points.

J. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

K. Install piping penetrating roofed areas to maintain integrity of roof assembly.

L. Install pipe identification in accordance with Section 22 05 53.

3.5 INSTALLATION - DOMESTIC WATER PIPING SYSTEMS

A. Install domestic water piping system in accordance with ASME B31.9.

3.6 INSTALLATION - SANITARY WASTE AND VENT PIPING SYSTEMS

A. Install sanitary waste and vent piping systems in accordance with ASME B31.9.

3.7 INSTALLATION - STORM DRAINAGE PIPING SYSTEMS

A. Install storm drainage piping systems piping in accordance with ASME B31.9.

3.8 FIELD QUALITY CONTROL

A. Section 01 45 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Test domestic water piping system in accordance with applicable code.

C. Test sanitary waste and vent piping system in accordance with applicable code.

D. Test storm drainage piping system in accordance with applicable code.

3.9 CLEANING

A. Section 01 77 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean and disinfect domestic water distribution system.

END OF SECTION

SECTION 220513 – ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 – GENERAL

1.1 SUMMARY

A. This section specifies the basic requirements for electrical components which are furnished with mechanical equipment (factory or field installed).

1.2 REFERENCES

A. The following references shall be applicable:
1. NEMA Standards MG 1: Motors and Generators
2. NEMA Standards ICS 2: Industrial Control Devices, Controllers, and Assemblies.
3. NEMA Standard 250: Enclosures for Electrical Equipment
4. NEMA Standard KS 1: Enclosed Switches
5. Comply with National Electrical Code (NFPA 70).

1.3 SUBMITTALS

A. Factory furnished electrical component product data submittal requirements are specified within the individual equipment specification sections.

1.4 QUALITY ASSURANCE

A. Electrical components and materials shall be UL or ETL labeled.

PART 2 – PRODUCTS

2.1 MOTORS

A. Electrical Characteristics shall meet the following unless otherwise indicated:
1. Frequency Rating: 60 HZ
2. Voltage Rating: Determined by voltage of circuit to which motor is connected for the following motor voltage ratings (utilization voltages):
a. 120V circuit: 115V motor rating.
b. 208V circuit: 200V motor rating.
c. 240V circuit: 230V motor rating.
d. 480V circuit: 460V motor rating.

B. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
1. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.

C. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors, unless otherwise indicated.

D. Temperature rating: Rated for 40°C (104°F) environment.

E. Temperature rise: Rated for maximum of 90°C (194°F) rise for continuous duty at full load, Class B insulation, except for inverter duty rated motors which shall use Class F insulation.

F. Starting capability: Frequency of starts as required to meet automatic control system sequence of operation, and not less than 5 evenly timed starts per hour.

G. Capacity: Sufficient to start and operate connected loads without exceeding name plate ratings.

H. Motor construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B," except "C" where required for high starting torque.
   1. Bearings:
      a. Re-greasable, except permanently sealed motor;
      b. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor;
   2. Mounting:
      a. Horizontal: foot mounted
      b. Vertical: base mounted
   3. Enclosure Type: See individual equipment specifications for enclosure type.
   4. Lifting Lug: lifting eye or lug for all motors exceeding 50 pounds.
   5. Stamped Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, efficiency, special features and similar information.
   6. All motors 1hp and larger shall be premium efficiency, constant speed, rpm as specified, squirrel cage, unless otherwise required to meet driven equipment's maximum starting duty. Minimum full-load nominal efficiencies per IEEE Standard 112, Test Method B shall be equal to or greater than those listed in the following tables.

I. Polyphase Motors:
   1. General: Squirrel-cage induction-type conforming to the following requirements except as otherwise indicated.
   2. Variable Speed Motors for Use with Solid-State Drives: Energy efficient, invertor ready, design B units with ratings, characteristics, and features coordinated with drive manufacturer.
   3. Bearings: Suitable for radial and thrust loading of the application.
   4. Severe Duty Motors: Minimum 1.25 service factor. Provide motors with regreasable bearings and equipped with capped relief vents. Insulate windings with nonhygroscopic material.
   5. Motors for Reduced Inrush Starting: Coordinate with reduced inrush controller type and with characteristics of driven equipment load. Provide required wiring leads in motor terminal box to suit control method.

J. Single-Phase Motors:
   1. Energy Efficient Motors: One of the following types as selected to suit the starting torque and other requirements of the specific motor application.
      a. Permanent Split Capacitor.
      b. Split-Phase Start, Capacitor-Run
      c. Capacitor-Start, Capacitor-Run
      d. Shaded-Pole.
      e. Capacitor Start, Induction Run.
   2. Internal Thermal Overload Protection for Motors: Protection shall automatically open the power supply circuit to the motor, or a control circuit. Protection shall operate when winding temperature exceeds a safe value calibrated to the temperature rating of the motor insulation. Motor shall automatically reset when motor temperature returns to normal range.

3. Bearings: Belt connected motors or other motors with high radial forces on motor shaft shall be ball bearing type. Sealed, prelubricated sleeve bearings may be used for other single phase motors.

2.2 STARTERS, DISCONNECTS AND ACCESSORIES

A. Motor Starter Characteristics:

1. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition. Minimum size starter shall be NEMA Size 1.

B. Manual Disconnect Switches:

1. Fusible switches: fused, each phase; general duty; horsepower rated; non-teasible quick-make, quick-break mechanism; dead front line side shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro silver plated current carrying parts; hinged doors; operating lever arranged for locking in the “OPEN” position; arc quenchers; capacity and characteristics as required by equipment manufacturer.
2. Non-fusible switches: horsepower rated toggle switch type; quantity of poles and voltage rating as required by equipment manufacturer.

C. Magnetic Starters:

1. Hand-off-auto, selector switches and pilot lights.
2. Trip-free thermal overload relays, each phase.
3. Interlocks, switches, contacts and similar devices as required for coordination with control requirements.
4. Built-in control circuit transformer, sized by manufacturer. Provide with minimum two normally-open and two normally closed spare auxiliary contacts.
5. Externally operated manual reset.
6. High voltage and low voltage protection in all three phases.
7. Internal Thermal Overload Protection For Motors: Protection shall automatically open control circuit. Protection shall operate when winding temperature exceeds safe value calibrated to the temperature rating of the motor insulation.

D. Starter Enclosures:

1. NEMA rated as required for environment in which equipment is to be installed.
2. Interlock covers of combination starters with operating handle providing access to inside of enclosure only when disconnect is in “OFF” position. Provide means to attach multiple padlocks for locking external operating handle in either the “ON” or “OFF” position.
3. Provide red colored RESET Button in cover of starter.
4. Provide and secure wiring diagram corresponding to motor and control wiring of associated equipment on inside of each magnetic and combination starter.
5. Manual starter shall have means for externally locking operating mechanism in “OFF” position.

E. Factory Installed Motor Connections:

1. Flexible conduit, except where plug-in electrical cords are specifically indicated.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Motors: Install field-installed motors in accordance with manufacturer's published instructions and the following:
   1. Direct Connected Motors: Mount securely in accurate laser alignment.
   2. Belt Drive Motors: Use adjustable motor mounting bases. Align pulleys and install belts. Use belts identified by the manufacturer and tension belts in accordance with manufacturer recommendations.
   3. Bearings: Provide extended lube lines for regreasable motors.

B. Motor Controllers (starters, Disconnects and Drives): Install field-installed starters, disconnects and drives in accordance with manufacturer's published instructions and the following:
   1. Locate controllers within sight of motors controller.
   2. Mounting: For control equipment at walls, bolt units to wall or mount on light-weight structural steel channels bolted to the wall. For controllers not at walls, provide freestanding racks fabricated of structural steel members and light-weight slotted structural steel channels. Use feet consisting of 3/8-inch thick steel plates, 6 inch square, bolted to the floor. Use feet for welded attachment of 1-1/2-inch thick steel plates, 6 inch square, bolted to the floor. Use feet for welded attachment of 1-1/2-inch by 1-1/2-inch by 1/4 –inch vertical angle pots not over three feet on centers. Connect the posts with horizontal lightweight slotted steel channels and bolt the control equipment to the channels.
   3. Clearances: All motor controllers shall be installed per NEC requirements.

3.2 ACCEPTANCE

A. The right is reserved by the Owner's Representative to reject any motor which, in his opinion, either under test or in actual service is found to be overloaded, develops excessive mechanical noise, magnetic hum, or otherwise operates unsatisfactorily, within the speed range and load specified. The contractor shall adjust, or if necessary replace any such deflected motor with one satisfactory to the Owner or Owner's Representative without any extra cost to the Owner.

END OF SECTION

SECTION 220519 – METERS AND GAGES

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following types of meters and gages:
   1. Temperature gages and fittings.
   2. Pressure gages and fittings.
   3. Flow meters.

1.2 SUBMITTALS

A. Product data for each type of meter and gage. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit meter and gage schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gage.

B. Product certificates signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and products' compliance with specified requirements.

C. Maintenance data for each type of meter and gage.

1.3 QUALITY ASSURANCE

A. UL Compliance: Comply with applicable UL standards pertaining to meters and gages.

B. ASME and ISA Compliance: Comply with applicable portions of ASME and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gages.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Mercury-In-Glass Thermometers:
   1. Marshalltown Instruments, Inc.
   2. Trerice (H.O.) Co.
   3. Weiss Instruments, Inc.
   4. Weksler Instruments Corp.

B. Direct-Mount Filled-System Dial Thermometers:
   1. Ashcroft Dresser Industries Instrument Div.
   2. Marsh Instrument Co., Unit of General Signal.
   3. Trerice (H.O.) Co.
   4. Weiss Instruments, Inc.
   5. Weksler Instruments Corp.

C. Remote-Reading Filled-System Dial Thermometers:
   1. Ametek, U.S. Gauge Div.
   2. Ashcroft Dresser Industries Instrument Div.

3. Marsh Instrument Co., Unit of General Signal.
4. Tel-Tru Manufacturing Co., Inc.
5. Trerice (H.O.) Co.
6. Weiss Instruments, Inc.
7. Weksler Instruments Corp.

D. Bimetal Dial Thermometers:
1. Ashcroft Dresser Industries Instrument Div.
2. Marshalltown Instruments, Inc.
3. Tel-Tru Manufacturing Co., Inc.
4. Trerice (H.O.) Co.
5. Weiss Instruments, Inc.
6. Weksler Instruments Corp.

E. Thermometer Wells: Same as for thermometers.

F. Insertion Dial Thermometers:
1. Ashcroft Dresser Industries Instrument Div.
2. Tel-Tru Manufacturing Co., Inc.
3. Trerice (H.O.) Co.
4. Weiss Instruments, Inc.
5. Weksler Instruments Corp.

G. Pressure Gages:
1. Ametek, U.S. Gauge Div.
2. Ashcroft Dresser Industries Instrument Div.
3. Marsh Instrument Co., Unit of General Signal.
4. Marshalltown Instruments, Inc.
5. Trerice (H.O.) Co.
6. Weiss Instruments, Inc.
7. Weksler Instruments Corp.
8. WIKA Instruments Corp.

H. Pressure Gage Accessories: Same as for pressure gages.

I. Water Orifice-Type Measurement System:
1. Armstrong Pumps, Inc.
2. Bell & Gossett, ITT, Fluid Handling Div.

J. Venturi-Type Flow Measurement System:
1. Armstrong Pumps, Inc.
2. Barco Div., Marison Industries.
3. Gerand Engineering Co.

K. Pitot Tube-Type Flow Measurement System:
1. Dieterich Standard, A Dover Industries Co.
2. Taco, Inc.

L. Window Type Flow Meters:

1. Armstrong Pumps, Inc.
2. Metraflex Co.

M. BTU Meters:
1. Data Industries Corp.
2. ISTA Energy Systems Corp.
3. Monitoring Systems & Controls, Inc.
4. QMI.

N. Test Plugs:
1. MG Piping Products Co.
2. Peterson Equipment Co., Inc.
3. Sisco, A Spedco, Inc. Co.
4. Trerice (H.O.) Co.
5. Watts Regulator Co.

2.2 THERMOMETERS, GENERAL

A. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span

B. Scale range: Temperature ranges for services listed as follows:
1. General: Temperature range shall be selected such that normal operating temperature is at 75% of scale.
2. Domestic Hot Water: 30 to 240°F with 2-degree scale divisions (0 to 115°C with 1-degree scale divisions).
3. Domestic Cold Water: 0 to 100°F with 2-degree scale divisions (minus 18 to 38°C with 1-degree scale divisions).
4. Hot Water: 30 to 300°F with 2-degree scale divisions (0 to 150°C with 1-degree scale divisions).
5. Condensed Water: 0 to 160°F with 2-degree scale divisions (minus 18 to 70°C with 1-degree scale divisions).
6. Chilled Water: 0 to 100°F with 2-degree scale divisions (minus 18 to 38°C with 1-degree scale divisions).
7. Steam and Condensate: 50 to 400°F with 2-degree scale divisions (10 to 205°C with 1-degree scale divisions).

2.3 MERCURY-IN-GLASS THERMOMETERS

A. Case: Die cast, aluminum finished, in baked epoxy enamel, glass front, spring secured, 9 inches long.

B. Adjustable Joint: Finished to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.

C. Tube: Red reading, mercury filled, magnifying lens.

D. Scale: Satin-faced, non-reflective aluminum, with permanently etched markings.

E. Stem: Copper-plated steel, aluminum or brass, for separable socket, length to suit installation.

2.4 DIRECT-MOUNT FILLED-SYSTEM DIAL THERMOMETERS

A. Type: Vapor actuated, universal angle.

B. Case: Drawn steel or cast aluminum, glass lens, 4-1/2-inch diameter.

C. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.

D. Thermal Bulb: Copper with phosphor bronze bourdon pressure tube.

E. Movement: Brass, precision geared.

F. Scale: Progressive, satin faced, non-reflective aluminum, permanently etched markings.

G. Stem: Copper-plated steel, aluminum, or brass, for separable socket, length to suit installation.

2.5 REMOTE-READING FILLED-SYSTEM DIAL THERMOMETERS

A. Type: Vapor actuated.

B. Case: Drawn steel or cast aluminum, glass lens, 4-1/2-inch diameter.

C. Movement: Brass, precision geared.

D. Scale: Progressive, satin faced, non-reflective aluminum, permanently etched markings.

E. Tubing: Bronze double-braided armor over copper capillary, length to suit installation.

F. Bulb: Copper with separable socket for liquids, averaging element for air.

2.6 BIMETAL DIAL THERMOMETERS

A. Type: Direct mounted, bimetal, universal angle.

B. Case: Stainless steel, glass lens, 5-inch diameter.

C. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.

D. Element: Bimetal coil.

E. Scale: Satin faced, non-reflective aluminum, permanently etched marking.

F. Stem: Stainless steel for separable socket, length to suit installation.

2.7 DIAL-TYPE INSERTION THERMOMETERS

A. Type: Bimetal, stainless steel case and stem, 1-inch-diameter dial, dust- and leakproof, 1/8-inch-diameter tapered-end stem with nominal length of 5 inches.

2.8 THERMOMETER WELLS

A. Thermometer Wells: Brass or stainless steel, pressure rated to match piping system design pressure; with 2-inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap.

2.9 PRESSURE GAGES

A. Type: General use, ASME B40.1, Grade A, phosphor bronze bourdon- tube type, bottom connection.

B. Case: Drawn steel or brass, glass lens, 4-1/2-inches diameter.

C. Connector: Brass, 1/4-inch NPS.

D. Scale: White coated aluminum, with permanently etched markings.

E. Accuracy: Plus or minus 1 percent of range span.

F. Range: Conform to the following:
   1. Vacuum: 30 inches Hg to 15 psi.
   2. All fluids: 2 times operating pressure.

2.10 PRESSURE GAGE ACCESSORIES

A. Syphon: 1/4-inch NPS straight coil constructed of brass tubing with threads on each end.

B. Snubber: 1/4-inch NPS brass bushing with corrosion-resistant porous metal disc. Disc material shall be suitable for fluid served and rated pressure.

2.11 FLOW METERS, GENERAL

A. Flow rate of elements and meters shall be same as connected equipment or system.

2.12 WAFER ORIFICE-TYPE FLOOD ELEMENTS

A. Type: Differential-pressure wafer-type orifice insert flow elements designed for installation between pipe flanges.

B. Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate. Elements shall be pressure rated for 300 psig and 250□F (120□C).

2.13 VENTURI-TYPE FLOW ELEMENTS

A. Type: Differential-pressure Venturi type, designed for installation in piping.

B. Construction: Bronze or cadmium-plated steel with brass fittings and attached tag with flow conversion data. Ends shall be threaded for 2 inches and smaller elements and flanged or welded for 2-1/2 inches and larger elements.

2.14 PITOT TUBE-TYPE FLOW ELEMENTS

A. Type: Differential-pressure pitot tube-type design with probe for insertion into piping.

B. Construction: Stainless steel probe of length to span inside of pipe, with brass fittings and attached tag with flow conversion data. Elements shall be pressure rated for 150 psig and 250□F (120□C).

2.15 METERS

A. Permanently Mounted Meters: Suitable for mounting on wall or bracket, 6-inch dial or equivalent with fittings and copper tubing for connecting to flow element.

B. Scale shall be in gpm unless otherwise indicated.

C. Accuracy: Plus or minus 1 percent between 20 to 80 percent of range.

D. Portable Meters: Differential-pressure gage and two 12-foot hoses in carrying case with handle.

E. Scale: In inches of water unless otherwise indicated.

F. Accuracy: Plus or minus 2 percent between 20 to 80 percent of range.

G. Each meter shall be complete with operating instructions.

2.16 WINDOW-TYPE FLOW METERS

A. Type: Window-type flow meters designed for installation on hydronic piping and measure flow directly in gpm.

B. Construction: Bronze body and impact tube, integral self-closing valve, glass calibrated tube with indicator ball, and protection shield. Meters shall be pressure rated for 150 psig and temperature rated for 240□F (116□C).

C. Accuracy: Plus or minus 5 percent.

2.17 BTU METERS

A. Type: BTU meters consisting of turbine wheel flow meter, 2 temperature sensors, solid-state calculator with integral battery pack, integral stop valves, strainer, and magnetic trap.

B. Construction: Bronze housing, 125 psig rating.

C. Temperature Ranges: 40 to 250□F (5 to 120□C).

D. Data Output: 6-digit electromechanical counter with readout in KWH or BTU.

E. Accuracy: Plus or minus 1 percent.

F. Battery Pack: 5-year lithium battery.

2.18 TEST PLUGS

A. Test Plugs shall be nickel-plated brass body, with 1/2-inch NPS fitting and 2 self-sealing valve-type core inserts, suitable for inserting a 1/8-inch O.D. probe assembly from a dial-type thermometer or pressure gage. Test plug shall have gasketed and threaded cap with retention chain and body of length to extend beyond insulation. Pressure rating shall be 500 psig.

B. Core Material: Conform to the following for fluid and temperature range:

1. Air, Water, Oil, and Gas, 20 to 200°F (minus 7 to 93°C): Neoprene.
2. Air and Water, minus 30 to 275°F (minus 35 to 136°C): EPDM.

C. Test Kit: Provide test kit consisting of 1 pressure gage, gage adapter with probe, 2 bimetal dial thermometers, and carrying case.

D. Ranges of pressure gage and thermometers shall be approximately 2 times systems operating conditions.

PART 3 – EXECUTION

3.1 THERMOMETERS INSTALLATION

A. Install thermometers in vertical and tilted positions to allow reading by observer standing on floor.

B. Install in the following locations and elsewhere as indicated:
1. At inlet and outlet of each hydronic zone.
2. At inlet and outlet of each hydronic boiler and chiller.
3. At inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
4. At inlet and outlet of each hydronic heat exchanger.
5. At inlet and outlet of each hydronic heat recovery unit.
6. At inlet and outlet of each thermal storage tank.

C. Remote-Reading Dial Thermometers: Install in control panels, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.

D. Thermometer Wells: Install in piping tee where thermometers are indicated, in vertical position. Fill well with oil or graphite and secure cap.

3.2 INSTALLATION OF PRESSURE GAGES

A. Install pressure gages in piping tee with pressure gage valve, located on pipe at most readable position.

B. Install in the following locations, and elsewhere as indicated:
1. At suction and discharge of each pump.
2. At discharge of each pressure-reducing valve.
3. At building water service entrance.
4. At chilled water and condenser water inlets and outlets of chillers.

C. Pressure Gage Needle Valves: Install in piping tee with snubber. Install syphon in lieu of snubber for steam pressure gages.

3.3 INSTALLATION OF TEST PLUGS

A. Test Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

3.4 INSTALLATION OF FLOW-MEASURING ELEMENTS AND METERS

A. General: Install flow meters for piping systems located in accessible locations at most readable position.

B. Locations: Install flow measuring elements and meters in the following locations and elsewhere as indicated.
   1. At discharge of each pump.
   2. At inlet of each hydronic coil in built-up central systems.

C. Differential-Pressure-Type Flow Elements: Install minimum straight lengths of pipe upstream and downstream from element as prescribed by the manufacturer's installation instructions.

D. Install wafer orifice-type element between 2 Class 125 pipe flanges, ANSI B16.1 (cast iron) or ANSI B16.24 (bronze).

E. Install connections for attachment to portable flow meters in a readily accessible location.

F. Meters for Use with Flow Elements: Install meters on wall or bracket in accessible location.

G. Install connections, tubing, and accessories between flow elements and meters as prescribed by the manufacturer's installation instructions.

H. Window Flow Meters: Install in vertical upward position with impact tube mounted in bushing centered on pipe with 10 pipe diameters upstream and 5 pipe diameters downstream of straight unrestricted piping for 1-1/4 inches and smaller, 20 pipe diameters upstream and 10 pipe diameters downstream for 1-1/2 inches and larger. Calibrate meter after installation in accordance with manufacturer's installation instructions.

I. BTU Meters: Install in piping where indicated in hydronic supply line. Install thermal well in return line for remote sensor. Mount meter on wall if accessible; if not, provide bracket to support meter.

3.5 ADJUSTING AND CLEANING

A. Adjusting: Adjust faces of meters and gages to proper angle for best visibility.

B. Cleaning: Clean windows of meters and gages and factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touch-up paint.

3.6 CONNECTIONS

A. Piping installation requirements are specified in other sections. The drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
   1. Install meters and gages piping adjacent to machine to allow servicing and maintaining of machine.

END OF SECTION

SECTION 220523 – VALVES

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes: This section includes general duty valves common to most plumbing piping systems. Special purpose valves are specified in individual piping system specifications.

1.2 SUBMITTALS

A. Product Data: Product data, including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances.

B. Valve Schedule: Valve schedule indicating manufacturer's figure number, size, location, and valve features for each required valve, and installation instructions.

1.3 QUALITY ASSURANCE

A. American Society of Mechanical Engineers (ASME) Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.

B. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the various MSS Standard Practices referenced.

C. Low Lead Content: All valves submitted for use in potable water systems shall meet NSF/ANSI 372 Standard for Low Lead Content.

1.4 STORAGE AND HANDLING

A. Storage: Use the following precautions during storage:
   1. Do not remove valve end protectors unless necessary for inspection; then reinstall for storage.
   2. Protect valves from weather. Store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement in watertight enclosures.

B. Handling: Use a sling to handle valves whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products from one of the manufacturers listed in valve schedule.

B. Provide valves of same manufacturer throughout where possible. Manufacturer's name, valve size, and pressure rating shall be clearly marked on outside of body.

2.2 VALVE FEATURES, GENERAL

A. Valve Design: Rising stem or rising outside screw and yoke stems.
   1. Non-rising stem valves may be used where headroom prevents full extension of rising stems.

B. Pressure and Temperature Ratings: As scheduled and required to suit system pressures and temperatures.

C. Sizes: Same size as upstream pipe, unless otherwise indicated.

D. Operators: Provide the following special operator features:
   1. Handwheels, fastened to valve stem, for valves other than quarter turn.
   2. Lever handles, on quarter-turn valves 6-inch and smaller, except for plug valves. Provide plug valves with square heads; provide one wrench for every 10 plug valves.
   3. Chain-wheel operators, for valves 2-1/2-inch and larger, install 72 inches or higher above finished floor elevation. Extend chains to an elevation of 5'-0" above finished floor elevation.
   4. Gear drive operators, on quarter-turn valves 8-inch and larger.

E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

F. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.

G. End Connections: As indicated in the valve specifications.
   1. Threads: Comply with ANSI B1.20.1.
   2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.
   3. Solder-Joint: Comply with ANSI B16.18.
      a. Caution: Where soldered end connections are used, use solder having a melting point below 840 DegF for gate, globe, and check valves; below 421 DegF for ball valves.

H. All valves submitted for use in potable water systems use shall meet NSF/ANSI 372 Standard for Low Lead Content.

2.3 GATE VALVES

A. Gate Valves, 3-Inch and Smaller: MSS SP-80; Class 125, body and bonnet of ASTM B 62 cast bronze; with threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, “Teflon” impregnated packing, and malleable iron handwheel.

B. Gate Valves, 2-1/2-Inch and Larger: MSS SP-70; Class 125 ductile iron epoxy coated body, bronze mounted, with body and bonnet conforming to ASTM A 536; with flanged ends, EPDM packing, and two-piece backing gland assembly.

2.4 BALL VALVES

A. Ball Valves, 1 Inch and Smaller: Rated for 150 psi saturated steam pressure, 600 psi WOG pressure; two-piece construction; with bronze body conforming to ASTM B 62, standard (or regular) port, chrome-plated brass ball, replaceable “Teflon” or “TFE” seats and seals, blowout-proof stem, and vinyl-covered steel handle. Provide solder ends for domestic hot and cold water service.

B. Ball Valves, 1-1/4-Inch to 2-1/2 Inch: Rated for 150 psi saturated steam pressure, 400 psi WOG pressure; 3-piece construction; with bronze body conforming to ASTM B 62, full port, stainless steel ball, replaceable “Teflon” or “TFE” seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide solder ends for domestic hot and cold water service.

2.5 BUTTERFLY VALVES

A. Butterfly Valves, 2-1/2-Inch and Larger: MSS SP-67; rated at 200 psi; cast-iron body conforming to ASTM A 126, Class B. Provide valves with field replaceable EPDM sleeve, aluminum bronze disc, stainless steel stem, and EPDM O-ring stem seals. Provide lever operators with locks for sizes 2 through 6 inches and gear operators with position indicator for sizes 8 through 24 inches.

2.6 CHECK VALVES

A. Swing Check Valves, 2-Inch and Smaller: MSS SP-80; Class 125, cast-bronze body and cap conforming to ASTM B 62; with horizontal swing, Y-pattern, and bronze disc; and having threaded or solder ends. Provide valves capable of being reground while the valve remains in the line.

B. Swing Check Valves, 2-1/2-Inch and Larger: MSS SP-71; Class 125, bronze body and threaded cap conforming to ASTM B283; horizontal swing, and brass disc with bronze disc ring; and soldered or threaded ends. Provide valves capable of being refitted while the valve remains in the line.

PART 3 – EXECUTION

3.1 VALVE ENDS SELECTION

A. Select valves with the following ends or types of pipe/tube connections:
   1. Copper Tube Size, 2-Inch and Smaller: Solder ends.
   2. Steel Pipe Sizes, 2-Inch and Smaller: Threaded end.
   3. Steel Pipe Sizes 2-1/2 Inch and Larger: Flanged.

3.2 VALVE INSTALLATIONS

A. General Application: Use gate, ball, and butterfly valves for shut-off duty; globe, ball, and butterfly for throttling duty. Refer to piping system specification sections for specific valve applications and arrangements.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.

D. Install balance valves in the hot water recirculation piping where shown on the drawings.

E. Install three-valve bypass around each pressure reducing valve.

F. Install valves in horizontal piping with stem at or above the center of the pipe.

G. Install valves in a position to allow full stem movement.

H. Installation of Swing Check Valves: Install for proper direction of flow and with horizontal position with hinge pin level.

I. Install access doors in ceilings or walls as required in the types and sizes to accommodate easy valve access and construction (sheet rock, etc. and fire rating).

3.3 SOLDER CONNECTIONS

A. Apply heat evenly to outside of valve around joint until solder will melt upon contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.4 FLANGED CONNECTIONS

A. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.5 FIELD QUALITY CONTROL

A. Tests: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.6 ADJUSTING AND CLEANING

A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.

3.7 VALVE PRESSURE/TEMPERATURE CLASSIFICATION SCHEDULES

SERVICE	GATE	BALL	CHECK
Domestic Hot and Cold Water	125	150	125

SERVICE	GATE	BUTTERFLY	CHECK
Domestic Hot and Cold Water	125	200	125

3.8 VALVE SCHEDULE

A. Gate Valves - 3 Inch and Smaller - Class 125:

MANUFACTURER	THREADED		SOLDER	
	NRS	RS	NRS	RS
Milwaukee	UP105	UP148	UP115	UP149
Nibco	T-113-LF	T-111-LF	S-113-LF	S-111-LF
Stockham	LFB-103	X	LFB-104	X
X means not available.				

B. Gate Valves - 2-1/2 Inch and Larger:

MANUFACTURER	OS & Y RS	NRS
Nibco	F607-RW	F-619-RW
Stockham	X	X
X means not available.		

C. Ball Valves - 1 Inch and Smaller:

MANUFACTURER	THREADED ENDS	SOLDER ENDS
Conbraco (Apollo)	70LF-100	70LF-200
Milwaukee	UPBA-100	UPBA-150
Nibco	T-580-66-LF	S-580-66-LF

D. Ball Valves - 1-1/4 Inch to 2-1/2 Inch:

MANUFACTURER	THREADED ENDS	SOLDER ENDS
Conbraco (Apollo)	82LF-100	82LF-200
Milwaukee	UPBA-300S	UPBA-350S
Nibco	T-595-Y-66-LF	S-595-Y-66-LF

E. Butterfly Valves - 2 Inch and Larger:

1. The following are model numbers for lug-type, with aluminum-bronze disc:

MANUFACTURER	LEVER	GEAR
Milwaukee	ML-233-E	ML-333-E
Nibco	LD-20003	LD-20005
Watts	BF-03-121-1P	BF-03-121-1G

F. Swing Check Valves - 2 Inch and Smaller:

MANUFACTURER	CLASS 125 THREADED ENDS	CLASS 125 SOLDER ENDS
Milwaukee	UP509	UP1509
Nibco	T-413-Y-LF	S-413-Y-LF
Stockham	LFB-319Y	LFB-309Y

G. Swing Check Valves - 2-1/2 Inch and Larger:

MANUFACTURER	CLASS 125
Milwaukee	UP967
Nibco	X
Stockham	X
X means not available.	

END OF SECTION

SECTION 220529 – HANGERS, SUPPORTS AND ANCHORS

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes the following:
   1. Horizontal-piping hangers and supports.
   2. Vertical-piping clamps.
   3. Hanger-rod attachments.
   4. Building attachments.
   5. Saddles and shields.
   6. Spring hangers and supports.
   7. Miscellaneous materials.
   8. Pipe alignment guides.
   9. Anchors.
   10. Equipment supports.

1.2 SUBMITTALS

A. Product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.

B. Assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.

C. Details of trapeze hangers and upper attachments for piping 4 inches in diameter and over. Include the number and size of pipe lines to be supported on each type of trapeze hanger.

D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

1.3 QUALITY ASSURANCE

A. NFPA Compliance: Hangers and supports shall comply with NFPA standard No. 13 when used as a component of a fire protection system.

B. MSS Compliance: Provide hangers, supports and components conforming to the latest requirements of MSS Standard Practices SP-58 and SP-69.

C. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code-Steel."
   1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

D. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

E. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.

1. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

PART 2 – PRODUCTS

2.1 MANUFACTURED UNITS

A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.
   1. Components shall have zinc chromate or red oxide coatings where installed for piping and equipment.

B. Hangers, Supports, and Components: Factory-fabricated according to MSS SP-58.
   1. Components include galvanized coatings where installed for piping and equipment that will not have a field-applied finish.
   2. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

C. Thermal-Hanger Shield Inserts: 100-psi (690kPa) average compressive strength, waterproofed calcium silicate, encased with sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.

D. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

E. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

2.2 PIPE HANGERS AND SUPPORTS

A. Pipe Insulation Shields: Fabricated of steel, with a minimum of 180 degrees, unless otherwise indicated. Shields for use with hangers and supports, with the exception of combination clevis type hangers, shall be in accordance with the following schedule:

PIPE OR TUBING SIZE (INCHES)	SHIELD LENGTH (INCHES)	SHIELD GAGE
Up to 2	12	18
3 & 4	12	16
6	18	16
8 & up	24	12

B. Pipe Covering Protection Saddles: 3/16 inch thick steel, of sufficient depth for the insulation thickness specified, notched so that saddle contact with the pipe is approximately 50 percent of the total axial cross section. Saddles for pipe 12 inches in size and larger shall have a center support.

C. Pipe Hangers: Height adjustable standard duty clevis type, with cross bolt and nut. Pipe spreaders or spacers shall be used on cross bolts of clevis hangers, when supporting piping 10 inches ips and larger.

D. Adjustable Floor Rests and Base Flanges: Steel.

E. Hanger Rods: Galvanized, mild low carbon steel, fully threaded with two nuts at each end for positioning rod and hanger, and locking each in place.

F. Riser Clamps: Malleable iron or steel.

G. Rollers: Cast Iron.

H. Restraints, Anchors, and Supports for Grooved End Piping System: As recommended by the grooved end fitting manufacturer.

2.3 FASTENERS

A. Sleeve Anchors (Group II, Type 3, Class 3): Molly's Div./USM Corp. Parasleeve Series, Ramset's Dynabolt Series, or Red Head/Phillips AN1405, HN-1614, FS-1411 Series.

B. Wedge Anchors (Zinc Plated, Group II, Type 4, Class 1): Hilti's Kwik Bolt Series, Molly's Div./USM Corp. Parabolt PB Series, Ramset's Trubolt T Series, or Red Head/Phillips WS-3822.

C. Self-Drilling Anchors (Group III, Type 1): Ramset's RD Series, or Red Head/Phillips Series S-14.

D. Non-Drilling Anchors (Group VIII, Type 1): Ramset's Dynaset DS Series, Hilti's HDI Series, or Red Head/Phillips J Series.

E. Stud Anchors (Group VIII, Type 2): Red Head/Phillips JS-38 Series.

F. Continuous Slotted Type Concrete Insert, Galvanized:
   1. Load rating 800 lbs/ft: Kindorf's D-986.
   2. Load rating 1500 lbs/ft: Kindorf's D-980.
   3. Load rating 3000 lbs/ft: Hohmann & Barnard's Inc. Type CS-H.
   4. Load rating 4500 lbs/ft: Hohmann & Barnard's Inc. Type CS-HD.

G. Threaded Type Concrete Insert: Galvanized ferrous castings, internally threaded to receive 3/4 inch dia. machine bolts.

H. Wedge Type Concrete Insert: Galvanized box-type ferrous castings, internally threaded to receive 3/4 inch bolts having special wedge shaped heads.

I. Bolts, Nuts, Washers, Lags, and Screws: Medium carbon steel; size and type to suit application; galvanized for high humidity locations, and treated wood; plain finish for other interior locations. Except where shown otherwise on the Drawings, furnish type, size, and grade required for proper installation of the Work.

2.4 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, track bolts and nuts.

C. Washers: ASTM F 844, steel, plain, flat washers.

D. Grout: ASTM C 1107, Grade B, nonshrink, nonmetallic.
   1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is nonstaining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.
   2. Design Mix: 5000-psi (34.5MPa), 28-day compressive strength.
   3. Water: Potable.
   4. Packaging: Premixed and factory-packaged.

E. Pipe Alignment Guides: Factory fabricated, of cast semisteel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe.
   1. Length of guides: As recommended by manufacturer to allow indicated travel.

PART 3 – EXECUTION

3.1 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69 and SP-89. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.

B. Do not hang or support one pipe from another or from ductwork.

C. Support all insulated horizontal piping conveying refrigerants or other fluids below ambient temperature, by means of hangers or supports with insulation shields installed outside of the insulation.

D. Space hangers or supports for horizontal piping on maximum center distances as listed in the following hanger schedules, except as otherwise specified, or noted on the Drawings.

E. For Steel, Alloy Steel, Threaded Brass Pipe and Fibrous Glass Reinforced Plastic Pipe (FRP):

PIPE SIZE (INCHES)	**MAXIMUM SPACING (FEET)**
1 and under	8
1-1/4 and 1-1/2	9
2	10
2-1/2 and 3	12
4	14
5	16
6	17
8 and over	18

F. For Steel Pipe Gas Lines: Space hangers or supports on maximum centers of 6 feet for 1/2 inch pipe size; 8 feet for 3/4 inch and 1 inch pipe sizes and 10 feet for 1-1/4 inch pipe size above.

G. For Grooved End Steel Pipe:

PIPE SIZE (INCHES)	MAXIMUM SPACING (FEET)
1-1/2 and under	7
2 through 4	10
5 and over	12

1. No pipe length shall be left unsupported between any two coupling joints.

TYPE	3/4 INCH AND UNDER	1 INCH AND 1-1/4 INCH	1-1/2 INCH AND OVER
	(Maximum spacing in feet)		
Glass Pipe	8	8	8
Plastic Tubing	3	5	7
Aluminum Tubing	3	5	7

H. For Cast Iron Soil Pipe: Space hangers or support pipe at each joint or on maximum centers of 5 feet. Support pipe in continuous 10 foot lengths or longer, on maximum centers of 10 feet. Place hangers or supports as close as possible to joints and when hangers or supports do not come within 1 foot of a branch line fitting, install an additional hanger or support at the fittings.

I. For Hubless Cast Iron Pipe: Space hangers or supports at every other joint, except when the horizontal distance between hangers exceeds 4 feet, provide hangers, or supports at each joint. Place hanger or supports as close as possible to joints and when hangers or supports do not come within 1 foot of a branch line fitting install an additional hanger or support at the fitting. Where piping is suspended on centers in excess of 18 inches by means of non-rigid hangers, provide sway bracing to prevent horizontal pipe movement. Submit details of sway braces.

J. For Directional Changes: Install a hanger or support close to the point of change of direction of all pipe runs in either a horizontal or vertical plane.

K. For Concentrated Loads: Install additional hangers or supports, spaced as required and directed, at locations where concentrated loads such as in-line pumps, valves, fittings or accessories occur, to support the concentrated loads.

L. For Branch Piping Runs and Runouts over 5 feet in Length: Install a minimum of one hanger, and additional hangers if required by the hanger spacing schedules.

M. Parallel Piping Runs: Where several pipe lines run parallel in the same plane and in close proximity to each other, trapeze hangers may be submitted for approval. Base hanger spacing for trapeze type hangers on the smaller size of pipe being supported. Design the entire hanger assembly based on a safety factor of five, for the ultimate strength of the material being used.

N. Support floor drain traps from the overhead construction, with hangers of type and design as required and approved. Overhead supports are not required for floor drain traps installed directly below earth supported concrete floors.

O. Size hanger rods in accordance with the following:

PIPE OR TUBING SIZE (INCHES)	SINGLE ROD HANGER SIZE (INCHES)		DOUBLE ROD HANGER SIZE (INCHES)	
	PIPE	TUBING	PIPE	TUBING
Up to 2 inches	3/8	1/4	3/8	1/4
2-1/2 and 3	1/2	3/8	3/8	1/4
4 and 5	5/8	1/2	1/2	3/8
6	3/4	1/2	5/8	1/2
8, 10, and 12	7/8	5/8	3/4	5/8

P. Size hanger rods, for piping over 12 inches in size and multiple line supports, based on a safety factor of five for the ultimate strength of the materials being used.

Q. Secure hanger rods as follows: Install one nut under clevis, angle or steel member; one nut on top of clevis, angle or steel member; one nut inside insert or on top of upper hanger attachment and one nut and washer against insert or on lower side of upper hanger attachment. A total of four nuts are required for each road, two at upper hanger attachment and two at hanger.

R. Vertical Piping:

1. Support vertical risers of piping systems, by means of heavy duty hangers installed close to base of pipe risers, and by riser clamps with extension arms at intermediate floors, with the distance between clamps not to exceed 25 feet, unless otherwise specified. Support pipe risers in vertical shafts equivalent to the aforementioned. Install riser clamps above floor slabs, with the extension arms resting on floor slabs. Provide adequate clearances for risers that are subject to appreciable expansion and contraction, caused by operating temperature ranges.
2. Support extension arms of riser clamps, secured to risers to be insulated for cold service, 4 inches above floor slabs, to allow room for insulating and vapor sealing around riser clamps.
3. Install intermediate supports between riser clamps on a maximum 6 foot centers, for copper tubing risers 1-1/4" in size and smaller, installed in finished rooms or spaces other than mechanical equipment machine or steam service rooms, or penthouse mechanical equipment rooms.
4. Floor Supports: Install adjustable yoke rests with base flanges, for the support of piping, unless otherwise indicated on the Drawings. Install supports in a manner, which will not be detrimental to the building structure.

S. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts.

T. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

U. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

V. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9 “Building Services Piping” is not exceeded.

3.2 UPPER HANGER ATTACHMENTS

A. General:
   1. In all cases, secure upper hanger attachments to overhead structural steel, steel bar joists, or other suitable structural members.
   2. Do not attach hangers to steel decks which are not to receive concrete fill.
   3. Do not attach hangers to precast concrete plank decks less than 2-3/4 inches thick.
   4. Do not use flat bars or bent rods as upper hanger attachments.

B. Attachment to Steel Frame Construction: Provide intermediate structural steel members where required by pipe support spacing. Select steel members for use as intermediate supports based on a minimum safety factor of five.
   1. Do not use drive-on beam clamps.
   2. Do not support piping over 4 inches in size from steel bar joists. Secure upper hanger attachments to steel bar joists at panel points of joists.
   3. Do not drill holes in main structural steel members.
   4. "C" clamp type of upper hanger attachments with restraining straps may be used as upper hanger attachments for the support of piping up to a maximum of 3 inches in size and a temperature from 50 DegF to 200 DegF.

C. Attachment to Concrete Filled Steel Deck (Total thickness, 2-1/2 inches or more): Where necessary, attach hangers to the deck with welding studs (except at roof decks), thru-bolts with fish plates or tee hangers. Do not support a load, in excess of 250 lbs from any single welded stud, and thru-bolts with fish plates or tee hangers shall not be used to support piping over 3 inches in size.

D. Attachment to Cast-In-Place Concrete:
   1. Secure to overhead construction by means of cast-in-place concrete inserts.
   2. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches (100 mm) thick.
   3. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches (100 mm) thick.

E. Attachment to Existing Cast-In-Place Concrete:
   1. For piping up to a maximum of 4 inches in size, secure hangers to overhead construction with self-drilling type expansion shields and machine tools.
   2. Secure hangers to wall or floor construction with single unit expansion shields or self-drilling type expansion shields and machine bolts.
   3. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches (100 mm) thick.

F. Attachment to Cored Precast Concrete Decks (Flexicore, Dox Plank, Spancrete, etc.): Secure attachments to structural steel wherever possible. When fill is applied over decks, thru-bolts and fish plates may be used to support piping up to a maximum of 4 inches in size; mechanically expanded rod hangers or toggle bolts may be installed in cells for the support of piping up to a maximum of 2-1/2 inches in size.

G. Attachment to Hollow Block or Tile Filled Concrete Decks: Secure hangers to structural steel wherever possible. Inserts may also be used by omitting a block and pouring a solid concrete block, with a cast-in-place insert where required.

H. Attachment to Waffle Type Concrete Decks: Provide cast-in-place inserts where required. When fill is applied over deck, thru-bolts and fish plates may be used.

I. Attachment to Precast Concrete Tee Construction:
   1. Secure hangers to tees by any of the following methods:
      a. Tee hanger inserts between adjacent flanges.
      b. Thru bolts and fish plates, except at roof deck without concrete fill.
      c. Dual unit expansion shields in webs of tees. Install shields as high as possible in the webs.
   2. Exercise extreme care in the field drilling of holes to avoid damage to reinforcing.
   3. Do not use powder driven fasteners.

J. Attachment to Wood Construction: Secure hangers to the sides (only) of wood members, by means of malleable iron side beam connectors, or malleable iron or steel side beam brackets. Do not secure hanger attachments to nailing strips resting on top of steel beams.
   1. Secure side beam connectors to wood members with two No. 18 x 1-1/2 inch long wood screws, or two No. 16 x 1-1/2 inch long drive screws. Do not support piping over 1-1/2 inches in size from side beam connectors. Do not hammer in wood screws.
   2. Secure side beam brackets to wood members with steel bolts or lag screws. Do not use lag screws in wooden members having a nominal thickness (beam face) under 2 inches in size. Install bolts or lag screws, in the sides of timber or a joist, at the mid-point or above, not less than 2-1/2 inches from the lower edge when supporting branch lines and not less than 3 inches from the lower edge when supporting mains. Install heavy gage steel washers under all nuts.
   3. Secure side beam brackets to wooden beams or joists, with lag screws or bolts of size as follows:

PIPE SIZE (INCHES)	LAG SCREW SIZE (INCHES)	BOLT DIAMETER (INCHES)
2 and under	3/8 diameter x 1-3/4	3/8
2-1/2 and 3	1/2 diameter x 2	1/2
4 and 5	Use bolt	5/8

      a. Do not support piping larger than 3 inches with lag screws. Predrill holes for lag screws 1/8 inch in diameter less than the root diameter of the lag screw thread.
      b. The minimum width of the lower face of wood beams or joints in which lag screws of size as specified may be used is as follows:

LAG SCREW DIAMETER (INCHES)	NOMINAL WIDTH OF BEAM FACE (INCHES)
3/8	2
1/2	3

3.3 TRAPEZES

A. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A 36 steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

3.4 ANCHORS, RESTRAINTS, RIGID SUPPORTS, STAYS, AND SWAY BRACES

A. Install pipe anchors, restraints, and sway braces, at locations noted on the Drawings. Design anchors so as to permit piping to expand and contract freely in opposite directions, away from anchor points. Install anchors independent of all hangers and supports, and in a manner which will not affect the structural integrity of the building.

B. In grooved end piping systems, install restraints, anchors, and rigid supports as recommended by the manufacturer of the grooved end fittings to ensure proper support and alignment of the piping under operating and testing pressures (maximum hanger or support spacing as previously specified).
   1. Horizontal piping: Maintain a constant pitch without sages, humps, or lateral deflections.
   2. Branch piping: Install perpendicular to main piping and/or risers.
   3. Vertical piping: Install in plumb without deflections.
   4. Vertical piping: Support rigidly or anchored at both top and bottom, and wherever necessary to prevent movement and/or shearing forces at branch connections.

3.5 PIPING IN TUNNELS

A. Support piping in tunnels on adjustable stanchions, fabricated in accordance with details on the Drawings, unless otherwise indicated. Install, secure and be responsible for the proper locations of all cast-in-place inserts and stanchion supports in ample time so as not to delay construction work. Secure tops of stanchions to overhead construction, as required and approved.

3.6 COMBINATION CLEVIS HANGER, PIPE INSULATION SHIELD, AND VAPOR BARRIER JACKETED HIGH DENSITY INSULATING SADDLES

A. Install a combination clevis hanger, pipe insulation shield and vapor barrier jacketed high density insulating saddles, at all points of support for piping or tubing to be insulated for cold service. Furnish companion high density vapor barrier jacketed saddle pieces, of the same material, thickness and length, for installation over the top 180 degree surface of pipe or tubing, at each point of support where an insulated clevis hanger is utilized.

3.7 PIPE INSULATION SHIELDS

A. Install a pipe insulation shield, at all points of support, for piping insulated with cold service insulation. Center shields on all hangers and supports, and install in such a manner so as not to cut, puncture or press into the insulation, or in any manner be detrimental to the vapor barrier.

3.8 PIPE COVERING PROTECTION SADDLES

A. Install pipe covering protection saddles at all points of support, for steel piping 6 inches in size and larger, insulated with hot service insulation. Weld saddles to piping to insure movement with pipe.

3.9 FIBROUS GLASS REINFORCED PLASTIC PIPE (FRP) SUPPORTS

A. Provide inserts between supports and FRP as detailed.

3.10 INSTALLATION OF ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and with AWS Standards D1.1.

C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions to control movement to compensators.

D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.11 INSTALLATION OF PIPE ALIGNMENT GUIDES

A. Install pipe alignment guides on piping that adjoins expansion joints and elsewhere as indicated.

B. Anchor to building substrate.

3.12 EQUIPMENT SUPPORTS

A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.

B. Grouting: Place grout under supports for piping and equipment.

3.13 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.

B. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds 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 touch-up of field-painted surfaces.
   1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

C. Ferrous Metals: Clean galvanized 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 Structure Painting Council.
   1. Blast steel surfaces clean as recommended by the paint system manufacturer and in accordance with requirements of SSPC specification SSPC-SP 10.
   2. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
   3. 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.

D. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum 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.

E. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

F. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, 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.
4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

3.14 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

END OF SECTION

220553-IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Nameplates.
   2. Tags.
   3. Labels.

B. Related Sections:
   1. Section 09 91 00 - Painting and Coating: Execution requirements for painting specified by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:
   1. ASME A13.1 - Scheme for the Identification of Piping Systems.

B. National Fire Protection Association:
   1. NFPA 99 - Standard for Health Care Facilities.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit manufacturers catalog literature for each product required.

C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Samples: Submit two tags, labels, and pipe markers, size used on project.

E. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 77 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 QUALITY ASSURANCE

A. Conform to NFPA 99 requirements for labeling and identification of medical gas piping systems and accessories.

B. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

C. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 PRE-INSTALLATION MEETINGS

A. Section 01 31 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 EXTRA MATERIALS

A. Section 01 77 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

2.2 TAGS

A. Metal Tags:
   1. Brass with stamped letters; tag size minimum 3 inches (38 mm) diameter with finished edges.

B. Information Tags:

1. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches (83 x 143 mm) with grommet and self-locking nylon ties.

C. Tag Chart: Typewritten letter size list of applied tags and location in anodized aluminum frame plastic laminated.

2.3 PIPE MARKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Plastic Pipe Markers:
1. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Tape Pipe Markers:
1. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

D. Plastic Underground Pipe Markers:
1. Bright colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Apply stencil painting in accordance with Section 09 91 00.

B. Install identifying devices after completion of coverings and painting.

C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

E. Install tags using corrosion resistant chain. Number tags consecutively by location.

F. Identify water heaters, pumps, tanks, and water treatment devices with nameplates. Identify in-line pumps and other small devices with tags.

G. Identify control panels and major control components outside panels with plastic nameplates.

H. Identify valves in main and branch piping with tags.

I. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4 inch (20 mm) diameter. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

3.3 SCHEDULES

A. Identification:
   1. Domestic Cold Water Piping.
      a. Identification Type: Pipe marker
      b. Background Color: Yellow
      c. Lettering Size: 3/4 inch
      d. Lettering Color: Black
   2. Domestic Hot Water.
      a. Identification Type: Pipe marker
      b. Background Color: Yellow
      c. Lettering Size: 2 inch
      d. Lettering Color: Black

B. Valve Tags:
   1. All valves.
      a. Tag Material: Brass
      b. Tag Size: 3”
      c. Tag Shape: Round

END OF SECTION

SECTION 220700 – PLUMBING INSULATION

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes pipe, duct, and equipment insulation.

1.2 DEFINITIONS

A. Hot Surfaces: Normal operating temperatures of 100ºF or higher.

B. Dual-Temperature Surfaces: Normal operating temperatures that vary from hot to cold.

C. Cold Surfaces: Normal operating temperatures less than 75ºF.

D. Thermal Resistivity: "r-values" represent the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees Fahrenheit between two exposed faces required to cause one Btu to flow through one square foot of material, in one hour, at a given mean temperature.

E. Density: Is expressed in lb/sq.ft.

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 mechanical insulation identifying k-value, thickness, and accessories.

C. Manufacturer's installation instructions.

D. Schedule of materials and thickness for each piece of equipment.

1.4 QUALITY ASSURANCE

A. Fire Performance Characteristics: Conform to the following characteristics for insulation including facings, cements, and adhesives, when tested according to ASTM E 84, by UL or other testing or inspecting organization acceptable to the authority having jurisdiction. Label insulation with appropriate markings of testing laboratory.
   1. Interior Insulation: Flame spread rating of 25 or less and a smoke developed rating of 50 or less.
   2. Exterior Insulation: Flame spread rating of 75 or less and a smoke developed rating of 150 or less.

B. Field-Constructed Mock-Up: Before installation, erect mock-up of size and at locations indicated to demonstrate workmanship quality. Include method of attachment and finishing for each.
   1. Interior and exterior equipment.
   2. Interior and exterior duct systems.
   3. Interior and exterior piping systems.

4. Retain and protect mock-ups during construction as a standard for judging completed unit of Work.
5. Remove mock-ups from Project site when directed.
6. Accepted mock-ups may become part of completed unit of Work.

1.5 SEQUENCING AND SCHEDULING

A. Schedule insulation application after testing of piping systems.

B. Schedule insulation application after installation and testing of heat trace tape.

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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Glass Fiber:
   a. CertainTeed Corporation.
   b. Knauf Fiberglass GmbH.
   c. Manville.
   d. Owens-Corning Fiberglas Corporation.
   e. USG Interiors, Inc. - Thermafiber Division.
2. Flexible Elastomeric Cellular:
   a. Armstrong World Industries, Inc.
   b. Halstead Industrial Products.
   c. IMCOA.
   d. Rubatex Corporation.
3. Calcium Silicate:
   a. Manville.
   b. Owens-Corning Corporation.
4. Open Weave Glass Cloth Membrane:
   a. Perma Glas-Mesh Corp.
5. Vinyl-Acrylic Mastic:
   a. Childers Products Co.

2.2 GLASS FIBER

A. Material: Inorganic glass fibers, bonded with a thermosetting resin.

B. Jacket: All-purpose, factory-applied, laminated glass-fiber-reinforced, flame-retardant Kraft paper and aluminum foil having self-sealing lap.

C. Preformed Pipe Insulation: ASTM C 547, Class 1, rigid pipe insulation, jacketed.
1. Thermal Conductivity: 0.27 average maximum at 75ºF mean temperature.
2. Density: 10 average maximum.

D. Adhesive: Produced under the UL Classification and Follow-up service.
   1. Type: Non-flammable, solvent-based.
   2. Service Temperature Range: Minus 20 to 180ºF.

E. Vapor Barrier Coating: Waterproof coating recommended by insulation manufacturer for outside service.

2.3 FLEXIBLE ELASTOMERIC CELLULAR

A. Material: Flexible expanded closed-cell structure with smooth skin on both sides.
   1. Tubular Materials: ASTM C 534, Type I.
   2. Sheet Materials: ASTM C 534, Type II.

B. Thermal Conductivity: 0.27 average maximum at 75ºF.

C. Coating: Water based latex enamel coating recommended by insulation manufacturer.

2.4 CALCIUM SILICATE

A. Material: ASTM C 533, Type I; inorganic, hydrous calcium silicate, non-asbestos fibrous reinforcement; incombustible.

B. Form: Molded flat block, curved block, grooved block, and preformed pipe sections as appropriate for surface.

C. Thermal Conductivity: 0.60 at 500ºF.

D. Dry Density: 15.0 pcf maximum.

E. Compressive Strength: 60 psi minimum at 5 percent deformation.

F. Fire Performance Characteristics: Provide materials identical to those whose fire performance characteristics have been determined, per test method indicated below, by UL or other testing and inspecting organization acceptable to authorities having jurisdiction.
   1. Test Method: ASTM E 84.
   2. Flame Spread: 0.
   3. Smoke Developed: 0.

2.5 INSULATING CEMENTS

A. Mineral Fiber: ASTM C 195.
   1. Thermal Conductivity: 1.0 average maximum at 500ºF mean temperature.
   2. Compressive Strength: 10 psi at 5 percent deformation.

B. Expanded or Exfoliated Vermiculite: ASTM C 196.
   1. Thermal Conductivity: 1.10 average maximum at 500ºF mean temperature.
   2. Compressive Strength: 5 psi at 5 percent deformation.

C. Mineral Fiber, Hydraulic-Setting Insulating and Finishing Cement: ASTM C 449.
   1. Thermal Conductivity: 1.2 average maximum at 400ºF mean temperature.
   2. Compressive Strength: 100 psi at 5 percent deformation.

2.6 ADHESIVES

A. Flexible Elastomeric Cellular Insulation Adhesive: Solvent-based, contact adhesive recommended by insulation manufacturer.

B. Lagging Adhesive: MIL-A-3316C, non-flammable adhesive in the following Classes and Grades:
   1. Class 1, Grade A for bonding glass cloth and tape to unfaced glass fiber insulation, sealing edges of glass fiber insulation, and bonding lagging cloth to unfaced glass fiber insulation.
   2. Class 2, Grade A for bonding glass fiber insulation to metal surfaces.

2.7 JACKETS

A. General: ASTM C 921, Type 1, except as otherwise indicated.

B. Foil and Paper Jacket: Laminated glass-fiber-reinforced, flame-retardant Kraft paper and aluminum foil.
   1. Water Vapor Permeance: 0.02 perm maximum, when tested according to ASTM E 96.
   2. Puncture Resistance: 50 beach units minimum, when tested according to ASTM D 781.

C. PVC Jacketing: High-impact, ultra-violet-resistant PVC, 20-mils thick, roll stock ready for shop or field cutting and forming to indicated sizes.
   1. Adhesive: As recommended by insulation manufacturer.

D. PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil-thick, high-impact, ultra-violet-resistant PVC.
   1. Adhesive: As recommended by insulation manufacturer.

E. Aluminum Jacket: ASTM B 209, 3003 Alloy, H-14 temper, roll stock ready for shop or field cutting and forming to indicated sizes or factory cut and rolled to indicated sizes.
   1. Finish and Thickness: Smooth finish, 0.010 inch thick.
   2. Finish and Thickness: Corrugated finish, 0.010 inch thick.
   3. Finish and Thickness: Stucco embossed finish, 0.016 inch thick.
   4. Finish and Thickness: Painted finish, 0.016 inch thick.
   5. Moisture Barrier: 1-mil, heat-bonded polyethylene and Kraft paper.
   6. Elbows: Preformed 45-degree and 90-degree, short- and long-radius elbows, same material, finish, and thickness as jacket.

F. Stainless-Steel Jacket: ASTM A 167, Type 304 or 316, 0.10-inch thick, No. 2B finish, and roll stock ready for shop or field cutting and forming to indicated sizes or factory cut and rolled to indicated sizes.
   1. Moisture Barrier: 1-mil, heat-bonded polyethylene and Kraft paper.
   2. Elbows: Gore type, for 45-degree and 90-degree elbows in same material, thickness, finish as jackets.

2.8 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Woven glass fiber fabrics, plain weave, presized a minimum of 8 ounces per sq. yd.
   1. Tape Width: 4 inches.
   2. Cloth Standard: MIL-C-20079H, Type I.
   3. Tape Standard: MIL-C-20079H, Type II.

B. Bands: 3/4-inch wide, in one of the following materials compatible with jacket:
   1. Stainless Steel: Type 304, 0.020 inch thick.
   2. Galvanized Steel: 0.005 inch thick.
   3. Aluminum: 0.007 inch thick.
   4. Brass: 0.01 inch thick.
   5. Nickel-Copper Alloy: 0.005 inch thick.

C. Wire: 14-gage nickel copper alloy, 16-gage, soft-annealed stainless steel, or 16-gage, soft-annealed galvanized steel.

D. Corner Angles: 28-gage, 1-inch by 1-inch aluminum, adhered to 2-inch by 2-inch Kraft paper.

E. Anchor Pins: Capable of supporting 20 pounds each. Provide anchor pins and speed washers of sizes and diameters as recommended by the manufacturer for insulation type and thickness.

2.9 SEALING COMPOUNDS

A. Vapor Barrier Compound: Water-based, fire-resistive composition.
   1. Water Vapor Permeance: 0.08 perm maximum.
   2. Temperature Range: Minus 20 to 180ºF.

B. Weatherproof Sealant: Flexible-elastomer-based, vapor-barrier sealant designed to seal metal joints.
   1. Water Vapor Permeance: 0.02 perm maximum.
   2. Temperature Range: Minus 50 to 250ºF.
   3. Color: Aluminum.

PART 3 – EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean, dry, and remove foreign materials such as rust, scale, and dirt.

B. Mix insulating cements with clean potable water. Mix insulating cements contacting stainless-steel surfaces with demineralized water.
   1. Follow cement manufacturer's printed instructions for mixing and portions.

3.2 INSTALLATION, GENERAL

A. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each mechanical system.

B. Select accessories compatible with materials suitable for the service. Select accessories that do not corrode, soften, or otherwise attack the insulation or jacket in either the wet or dry state.

C. Install vapor barriers on insulated pipes and equipment having surface operating temperatures below 60ºF.

D. Install insulation only after systems to be insulated have been tested and approved.

E. Apply insulation material, accessories, and finishes according to the manufacturer's printed instructions.

F. Install insulation with smooth, straight, and even surfaces.

G. Seal joints and seams to maintain vapor barrier on insulation requiring a vapor barrier.

H. Seal penetrations for hangers, supports, anchors, and other projections in insulation requiring a vapor barrier.

I. Seal Ends: Except for flexible elastomeric insulation, taper ends at 45 degree angle and seal with lagging adhesive. Cut ends of flexible elastomeric cellular insulation square and seal with adhesive.

J. Apply adhesives and coatings at manufacturer's recommended coverage-per-gallon rate.

K. Keep insulation materials dry during application and finishing.

L. Install board and block materials with a minimum dimension of 12 inches and a maximum dimension of 48 inches.

M. Items Not Insulated: Unless otherwise indicated do not apply insulation to the following systems, materials, and equipment:
   1. Flexible connectors for pipes.
   2. Vibration control devices.
   3. Testing laboratory labels and stamps.
   4. Nameplates and data plates.
   5. Access panels and doors in air distribution systems.
   6. Fire protection piping systems.
   7. Sanitary drainage and vent piping, except for exposed sanitary on fixtures for the disabled.
   8. Drainage piping located in crawl spaces, unless indicated otherwise.
   9. Below grade piping.
   10. Chrome-plated pipes and fittings, except for plumbing fixtures for the disabled.
   11. Piping specialties including air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.3 PIPE INSULATION INSTALLATION, GENERAL

A. Tightly butt longitudinal seams and end joints. Bond with adhesive.

B. Stagger joints on double layers of insulation.

C. Apply insulation continuously over fittings, valves, and specialties, except as otherwise indicated.

D. Apply insulation with a minimum number of joints.

E. Apply insulation with integral jackets as follows:
   1. Pull jacket tight and smooth.
   2. Cover circumferential joints with butt strips, at least 3-inches wide, and of same material as insulation jacket. Secure with adhesive along both edges of butt strip and space 4 inches on center.
   3. Longitudinal Seams: Overlap seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
   4. Vapor Barrier Coatings: Where vapor barriers are indicated, apply on seams and joints and at ends butt to flanges, unions, valves, and fittings.

5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor barrier coating.
6. Repair damaged insulation jackets, except metal jackets, by applying jacket material around damaged jacket. Adhere and seal. Extend patch at least 2 inches in both directions beyond damaged insulation jacket and around the entire circumference of the pipe.

F. Roof Penetrations: Apply insulation for interior applications to a point even with the top of the roof flashing. Seal with vapor barrier coating. Apply insulation for exterior applications butted tightly to interior insulation ends. Extend metal jacket for exterior insulation outside roof flashing at least 2 inches below top of roof flashing. Seal metal jacket to roof flashing with vapor barrier coating.

G. Exterior Wall Penetrations: For penetrations of below grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor barrier coating.

H. Exterior Wall Penetrations: For penetrations of below grade exterior walls, extend metal jacket for exterior insulation through penetration to a point 2 inches from interior surface of wall inside the building. Seal ends of metal jacket with vapor barrier coating. Secure metal jacket ends with metal band. At point where insulation metal jacket contacts mechanical sleeve seal, insert cellular glass preformed pipe insulation to allow sleeve seal tightening against metal jacket. Tighten and seal sleeve to jacket to form a watertight seal.

I. Interior Walls and Partitions Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions. Apply an aluminum jacket with factory-applied moisture barrier over insulation. Extend 2 inches from both surfaces of wall or partition. Secure aluminum jacket with metal bands at both ends. Seal ends of jacket with vapor barrier coating. Seal around penetration with joint sealer. Refer to Division 7.

J. Fire-Rated Walls and Partitions Penetrations: Terminate insulation at penetrations through fire-rated walls and partitions. Seal insulation ends with vapor barrier coating. Seal around penetration with firestopping or fire-resistant joint sealer. Refer to Division 7 for firestopping and fire-resistant joint sealers.

K. Floor Penetrations: Terminate insulation underside of floor assembly and at floor support at top of floor.

L. Flanges, Fittings, and Valves - Interior Exposed and Concealed: Coat pipe insulation ends with vapor barrier coating. Apply premolded, precut, or field-fabricated segments of insulation around flanges, unions, valves, and fittings. Make joints tight. Bond with adhesive.
1. Use same material and thickness as adjacent pipe insulation.
2. Overlap nesting insulation by 2 inches or 1-pipe diameter, whichever is greater.
3. Apply materials with adhesive, fill voids with mineral fiber insulating cement. Secure with wire or tape.
4. Insulate elbows and tees smaller than 3-inches pipe size with premolded insulation.
5. Insulate elbows and tees 3 inches and larger with premolded insulation or insulation material segments. Use at least 3 segments for each elbow.
6. Cover insulation, except for metal jacketed insulation, with PVC fitting covers and seal circumferential joints with butt strips.
7. Cover insulation, except for metal jacketed insulation, with 2 layers of lagging adhesive to a minimum thickness of 1/16 inch. Install glass cloth between layers. Overlap adjacent insulation by 2 inches in both directions from joint with glass cloth and lagging adhesive.

M. Hangers and Anchors: Apply insulation continuously through hangers and around anchor attachments. Install saddles, shields, and inserts as specified in “Hangers, Supports and Anchors.” For cold surface piping, extend insulation anchor legs a minimum of 12 inches and taper and seal insulation ends.

1. Inserts and Shields: Cover hanger inserts and shields with jacket material matching adjacent pipe insulation.
2. Special Treatment at Hanger Locations: At hanger locations on insulated piping 2 inches and larger, install high density rigid fiber glass pipe support blocks. On piping up to and including 5 inches, install one block at each hanger, directly on the bottom of the pipe. For 6-, 8-, and 10-inch piping, install two (2) blocks at each hanger oriented 30 degrees from each side of the bottom. For piping 12 inches and larger, orientate blocks at both the 30 degrees positions and directly on the bottom. Install blocks inside cut out section of pipe insulation, being careful not to damage the vapor barrier jacketing. Any jacketing so damaged should be repaired with matching vapor barrier tape.

3.4 BELOW GROUND PIPE INSULATION INSTALLATION

A. General: The following are additional requirements for insulation applied to piping installed below ground.

B. Coat bore surfaces of insulation materials with insulating cement of type recommended by insulation manufacturer. Apply enough cement to fill surface cells. Do not use adhesives for this coating.

C. Secure insulation with a minimum of 2 stainless-steel bands for each section of insulation.

D. Terminate insulation at anchor blocks.

E. Apply insulation continuously through sleeves and manholes, except as specified above for exterior wall penetrations.

F. Finishing: Apply 3 coats of asphaltic mastic to a finish thickness of 3/16 inch over insulation materials. Apply 10 x 10 mesh glass cloth between coats. Overlap edges of glass cloth by 2 inches.

3.5 GLASS FIBER PIPE INSULATION INSTALLATION

A. Bond insulation to pipe with lagging adhesive.

B. Seal exposed ends with lagging adhesive.

C. Seal seams and joints with vapor barrier compound.

3.6 FLEXIBLE ELASTOMERIC CELLULAR PIPE INSULATION INSTALLATION

A. Slip insulation on the pipe before making connections wherever possible. Seal joints with adhesive. Where the slip-on technique is not possible, cut one side longitudinally and apply to the pipe. Seal seams and joints with adhesive.

B. Valves, Fittings, and Flanges: Cut insulation segments from pipe or sheet insulation. Bond to valve, fitting, and flange and seal joints with adhesive.

1. Miter cut materials to cover soldered elbows and tees.
2. Fabricate sleeve fitting covers from flexible elastomeric cellular insulation for screwed valves, fittings, and specialties. Miter cut materials. Overlap adjoining pipe insulation.

3.7 CALCIUM SILICATE PIPE INSULATION INSTALLATION

A. Secure insulation with stainless-steel bands spaced at 12-inch intervals.

B. Apply 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 16-gage soft-annealed stainless-steel wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

C. Finishing: Apply a skim coat of mineral fiber, hydraulic-setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on 1 layer of glass cloth or glass tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth finish.

D. Metal Jacket: Where indicated, apply metal jacket over finished insulation as specified in this Section for installation of metal jackets.

3.8 EQUIPMENT INSULATION INSTALLATION, GENERAL

A. Groove and score insulation materials as required to fit as closely as possible to the equipment and to fit contours of equipment. Stagger end joints.

B. Insulation Thicknesses Greater than 2 Inches: Install insulation in multiple layers with staggered joints.

C. Bevel insulation edges for cylindrical surfaces for tight joint.

D. Secure sections of insulation in place with wire or bands spaced at 9-inch centers, except for flexible elastomeric cellular insulation.

E. Protect exposed corners with corner angles under wires and bands.

F. Manholes, Handholes, and Information Plates: Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.

G. Removable Insulation: Install insulation on components that require periodic inspecting, cleaning, and repairing for easy removal and replacement without damage to adjacent insulation.

H. Pumps: Where insulation is indicated, fabricate galvanized steel boxes lined with insulation. Fit boxes around pumps and coincide joints in box with the splits in the pump casings. Fabricate joints with outward bolted flanges.

I. Finishing: Except for flexible elastomeric cellular insulation, apply 2 coats of vapor barrier compound to a minimum thickness of 1/16 inch. Install a layer of glass cloth embedded between layers.

3.9 GLASS FIBER EQUIPMENT INSULATION INSTALLATION

A. Secure insulation with anchor pins and speed washers.

B. Space anchors at maximum intervals of 18 inches in both directions and not more than 3 inches from edges and joints.

C. Apply a smoothing coat of insulating and finishing cement to finished insulation.

3.10 FLEXIBLE ELASTOMERIC CELLULAR EQUIPMENT INSULATION INSTALLATION

A. Install sheets of the largest manageable size.

B. Apply full coverage of adhesive to the surfaces of the equipment and to the insulation.

C. Butt insulation joints firmly together and apply adhesive to insulation edges at joints.

3.11 JACKETS

A. Foil and Paper Jackets (FP): Install jackets drawn tight. Install lap or butt strips at joints with material same as jacket. Secure with adhesive. Install jackets with 1-1/2-inch laps at longitudinal joints and 3-inch-wide butt strips at end joints.

1. Seal openings, punctures, and breaks in vapor barrier jackets and exposed insulation with vapor barrier compound.
2. Provide PVC fitting covers.

B. Interior Exposed Insulation: Install continuous stainless-steel jackets.

C. Interior Exposed Insulation: Install continuous aluminum jackets.

D. Interior Exposed Insulation: Install continuous PVC jackets.

E. Interior Exposed Insulation: Install continuous glass cloth jackets.

F. Exterior Exposed Insulation: Install continuous aluminum jackets and seal all joints and seams with waterproof sealant.

G. Exterior Exposed Insulation: Install continuous stainless-steel jackets and seal all joints and seams with waterproof sealant.

H. Exterior Exposed Insulation: Install continuous PVC jackets and seal all joints and seams with waterproof sealant.

I. Install metal jacket with 2-inch overlap at longitudinal and butt joints. Overlap longitudinal joints to shed water. Seal butt joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel draw bands 12 inches on center and at butt joints.

J. Install the PVC jacket with 1-inch overlap at longitudinal and butt joints and seal with adhesive.

K. Install glass cloth jacket directly over insulation. On insulation with a factory applied jacket, install the glass cloth jacket over the factory applied jacket. Install jacket drawn smooth and tight with a 2-inch overlap at joints. Embed glass cloth between (2) 1/16-inch-thick coats of lagging adhesive. Completely encapsulate the insulation with the jacket, leaving no exposed raw insulation.

3.12 FINISHES

A. Paint finished insulation as specified in Division 9.

B. Flexible Elastomeric Cellular Insulation: After adhesive has fully cured, apply 2 coats of protective coating to exposed insulation.

3.13 APPLICATIONS

A. General: Materials and thicknesses are specified in schedules at the end of this Section.

B. Interior Piping Systems: Unless otherwise indicated, insulate the following piping systems:
   1. Domestic cold water.
   2. Storm water. Insulate only roof drain bodies and horizontal rainwater leaders of storm water piping.
   3. Domestic hot water.
   4. Domestic recirculated hot water.
   5. Sanitary drains for fixtures accessible to the disabled.
   6. Chilled water.
   7. Cooling coil condensate.

C. Exterior Piping Systems: Unless otherwise indicated, insulate the following piping systems:
   1. Domestic cold water.
   2. Domestic hot water.
   3. Domestic recirculated hot water.
   4. Storm water.

D. Equipment: Unless otherwise indicated, insulate the following indoor equipment:
   1. Domestic cold water equipment, tanks, and pumps.
   2. Domestic hot water equipment, tanks, and water heaters.
   3. Low temperature brine equipment, tanks, pumps, and heat exchangers, 0ºF to 34ºF.
   4. Refrigerated drinking water equipment, tanks, pumps, and heat exchangers.

3.14 PIPE INSULATION SCHEDULES

A. General: Abbreviations used in the following schedules include:
   1. Field-Applied Jackets: P - PVC, K - Foil and Paper, A-Aluminum, SS - Stainless Steel.
   2. Pipe Sizes: NPS - Nominal Pipe Size.

B. Domestic Cold Water, Cooling Coil Condensate, and Storm Water All Sizes (Interior): 1/2-inch-thick glass fiber insulation. Field-applied jacket is not required.
   1. Interior Domestic Hot Water and Recirculated Hot Water:

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
All	Glass Fiber	1	No	None

   2. Sanitary Drains and Traps Exposed at Fixtures for Disabled:

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
1 to 1-1/2	Glass Fiber	1	No	None

3.15 EQUIPMENT INSULATION SCHEDULES

A. General: Abbreviations used in the following schedules include:

1. Field-Applied Jackets:
   a. P - PVC.
   b. K - Foil and Paper.
   c. A - Aluminum.
   d. SS - Stainless Steel.
2. Pipe Sizes: NPS - Nominal Pipe Size.
3. Interior Exposed Domestic Cold Water Equipment, Tanks, and Pumps:

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
Glass Fiber	Block or Board	1	Yes	(P) (K) (A) (SS)
Flexible Elastomeric	Sheet	3/4	Yes	None

4. Interior Exposed Domestic Hot Water Equipment, Tanks, and Pumps:

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
Glass Fiber	Block	2	No	(A) (SS)
Calcium Silicate	Block	2	No	(A) (SS)

5. Interior Exposed Refrigerated Drinking Water Equipment, Tanks, Pumps, and Heat Exchangers:

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
Glass Fiber	Block	2	Yes	(P)

END OF SECTION

221100-FACILITY WATER DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Domestic water piping, buried beyond 5 feet of building.
2. Domestic water piping, within 5 feet of building.
3. Domestic water piping, above grade.
4. Unions and flanges.
5. Valves.
6. Pipe hangers and supports.
7. Water pressure reducing valves.
8. Strainers.
9. Backflow preventers.
10. Thermostatic mixing valves.
11. Underground pipe markers.
12. Bedding and cover materials.

B. Related Sections:
1. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for placement of concrete house keeping pads specified by this section.
2. Section 07 84 00 - Firestopping: Product requirements for firestopping for placement by this section.
3. Section 08 31 13 - Access Doors and Frames: Product requirements for access doors for placement by this section.
4. Section 09 90 00 - Painting and Coating: Product and execution requirements for painting specified by this section.
5. Section 22 05 03 - Pipes and Tubes for Plumbing Piping and Equipment: Product and installation requirements for piping materials applying to various system types.
6. Section 22 05 13 - Common Motor Requirements for Plumbing Equipment: Product requirements for motors for placement by this section.
7. Section 22 05 16 - Expansion Fittings and Loops for Plumbing Piping: Execution requirements for pipe expansion devices for placement by this section.
8. Section 22 05 23 - General-Duty Valves for Plumbing Piping: Product requirements for valves for placement by this section.
9. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment: Product requirements for vibration isolators for placement by this section.
10. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Product requirements for pipe identification and valve tags for placement by this section.
11. Section 22 07 00 - Plumbing Insulation: Product and execution requirements for pipe insulation.
12. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections to equipment specified by this section.
13. Section 31 05 13 - Soils for Earthwork: Soils for backfill in trenches.

14. Section 31 05 16 - Aggregates for Earthwork: Aggregate for backfill in trenches.
15. Section 31 23 16 - Excavation: Product and execution requirements for excavation and backfill required by this section.
16. Section 31 23 17 - Trenching: Execution requirements for trenching required by this section.
17. Section 31 23 23 - Fill: Requirements for backfill to be placed by this section.
18. Section 33 13 00 - Disinfecting of Water Utility Distribution: Product and execution requirements for disinfection of domestic water piping beyond 5 feet of building.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI Z21.22 - Relief Valves for Hot Water Supply Systems.

B. American Society of Mechanical Engineers:
   1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
   2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
   3. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
   4. ASME B31.9 - Building Services Piping.
   5. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
   6. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
   7. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

C. American Society of Sanitary Engineering:
   1. ASSE 1010 - Performance Requirements for Water Hammer Arresters.
   2. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers.
   3. ASSE 1012 - Performance Requirements for Backflow Preventer with Intermediate Atmospheric Vent.
   4. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
   5. ASSE 1019 - Performance Requirements for Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type.
   6. ASSE 5013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers (RP) and Reduced Pressure Fire Protection Principle Backflow Preventers (RFP).
   7. ASSE 5015 - Performance Requirements for Testing Double Check Backflow Prevention Assemblies (DC) and Double Check Fire Protection Backflow Prevention Assemblies (RPDF).

D. ASTM International:
   1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
   3. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
   4. ASTM A536 - Standard Specification for Ductile Iron Castings.
   5. ASTM B32 - Standard Specification for Solder Metal.

6. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
7. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
8. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
9. ASTM D 3311 - Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns.
10. ASTM E1 - Standard Specification for ASTM Thermometers.
11. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.
12. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

E. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

F. American Water Works Association:
1. AWWA C104 - American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
4. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
6. AWWA C651 - Disinfecting Water Mains.
7. AWWA C700 - Cold-Water Meters - Displacement Type, Bronze Main Case.
8. AWWA C701 - Cold-Water Meters - Turbine Type, for Customer Service.
9. AWWA C702 - Cold-Water Meters - Compound Type.
10. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold-Water Meters.
11. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

G. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 67 - Butterfly Valves.
3. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
4. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
5. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
6. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
7. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
8. MSS SP 85 - Cast Iron Globe & Angle Valves, Flanged and Threaded.
9. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
10. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

H. National Electrical Manufacturers Association:
1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

I. Plumbing and Drainage Institute:
   1. PDI WH201 - Water Hammer Arrester Standard.

J. Underwriters Laboratories Inc.:
   1. UL 393 - Indicating Pressure Gauges for Fire-Protection Service.
   2. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data:
   1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturer's catalog information.
   2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
   3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
   4. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
   5. Pumps: Submit pump type, capacity, certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Submit installation instructions for pumps, valves and accessories.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of valves and equipment.

C. Operation and Maintenance Data: Submit spare parts list, exploded assembly views and recommended maintenance intervals.

1.5 QUALITY ASSURANCE

A. For drinking water service, provide valves complying with NSF 61.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept valves and equipment on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not install underground piping when bedding is wet or frozen.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for domestic water piping.

1.11 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish two packing kits for each size valve.

PART 2 PRODUCTS

2.1 DOMESTIC WATER PIPING, BURIED BEYOND 5 FEET OF BUILDING

A. Ductile Iron Pipe: AWWA C151.
   1. Fittings: AWWA C110, ductile gray iron, standard thickness.
   2. Joints: AWWA C111, rubber gasket with rods.
   3. Jackets: AWWA C105 polyethylene jacket Double layer, half lapped, polyethylene tape.

2.2 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Ductile Iron Pipe: AWWA C151.
   1. Fittings: AWWA C110, ductile gray iron, standard thickness.
   2. Joints: AWWA C111, rubber gasket with rods.
   3. Jackets: AWWA C105 polyethylene jacket.

2.3 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tubing: ASTM B88, Type L, hard drawn.
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
   2. Joints: ASTM B32, Alloy Grade Sb5 tin-antimony, or Alloy Grade Sn95 tin-silver, lead free solder AWS A5.8 Classification BCuP-3 or BCuP-4 silver braze.

2.4 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:
   1. Ferrous Piping: Class 150, malleable iron, threaded.
   2. Copper Piping: Class 150, bronze unions with soldered.
   3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

B. Flanges for Pipe 2-1/2 inches and Larger:
   1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
   2. Copper Piping: Class 150, slip-on bronze flanges.
   3. PVC Piping: PVC flanges.
   4. CPVC Piping: CPVC flanges.
   5. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.5 WATER PRESSURE REDUCING VALVES

A. 2 inches and Larger: MSS SP 85, cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.6 STRAINERS

A. 1-1/2 inch to 4 inch: Class 125, flanged iron body, Y pattern with 1/16-inch stainless steel perforated screen. Provided with backflow preventer manufacturer.

2.7 BACKFLOW PREVENTERS

A. Manufacturers:
   1. Watts LF909QT-FDA-S-FDA.
   2. Substitutions: Section 01 60 00 - Product Requirements.

B. Reduced Pressure Zone Assemblies Backflow Preventers:
   1. Comply with ASSE 1013, AWWA C511-92.
   2. Bronze body, with stainless steel internal parts and stainless steel springs.
   3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two quarter-turn ball valves, strainer, and four test cocks.
   4. Replaceable seat
   5. Industrial strength sensing hose.
   6. Lead Free backflow preventer.
   7. Air-in/Water-out relief valve design.
   8. Quarter turn ball valves on inlet and discharge side of backflow preventer.

C. Double Check Valve Assemblies: Comply with ASSE ASSE 1015 or AWWA C510; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

2.8 THERMOSTATIC MIXING VALVES

A. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment. Conform to ASSE 1070 to temper water to maximum 110 degrees F

B. Accessories:
   1. Check valve on inlets.
   2. Volume control shut-off valve on outlet.
   3. Stem thermometer on outlet.
   4. Strainer stop checks on inlets.

C. Cabinet: 16 gage prime coated enameled steel, for surface mounting with keyed lock.

2.9 UNDERGROUND PIPE MARKERS

A. Plastic Ribbon Tape: Bright colored, continuously printed, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

B. Trace Wire: Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Domestic Water Service" in large letters.

2.10 BEDDING AND COVER MATERIALS

A. Bedding: Fill Type A1 A2 as specified in Section 31 05 16.

B. Cover: Fill Type A1 A2, as specified in Section 31 05 16.

C. Soil Backfill from Above Pipe to Finish Grade: Soil Type S1, as specified in Section 31 05 13. Subsoil with no rocks over 6 inches (150 mm) in diameter, frozen earth or foreign matter.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

3.3 INSTALLATION - METERS

A. Install positive displacement meters in accordance with AWWA M6, with isolating valves on inlet and outlet. Provide full line size bypass with globe valve for liquid service meters.

3.4 INSTALLATION - BURIED PIPING SYSTEMS

A. Verify connection to existing piping system size, location, and invert are as indicated on Drawings.

B. Establish elevations of buried piping with not less than 3 ft of cover.

C. Remove scale and dirt on inside of piping before assembly.

D. Install pipe to elevation as indicated on Drawings.

E. Place bedding material at trench bottom to provide uniform bedding for piping, level bedding materials in one continuous layer not exceeding 4 inches compacted depth.

F. Install pipe on prepared bedding.

G. Route pipe in straight line.

H. Install pipe to allow for expansion and contraction without stressing pipe or joints.

I. Install plastic ribbon tape continuous over top of pipe buried 6 inches below finish grade, above pipe line; coordinate with Section 31 23 23.

J. Pipe Cover and Backfilling:
   1. Backfill trench in accordance with Section 31 23 23.
   2. Maintain optimum moisture content of fill material to attain required compaction density.
   3. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 6 inches compacted layers to 12 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
   4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
   5. Do not use wheeled or tracked vehicles for tamping.

3.5 INSTALLATION - ABOVE GROUND PIPING

A. Install non-conducting dielectric connections wherever jointing dissimilar metals.

B. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

C. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.

D. Group piping whenever practical at common elevations.

E. Slope piping and arrange systems to drain at low points.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 21 05 16.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 00.

H. Provide access where valves and fittings are not accessible.

I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

J. Provide support for utility meters in accordance with requirements of utility companies.

K. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 90 00.

L. Install domestic water piping in accordance with ASME B31.9.

M. Sleeve pipes passing through partitions, walls and floors. Refer to Section 22 05 29.

N. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Section 07 84 00.

O. Install unions downstream of valves and at equipment or apparatus connections.

P. Install valves with stems upright or horizontal, not inverted.

Q. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

R. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

S. Install ball valves for throttling, bypass, or manual flow control services.

T. Provide lug end butterfly valves adjacent to equipment when functioning to isolate equipment.

U. Provide spring loaded check valves on discharge of water pumps.

V. Install potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.

W. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.

X. Test backflow preventers in accordance with ASSE 5013 5015.

3.6 INSTALLATION - SERVICE CONNECTIONS

A. Provide new water service complete with approved reduced pressure **back-flow preventer,** water meter with by-pass valves pressure reducing valve, and strainer.

B. Provide sleeve in wall for service main and support at wall with reinforced-concrete bridge. Caulk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.

3.7 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. Test domestic water piping system in accordance with applicable code local authority having jurisdiction.

3.8 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Disinfect water distribution system in accordance with Section 33 13 00.

C. Prior to starting work, verify system is complete, flushed and clean.

D. Verify pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

E. Inject disinfectant, free chlorine in liquid, powder and tablet or gas form, throughout system to obtain residual from 50 to 80 mg/L.

F. Bleed water from outlets to obtain distribution and test for disinfectant residual at minimum 15 percent of outlets.

G. Maintain disinfectant in system for 24 hours.

H. When final disinfectant residual tests less than 25 mg/L, repeat treatment.

I. Flush disinfectant from system until residual concentration is equal to incoming water or 1.0 mg/L.

J. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

END OF SECTION

SECTION 221116 – WATER DISTRIBUTION PIPING

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes potable water distribution, including cold- and hot-water supply and hot-water recirculation to a point 5 feet outside the building.

1.2 SUBMITTALS

A. Product data for all products specified in this section.

B. Water samples, test results, and reports specified in “Field Quality Control” and “Cleaning” Articles.

C. Coordination drawings, drawn accurately to scale and coordinating penetrations.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide piping system with the following minimum working pressure ratings, except where indicated otherwise:
   1. Water Distribution Systems, Below Ground: 150 psig.
   2. Water Distribution Systems, Above Ground: 125 psig.

1.4 QUALITY ASSURANCE

A. Comply with the provisions of ASME B31.9 “Building Services Piping” for materials, products, and installation.

B. Provide listing/approval stamp, label, or other marking on piping made to specified standards.

PART 2 – PRODUCTS

2.1 GENERAL

A. All products specified in this section shall be manufactured in the USA and/or Canada.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Couplings for Grooved-End Steel Pipe and Grooved-End Ferrous Fittings:
      a. Grinnell Supply Sales Co., Grinnell Corp.
      b. Gustin-Bacon Div., Tyler Pipe.
      c. Mech-Line Div., James Hardie Industries, Ltd.
      d. Sprink, Inc., James Hardie Industries, Ltd.
      e. Stockham Valves & Fittings, Inc.
      f. Victaulic Co. of America.
   2. Couplings for AWWA-Size, Grooved-End, Ductile-Iron Pipe and Fittings:
      a. Gustin-Bacon Div., Tyler Pipe.
      b. Victaulic Co. of America.
   3. Couplings for Grooved-End Copper Tube and Grooved-End Copper Fittings:
      a. Victaulic Co. of America.

2.2 PIPES AND TUBES

A. General: The application of the following pipe, tube, and fitting materials and joining methods required for plumbing piping systems are indicated in Part 3 Article "Pipe and Fittings Applications."

B. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.

C. Soft Copper Tube: ASTM B 88, Types K and L, water tube, annealed temper.

D. Steel Pipe: ASTM A 53, Type S, Grade A, Schedule 40, seamless, galvanized, plain ends.
   1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53 or ASTM A 106, Schedule 40, seamless, galvanized, carbon-steel pipe.

E. Ductile-Iron Pipe: AWWA C151, Classes 50 and 51, mechanical joint and push-on joint, with AWWA C104 cement-mortar lining.

F. Flanged Ductile-Iron Pipe: AWWA C115, ductile-iron barrel, Class 150 or 300 iron-alloy threaded flanges, with AWWA C104 cement-mortar lining.

2.3 PIPE FITTINGS AND TUBE FITTINGS

A. Wrought-Copper, Solder-Joint Pressure Fittings: ASME B16.22.

B. Cast-Copper-Alloy, Solder-Joint Pressure Fittings: ASME B16.18.

C. Wrought-Copper and Bronze, Grooved-End Fittings: ASTM B 75 Tube and ASTM B 584 Bronze Castings.

D. Copper Tube, Grooved-End Mechanical Fittings: ASTM B 75, copper tube and ASTM B 584 bronze castings.

E. Bronze Flanges: ASME B16.24, Classes 150 and 300.

F. Copper Unions: ASME B16.18, cast-copper-alloy body, hexagonal stock, with ball-and-socket joint, metal-to-metal seating surfaces, and solder-joint, threaded, or solder-joint and threaded ends.
   1. Threaded Ends: Threads conforming to ASME B1.20.1.

G. Malleable-Iron Unions: ASME B16.39, Classes 150 and 300, hexagonal stock, with ball-and-socket joint, metal-to-metal bronze seating surfaces, and female threaded ends having threads conforming to ASME B1.20.1.

H. Galvanized, Cast-Iron Threaded Fittings: ASME B16.4, Classes 125 and 250, standard pattern, with threads conforming to ASME B1.20.1.

I. Steel Pipe, Grooved-End Fittings: ASTM A 47 malleable-iron, ASTM A 106 steel, or ASTM A 536 ductile-iron, galvanized, grooved-end fittings designed to accept couplings for grooved or shouldered joints.

J. Ductile-Iron Pipe, Grooved-End Fittings: ASTM A 47 malleable-iron or ASTM A 536 ductile-iron, AWWA-pipe-size, grooved-end fittings having cement lining or FDA-approved interior coating, designed to accept AWWA C606 couplings, for AWWA grooved joints.

K. Cast-Iron Threaded Flanges: ASME B16.1, Classes 125 and 300.

L. Ductile-Iron and Gray-Iron Gasketed Fittings: AWWA C110 standard pattern or ductile-iron AWWA C153 compact pattern, 250 psig minimum pressure rating, with AWWA C104 cement-mortar lining and AWWA C111 rubber gaskets.

M. Ductile-Iron and Gray-Iron Flanged Fittings: AWWA C110, 250-psig minimum pressure rating, with AWWA C104 cement-mortar lining.

N. Polyethylene Encasement: AWWA C105, 8-mil minimum thickness, tube or sheet.

2.4 JOINING MATERIALS

A. Solder, brazing, and welding filler metals are specified in other Sections.

B. Ductile-Iron Pipe and Ductile-Iron or Cast-Iron Fittings: The following materials apply:
1. Push-On Joints: AWWA C111 rubber gaskets and lubricant.
2. Mechanical Joints: AWWA C111 ductile-iron or gray-iron glands, high-strength steel bolts and nuts, and rubber gaskets.
3. Flanged Joints: AWWA C115 ductile-iron or gray-iron pipe flanges, rubber gaskets, and high-strength steel bolts and nuts.

C. Couplings for Grooved-End Copper Tube and Grooved-End Copper Fittings: ASTM A 536 ductile-iron or ASTM A 47 malleable-iron housing having copper-colored enamel finish, with synthetic-rubber gasket having central-cavity, pressure-responsive design and suitable for hot water, with ASTM A 183 carbon-steel bolts and nuts.

2.5 VALVES

A. Refer to other Sections.

PART 3 – EXECUTION

3.1 EXCAVATION

A. Excavation, trenching, and backfilling are specified elsewhere.

3.2 PIPE AND FITTINGS APPLICATIONS

A. General: Use pipe, tube, fittings, and joining methods for piping systems according to the following applications.

B. Water Distribution Piping Below Ground: Use the following:
1. 3 to 12 Inches: Ductile-iron pipe, ductile-iron or gray-iron fittings, rubber gaskets, and push-on or mechanical joints.
2. 3 to 12 Inches: Ductile-iron pipe, ductile-iron compact fittings, rubber gaskets, and push-on or mechanical joints.
3. 3 Inches and smaller: Soft copper tube, Type K, cast-copper-alloy solder-joint pressure fittings and soldered joints with Alloy Sn95 solder.

C. Water Distribution Piping Above Ground: Use the following:
1. 4 to 12 Inches: Galvanized steel pipe; galvanized cast-iron threaded fittings; galvanized cast-iron threaded flanges; galvanized flanged steel expansion joints; malleable-iron unions.

2. 4 to 6 Inches: Hard copper tube, Type L; wrought-copper and bronze grooved-end fittings; couplings for grooved-end copper tube and grooved-end copper fittings; and grooved copper tube and grooved tube fitting joints.
3. 4 to 12 Inches: Flanged ductile-iron pipe, flanged ductile-iron or gray-iron fittings, and flanged joints.
4. 6 Inches and Smaller: Hard copper tube, Type L; wrought-copper or cast-copper-alloy pressure fittings; copper unions; bronze flanges; and solder joints with Alloy Sn95 solder.

3.3 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use gate, ball, or butterfly valves.
2. Throttling Duty: Use globe, ball, or butterfly valves.

3.4 PIPING INSTALLATION, GENERAL

A. Basic piping installation requirements are specified in other Sections.

3.5 SERVICE ENTRANCE PIPING

A. Extend water distribution piping and connect to water service piping of size and in location indicated for service entrance to building. Coordinate with other Sections.

B. Install shutoff valve, inside building at water service entrance.

C. Ductile-Iron Water Service Pipe: Comply with AWWA C600. Install buried pipe inside building between shutoff valve, wall and floor penetrations, and point 5 feet outside building, with restrained joints, including anchoring pipe to wall or floor. Provide supports (thrust blocks) at vertical and horizontal offsets.
1. Wrap pipe with polyethylene encasement.

D. Install sleeve at service penetrations through foundation wall.

E. Install sleeve and mechanical sleeve seal at service penetrations through below grade walls.

3.6 WATER DISTRIBUTION PIPING INSTALLATION

A. Install piping with 1/32-inch-per-foot (1/4 percent) slope downward toward drain.

3.7 JOINT CONSTRUCTION

A. Basic piping joint construction is specified in other Sections.

B. Grooved Copper Tube and Grooved-Tube Fitting Joints: Assemble joints with coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer’s written instructions.

3.8 ROUGHING-IN FOR WATER METER

A. Install roughing-in piping and plumbing specialties specified in other Sections for water meter installation according to utility company’s instructions and requirements.

3.9 INSTALLATION OF VALVES

A. Sectional Valves: Install sectional valves close to main on each branch and riser serving 2 or more plumbing fixtures or equipment connections and where indicated.

B. Shutoff Valves: Install shutoff valves on inlet to each plumbing equipment item, on each supply to each plumbing fixture not having stops on supplies, and elsewhere as indicated.

C. Drain Valves: Install drain valves, specified in other Sections, on each plumbing equipment item located to drain equipment for service and repair. Install drain valve at base of each riser, at low points of horizontal runs, and where required to drain water distribution piping system.
   1. Install hose-end drain valves at low points in water mains, risers, and branches.
   2. Install stop and waste drain valves where indicated.

D. Check Valves: Install check valve on discharge side of each pump and elsewhere as indicated.

E. Balance Valves: Install valve in each hot-water circulating loop, discharge side of each pump, and elsewhere as indicated.

3.10 HANGERS AND SUPPORTS INSTALLATION

A. Hanger, support and anchor devices are specified in other Sections.

3.11 CONNECTIONS

A. Supply Runouts to Fixtures: Install hot- and cold-water supply piping runouts of sizes indicated, but not smaller than required by plumbing code to fixtures.

B. Mechanical Equipment Connections: Connect hot- and cold-water supply piping system to mechanical equipment as indicated. Provide shutoff valve and union for each connection. Use flanges instead of unions for connections 2-1/2 inches and larger.

3.12 FIELD QUALITY CONTROL

A. Inspect water distribution piping as follows:
   1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.
   2. During progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to time inspection must be made. Perform tests specified below in presence of the plumbing official.
      a. Roughing-In Inspection: Arrange for inspection of piping system before concealed or closed-in after system roughing-in and prior to setting fixtures.
      b. Final Inspection: Arrange for final inspection by plumbing official to observe tests specified below and to ensure compliance with requirements of plumbing code.
   3. Reinspections: When a plumbing official finds that piping system will not pass test or inspection, make required corrections and arrange for reinspection by the plumbing official.
   4. Reports: Prepare inspection reports signed by plumbing official.

B. Test water distribution piping as follows:
   1. Test for leaks and defects in new water distribution piping systems and parts of existing systems 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 system tested.

2. Leave uncovered and unconcealed in new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved for testing.
3. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.13 CLEANING

A. Clean and disinfect water distribution piping as follows:
1. Purge new potable water distribution piping systems and parts of existing potable water systems that have been altered, extended, or repaired prior to use.
2. Use purging and disinfecting procedure prescribed by authority having jurisdiction or, if a method is not prescribed by that authority, the procedure described in either AWWA C651 or AWWA C652 or as described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill system or part thereof with water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) and allow to stand for 24 hours.
   c. Drain system or part thereof of previous solution and refill with water/chlorine solution containing at least 200 parts per million of chlorine. Isolate and allow to stand for 3 hours.
   d. Flush system with clean, potable water until the chlorine level matches the level in clean potable water source.
   e. Submit water samples in sterile bottles to authority having jurisdiction. Repeat procedure if biological examination made by the authority shows evidence of contamination.

B. Prepare and submit reports for purging and disinfecting activities.

C. Clean interior of piping system. Remove dirt and debris as work progresses.

3.14 COMMISSIONING

A. Fill water systems. Check compression tanks to determine that they are not air bound and that system is completely full of water.

B. Before operating systems, perform these steps:
1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to full open position.
3. Open throttling valves to proper setting.
4. Remove plugs used during testing of piping systems and plugs used for temporary sealing of piping during installation.
5. Remove, clean, and reinstall strainer screens. Replace damaged strainer screens. Close drain valves and replace drain plugs.
6. Remove filter cartridges from housings and verify that cartridges are clean, and ready for use.

C. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.

D. Check plumbing specialties and verify proper settings, adjustments, and operation.

E. Energize pumps and verify proper operation.

END OF SECTION

SECTION 221119 – PLUMBING SPECIALTIES

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes plumbing specialties for water distribution systems; soil, waste, and vent systems; and storm drainage systems.

1.2 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with following minimum working pressure ratings, except where otherwise indicated:
   1. Water Distribution Systems, Below Ground: 150 psig.
   2. Water Distribution Systems, Above Ground: 125 psig.
   3. Soil, Waste, and Vent Systems: 10-foot head of water.
   4. Storm Drainage Systems: 10-foot head of water.
   5. Sanitary Sewage, Pumped Piping Systems: 75 psig.
   6. Storm Sewage, Pumped Piping Systems: 75 psig.

1.3 SUBMITTALS

A. Submit product data for all materials specified within this Section, including rated capacities of selected models and weights (shipping, installation, and operation). Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following plumbing specialty products.

B. Maintenance data for all materials specified within this Section for inclusion in Operating and Maintenance manuals.

1.4 QUALITY ASSURANCE

A. Comply with ASME B31.9, “Building Services Piping,” for materials, products, and installation.

B. Electrical Component Standard: NFPA 70, “National Electrical Code.”

C. Listing and Labeling: Provide equipment that is listed and labeled.
   1. The Terms “Listed” and “Labeled” as defined in the “National Electrical Code,” Article 100.

D. Design Concept: The Drawings indicate capacities, sizes, and dimensional requirements of system components. Components having equal performance characteristics that deviate from the indicated size and dimensions may be considered, provided deviations do not change the design concept or intended performance. The burden of proof for equality of products is on the Contractor.

1.5 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials matching products installed as described below. Package them with protective covering for storage and identify with labels clearly describing contents.

B. Water Filter Cartridges: Furnish quantity not less than 200 percent of amount of each type and size installed.

C. Operating Keys (Handles): Furnish 2 extra keys for each key-operated hose bibb and hydrant installed.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Water Meters:
   a. Badger Meter, Inc.
   b. Hersey Products, Inc., Grinnell Corp.
   c. Neptune Water Div., Schlumberger Industries, Inc.
2. Backflow Preventers:
   a. Conbraco Industries, Inc.
   b. Febco.
   c. Watts Regulator Co.
   d. Wilkins Regulator Div., Zurn Industries, Inc.
3. Water Pressure Regulators:
   a. Conbraco Industries, Inc.
   b. Spence Engineering Co., Inc.
   c. Watts Regulator Co.
   d. Wilkins Regulator Div., Zurn Industries, Inc.
4. Water Filters:
   a. CUNO, Inc. Unit, Commercial Intertech Corp.
   b. Filpro Corp.
   c. Filterite Div., Memtec Corp.
   d. Filtrine Manufacturing Co.
   e. Keystone Filter Div., Met-Pro Corp.
   f. Watts Regulator Co.
5. Thermostatic Water-Mixing Valves:
   a. Heat-Timer.
   b. Lawler Manufacturing Co., Inc.
   c. Leonard Valve Co.
   d. Powers Process Controls Unit, Mark Controls Corp.
   e. Symmons Industries, Inc.
   f. T & S Brass and Bronze Works, Inc.
6. Water-Tempering Valves:
   a. Cash by A.W. Cash Valve Mfg. Corp.
   b. Leonard Valve Co.
   c. Watts Regulator Co.
7. Wall Hydrants and Post Hydrants:
   a. Josam Co.
   b. Smith by Jay R. Smith Mfg. Co. Div., Smith Industries, Inc.
   c. Watts Regulator Co.
   d. Zurn by Hydromechanics Div., Zurn Industries, Inc.
8. Sanitary Hydrants:

a. Murdock, Inc.

9. Water Hammer Arresters:
   a. Amtrol, Inc.
   b. Josam Co.
   c. Smith by Jay R. Smith Mfg. Co. Div., Smith Industries, Inc.
   d. Watts Regulator Co.
   e. Zurn by Hydromechanics Div., Zurn Industries, Inc.
10. Trap Seal Primer Valves:
   a. Jones Manufacturing Co., Inc.
   b. Josam Co.
   c. Smith by Jay R. Smith Mfg. Co. Div., Smith Industries, Inc.
   d. Wade Div., Tyler Pipe.
   e. Watts Regulator Co.
   f. Zurn by Hydromechanics Div., Zurn Industries, Inc.
11. Backwater Valves:
   a. Ancon, Inc.
   b. Josam Co.
   c. Smith by Jay R. Smith Mfg. Co. Div., Smith Industries, Inc.
   d. Zurn by Hydromechanics Div., Zurn Industries Inc.
12. Sleeve Penetration Systems:
   a. Proset Systems, Inc.

2.2 WATER METERS

A. General: Register in gallons, except where registration in cubic feet is indicated.

B. Water Meters: AWWA C700, displacement (disc) type, with bronze main case.

C. Water Meters: AWWA C701, turbine type.

D. Water Meters: AWWA C702, compound type.

E. Water Meters: AWWA C703, fire service type.

F. Water Meters: AWWA C704, propeller type.

G. Water Meters: AWWA C710, displacement (disc) type, with plastic main case.

H. Remote Registration Systems: Specified water meter type, modified to include factory- or field-installed, self-contained, pulsing- type, generating system transmitter. Include low-voltage connecting wiring, totalizing device, and remote wall register.
   1. Direct-Reading, Remote-Registration System: AWWA C706; meter-mounted transmitter; 2-conductor connecting wire; weatherproof, outdoor, remote totalizing wall unit for visual reading; and conforming to utility standards.
   2. Encoder-Type, Remote-Registration System: AWWA C707; meter-mounted transmitter; totalizing device; 2- or 3-conductor connecting wire; weatherproof, outdoor, remote receptacle for automatic reading and billing; and conforming to utility standards.
      a. Include hand-held, automatic reader.

2.3 BACKFLOW PREVENTERS

A. General: ASSE Standard, backflow preventers, of size indicated for maximum flow rate indicated and maximum pressure loss indicated.
   1. Working Pressure: 150 psig minimum except where indicated otherwise.
   2. 2 Inches and Smaller: Bronze body with threaded ends.
   3. 2-1/2 Inches and Larger: Bronze, cast-iron, steel, or stainless-steel body with flanged ends.
   4. Interior Components: Corrosion-resistant materials.
   5. Exterior Finish: Manufacturer's standard finish unless noted otherwise.
   6. Strainer on inlet, where strainer is indicated.

B. Pipe-Applied, Atmospheric-type Vacuum Breakers: ASSE 1001, with floating disc and atmospheric vent.

C. Hose Connection Vacuum Breakers: ASSE 1011, nickel plated, with nonremovable and manual drain features, and ASME B1.20.7 garden-hose threads on outlet. Units attached to rough-bronze-finish hose connections may be rough bronze.

D. Intermediate Atmospheric-Vent Backflow Preventers: ASSE 1012, consisting of inlet screen and 2 independent check valves with intermediate atmospheric vent for continuous pressure application.

E. Reduced-Pressure-Principle Backflow Preventer: ASSE 1013, consisting of (OS&Y) gate valves on inlet and outlet and strainer on inlet. Include test cocks and pressure-differential relief valve having ASME A112.1.2 air-gap fitting located between 2 positive-seating check valves for continuous pressure application.
   1. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.

F. Double-Check Backflow Prevention Assemblies: ASSE 1015, consisting of shutoff valves on inlet and outlet and strainer on inlet. Include test cocks with 2 positive-seating check valves for continuous pressure application.
   1. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.

G. Antisiphon, Pressure-Type Vacuum Breakers: ASSE 1020, consisting of valves, spring-loaded check valve, and spring-loaded floating disc. Include test cocks and atmospheric vent for continuous pressure application.
   1. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.

H. Dual-Check-Valve Type Backflow Preventers: ASSE 1024, consisting of union inlet and 2 independent check valves for continuous pressure application.

I. Dual-Check-Valve-Type Backflow Preventers: ASSE 1032, stainless-steel body, primary and secondary checks, ball check, intermediate atmospheric vent port for relieving carbon dioxide, threaded ends, 3/8-inch size for continuous pressure application for carbonated beverage dispensers.

J. Laboratory Faucet Vacuum Breakers: ASSE 1035, chrome plated; consisting of primary and secondary checks, intermediate vacuum breaker, threaded ends, ¼- or 3/8-inch size as required, for continuous pressure application.

K. Reduced-Pressure Detector Assembly Backflow Preventers: ASSE 1047, FM approved or UL listed, consisting of OS&Y gate valves on inlet and outlet, and strainer on inlet. Include pressure-differential relief valve having ASME A112.1.2 air-gap fitting located between 2 positive-seating

check valves, test cocks, and bypass with displacement-type water meter, valves, and reduced-pressure backflow preventer, for continuous pressure application.

1. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.

L. Double-Check Detector Assembly Backflow Preventers: ASSE 1048, FM approved or UL listed, consisting of OS&Y gate valves on inlet and outlet and strainer on inlet. Include 2 positive-seating check valves and test cocks, and bypass with displacement-type water meter, valves, and double-check backflow preventer, for continuous pressure application.

1. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.

2.4 WATER PRESSURE REGULATORS

A. General: ASSE 1003, water pressure regulators, rated for initial working pressure of 150 psig minimum, of size, flow rate, and inlet and outlet pressures indicated. Include integral factory-installed or separate field-installed Y type strainer.

1. 2 Inches and Smaller: Bronze body with threaded ends.
2. 2-1/2 Inches and Larger: Bronze or cast-iron body with flanged ends.
3. Interior Components: Corrosion-resistant materials.
4. Exterior Finish: Polished chrome plate when used in chrome plated piping system.

B. Single-seated, direct-operated type.

C. Single-seated, direct-operated, integral-bypass type.

D. Pilot-operated type, single- or double-seated, cast-iron body main valve, with bronze-body pilot valve.

2.5 WATER FILTERS

A. General: Cartridge-type assemblies consisting of housing, fittings, cartridges, and cartridge end caps; and suitable for potable water, of size and at flow rate and pressure loss indicated.

B. Wall Mounting, Cartridge Type: Housing head section has threaded inlet and outlet and mounting bracket. Housing lower section is removable for 10-inch-long filter cartridge.

1. Housing Material: Stainless steel, 150-psig minimum operating pressure.
2. Housing Material: Plastic, 125-psig minimum operating pressure.
3. Cartridge: Activated-charcoal media, 10-inch, 10-micron-particulate removable-rating.
4. Cartridge: Wound- or molded-fiber media, 10-inch, 10-micron-particulate removable-rating.
5. Cartridge: Pleated-polypropylene media, 10-inch, 10-micron-particulate removable-rating.

C. Floor Mounting, Cartridge Type: Stainless-steel housing rated at 150 psig minimum operating pressure.

1. Base Section: Floor-mounting section with inlet and outlet connections and removable top section for 1 or more 10-micron-particulate removable-rating cartridges.
2. Connections 2 Inches and Smaller: Threaded.
3. Connections 2-1/2 Inches and Larger: Flanged.
4. Cartridge: Activated-charcoal filter media.
5. Cartridge: Wound- or molded-fiber filter media.
6. Cartridge: Pleated-polypropylene filter media.

2.6 THERMOSTATIC WATER-MIXING VALVES

A. General: ASSE 1017, manually adjustable, thermostatic water-mixing valve with bronze body. Include checkstop and union on hot-water and cold-water supply inlets, adjustable temperature setting, and capacity at pressure loss as indicated.
   1. Operation and Pressure Rating: Bimetal thermostat, 125 psig minimum.
   2. Operation and Pressure Rating: Liquid-filled motor, 100 psig minimum.

B. Thermostatic Water-Mixing Valves: Unit, with options as indicated.
   1. Piping, of sizes and in arrangement, with valves and unions indicated.
   2. Piping Component Finish: Polished chrome plate.
   3. Piping Component Finish: Satin spray.
   4. Piping Component Finish: Rough brass.
   5. Cabinet: Steel box with steel hinged door and white enameled finish.
   6. Cabinet: Stainless-steel box with stainless-steel, hinged door.
   7. Cabinet Mounting: Recessed.
   8. Cabinet Mounting: Surface.
   9. Thermometer.

C. Manifolded, Thermostatic Water-Mixing Valve Assemblies: Factory-fabricated unit consisting of parallel arrangement of thermostatic water-mixing valves.
   1. Arrangement: 1 large-flow thermostatic water mixing valve with flow control valve, pressure regulator, inlet and outlet pressure gages, and 1 small-flow thermostatic water-mixing valve with flow control valve. Include outlet thermometer, factory- or field-installed inlet and outlet valves, and other indicated options.
   2. Piping, of sizes and in arrangement, with valves and unions, indicated.
   3. Piping Component Finish: Polished chrome plate.
   4. Piping Component Finish: Satin spray.
   5. Piping Component Finish: Rough brass.
   6. Cabinet: Steel box with steel, hinged door and white enameled finish.
   7. Cabinet: Stainless-steel box with stainless-steel, hinged door.
   8. Cabinet Mounting: Recessed.
   9. Cabinet Mounting: Surface.

D. Hydrotherapy Thermostatic Water-Mixing Valve Assemblies: Factory-fabricated, thermostatic water-mixing valve, 2 shutoff and 1 volume-control valves, unions, checkstops, thermometer, atmospheric vacuum breaker, piping, escutcheons, and cabinet.
   1. Arrangement and Sizes: As indicated.
   2. Piping Component Finish: Polished chrome plate.
   3. Piping Component Finish: Satin spray.
   4. Piping Component Finish: Rough brass.
   5. Cabinet: Steel box with steel hinged door and white enameled finish.
   6. Cabinet: Stainless-steel box with stainless-steel, hinged door.
   7. Cabinet Mounting: Recessed.
   8. Cabinet Mounting: Surface.

E. Photographic-Process Thermostatic Water-Mixing Valve Assemblies: Factory-fabricated, thermostatic water-mixing valve; volume-control valve, unions, checkstops, thermometer, atmospheric vacuum breaker, piping, escutcheons, and panel enclosure.

1. Arrangement and Sizes: As indicated, with controls mounted in front of panel cover and factory- or field-installed inlet valves. Assembly can control outlet water temperature within 1/2EF (1/4EC) throughout temperature and flow operating ranges.
2. Panel: Steel box with white enameled finish.
3. Panel: Stainless-steel box.
4. Panel Mounting: Recessed.
5. Panel Mounting: Surface.

2.7 WATER-TEMPERING VALVES

A. General: Manually-adjustable, thermostatically-controlled water-tempering valve, bronze body, and adjustable temperature setting.

B. System Water-Tempering Valves: Piston or discs controlling both hot-water and cold-water flow, capable of limited antiscald protection. Include threaded inlets and outlet, and capacity at pressure loss, and temperature range or setting as indicated.
   1. Finish: Rough bronze, except where chrome-plated finish is indicated.

C. Limited-Volume Water-Tempering Valves: Solder-joint inlets and outlet, capacity indicated at pressure loss indicated.

2.8 MISCELLANEOUS PIPING SPECIALTIES

A. Piping specialties such as escutcheons, dielectric fittings, sleeves, and sleeve seals are specified in other Sections.

B. Strainers: Y pattern, except where otherwise indicated, full size of connecting piping. Include Type 304 stainless-steel screens with 3/64-inch perforations except where other screens are indicated.
   1. Pressure Rating: 125-psig minimum steam working pressure except where otherwise indicated.
   2. Sizes 2 Inches and Smaller: Bronze body, with female threaded ends.
   3. Sizes 2-1/2 Inches and Larger: Cast-iron body, with interior FDA-approved epoxy coating and flanged ends.
   4. Y-Type Strainers: Screwed screen retainer with centered blowdown.
      a. Drain: Pipe plug.
      b. Drain: Factory- or field-installed, hose-end drain valve.
   5. T-Type Strainers: Malleable-iron or ductile-iron body with grooved ends; access end cap with drain plug and access coupling with EDPM gasket.
   6. Basket-Type Strainers: Bolted flange or clamp cover, and basket having lift-out handle.
      a. Simplex Type: Single unit, with 1 basket.
      b. Duplex Type: Double unit, with bronze or stainless-steel diverter valve and 2 baskets.
      c. Drain: Pipe plug.
      d. Drain: Factory- or field-installed hose-end, drain valve.

C. Hose Bibbs: Bronze body, with renewable composition disc, 1/2- or 3/4-inch threaded or solder-joint inlet. Provide ASME B1.20.7 garden-hose threads on outlet and integral or field-installed, nonremovable, drainable, hose-connection vacuum breaker.
   1. Finish: Rough brass.
   2. Finish: Chrome or nickel plated.
   3. Operation: Wheel handle.
   4. Operation: Operating key (handle). Provide 1 operating key.

D. Wall Hydrants: ASME A112.21.3M, nonfreeze, key operation. Provide 1 operating key.
   1. Inlet: 3/4- or 1-inch threaded or solder joint.
   2. Outlet: ASME B1.20.7 garden-hose threads, and integral or field-installed, nonremovable and drainable hose-connection vacuum breaker having ASME B1.20.7 garden-hose threads on outlet.
   3. Type: Projecting.
   4. Type: Recessed.
   5. Finish: Rough bronze.
   6. Finish: Polished bronze.
   7. Finish: Nickel bronze.

E. Wall Hydrants: ASME A112.21.3M or ASSE 1019, nonfreeze, automatic draining, antibackflow type, key operation, with 3/4- or 1-inch threaded or solder-joint inlet, and ASME B1.20.7 garden-hose threads on outlet. Provide 1 operating key.
   1. Type: Projecting.
   2. Type: Recessed.
   3. Finish: Rough bronze.
   4. Finish: Polished bronze.
   5. Finish: Nickel bronze.

F. Wall Hydrants: ASME A112.21.3M, projecting, automatic-draining, antibackflow type, key operation. Provide 1 operating key.
   1. Inlet: 3/4- or 1-inch threaded or solder-joint.
   2. Outlet: ASME B1.20.7 garden-hose threads.
   3. Finish: Rough bronze.
   4. Finish: Polished bronze.
   5. Finish: Nickel bronze.

G. Post Hydrants: ASME A112.21.3M, nonfreeze, bronze casing, cast-iron or cast-aluminum casing guard, key operation. Provide 1 operating key.
   1. Inlet: 3/4- or 1-inch threaded.
   2. Outlet: Integral or field-installed, nonremovable and drainable hose-connection vacuum breaker, with outlet conforming to ASME B1.20.7 for garden-hose thread, and tapped drain port in valve housing.
   3. Length: As required for installing inlet valve below frost line.

H. Sanitary Hydrants: Nonfreeze, post type, with nondraining chamber for storing water trapped downstream of inlet valve.
   1. Inlet: 1-inch threaded.
   2. Outlet: Integral or field-installed hose connection with nonremovable and drainable, vacuum breaker with outlet conforming to ASME B1.20.7 for garden-hose thread. Include brass or bronze casing and other parts in contact with water, and handle or key operation. Provide 1 operating key for key-operated unit.
   3. Length: As required for installation of storage chamber below frost line. Use of draining-type post hydrant for this application is prohibited.

I. Hose-End, Drain Valves: 3/4-inch ball valve, rated for 400 psig WOG. Include 2-piece bronze body conforming to ASTM B 62, standard port, chrome-plated brass ball, replaceable “TFE” seats and seals, blowout-proof stem, and vinyl-covered steel handle.
   1. Inlet: Solder-joint or threaded.

2. Outlet: Short-threaded nipple with ASME B1.20.7 garden-hose thread and cap.
3. Hose-End, Drain Valve Option: MSS SP-80, gate valve, Class 125, ASTM B 62 body, with 3/4-inch solder-joint or threaded inlet and ASME B1.20.7 garden-hose thread outlet and cap. Hose bibbs are prohibited for this application.
4. Fire-Hose-End Drain Valve Option: UL 668, 1-1/2-inch, bronze body, 90-degree angle or straightway pattern hose valve, rated for 175-psig minimum working pressure.
    a. Male Outlet Threads: Conform to NFPA 1963 and local fire department standards and complete with attached chain and cap.
        1) 2-1/2-inch valves with 2-1/2- by 1-1/2-inch adapter and attached chain and cap may be provided instead of 1-1/2-inch valves.

J. Stop-and-Waste Drain Valves: Ball valve or MSS SP-80 gate valve, rated for 200 psig WOG minimum, ASTM B 62 bronze body, with 1/8-inch side drain outlet and cap.

K. Water Hammer Arresters: ASME A112.26.1M, ASSE 1010, or PDI WH-201, bellows or piston type with pressurized cushioning chamber. Sizes are based on water-supply fixture units, ASME A112.26.1M sizes “A” through “F” and PDI WH-201 sizes “A” through “F.”

L. Trap Seal Primer Valves: ASSE 1018, water-supply-fed type, with the following characteristics:
1. 125-psig minimum working pressure.
2. Bronze body with atmospheric-vented drain chamber.
3. Inlet and Outlet Connections: 1/2-inch threaded, union, or solder joint.
4. Gravity Drain Outlet Connection: 1/2-inch threaded or solder joint.
5. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

M. Horizontal Backwater Valves: ASME A112.14.1, cast-iron body, with removable bronze swing-check valve and threaded or bolted cover.
1. Closed-Position Check Valve: Factory assembled or field modified to hang closed except when subject to backflow condition.
2. Open-Position Check Valve: Factory assembled or field modified to hang open except when subject to backflow condition.
3. Extension: Full-size, Service Class, cast-iron soil-pipe extension to field-installed cleanout at floor, instead of cover.

N. Drain Outlet, Backwater Valves: Cast-iron or bronze body, with removable ball float, threaded inlet, and threaded or spigot outlet.

O. Drainage-Type Basket Strainers: Non-pressure rated, cast-iron or coated-steel body, with bolted flange or clamp cover, drain with plug.
1. Basket: Bronze or stainless steel with 1/8- or 3/16-inch diameter holes and lift-out handle.
2. Female threaded ends for sizes 2 inches and smaller, and flanged ends for sizes 2-1/2 inches and larger.

P. Air-Admittance Valves: ASSE 1051, plastic housing with mechanical-operation sealing diaphragm, designed to admit air into drainage and vent system piping and prevent transmission of sewer gas into building.
1. Fixture Vent Valve: Designed for installation on waste piping (instead of vent connection) for single fixture, in sizes 1-1/4 through 2 inches.
2. Stack Vent Valve: Designed for installation as terminal on soil, waste, and vent stacks (instead of stack vent extending through roof), in sizes 2 through 4 inches.

Q. Stack Flashing Fittings: Counterflashing-type, cast-iron fitting, with bottom recess for termination of roofing membrane, and with threaded or hub top for extension of vent pipe.

R. Vent Caps: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.

S. Vent Terminals: Commercially manufactured, shop-fabricated or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing, as indicated.

T. Roof Flashing Assemblies: Manufactured assembly consisting of 4-psf lead flashing collar with boot and skirt extending at least 8 inches from pipe, with galvanized steel boot reinforcement and counterflashing fitting.
   1. Option 1: Open top.
   2. Option 2: Low-silhouette model with vandal-proof vent cap.
   3. Option 3: Extended model with field-installed, vandal-proof vent cap.

2.9 CLEANOUTS

A. General: Size cleanouts as indicated on drawings, or where not indicated, same size as connected drainage piping. Cleanouts larger than 4 inches are not required except where indicated.

B. Cleanouts: ASME A112.36.2M, cast-iron body with straight threads and gasket seal or taper threads for plug, flashing flange and clamping ring, and a brass closure plug. Cleanouts for installation in floors not having membrane waterproofing may be furnished without clamping ring. See Product Data Sheet at end of Part 3 of this Section for deck plate shape, top-loading classification, access cover, finish, and other specific features.

C. Plastic Cleanouts: Fabricate units of plastic pipe and fittings, with removable threaded plastic closure plug. See Product Data Sheet at end of Part 3 of this Section for separate deck plate, top-loading classification, and finish, when required; for access covers when required; and other specific features.

D. Products: Subject to compliance with requirements, provide one of the products specified in each schedule.

2.10 FLOOR DRAINS

A. General: Size outlets as indicated on schedule.

B. Floor Drains: ASME A112.21.1M, cast-iron body, with seepage flange and clamping device. Floor drains for installation in floors not having membrane waterproofing may have seepage flange without clamping device. Floor drains for use as area drains in exterior slab on grade may be furnished with anchor flange instead of seepage flange and clamping device. See schedule for shape, dimensions, strainer and body top finish, top-loading classification, sump size, and specific features.

C. Trench Drains: ASME A112.21.1M, cast-iron body, with seepage flange and clamping device. Trench drains for installation in floors not having membrane waterproofing may have seepage flange without clamping device. Trench drains for use as area drains in exterior slab on grade may be furnished with anchor flange or other anchoring device instead of seepage flange and clamping device. See schedule for shape, dimensions, grate material, grate and body top finish, top-loading classification, sump size, number of outlets, and specific features.

D. Plastic Floor Drains: ASME A112.21.1M standard design and pattern except material and top-loading classification. See schedule for specific features.

E. Open Drains: Shop- or field-fabricate from ASTM A 74, Service Class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P trap, hub-and-spigot riser section of length to provide depth indicated, and where indicated increaser fitting of size indicated, joined with ASTM C 564 neoprene gaskets. Size P trap as indicated on drawings.

F. Deep Seal Traps: Cast iron or bronze, with inlet and outlet matching connected piping, cleanout where indicated, and trap seal primer valve connection where indicated.
   1. 2-Inch Size: 4-inch-minimum water seal.
   2. 2-1/2 Inches and Larger: 5-inch-minimum water seal.

G. Inlet Fittings: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.

H. Air Gap Fittings: ASME A112.1.2, cast iron or cast bronze, with fixed air gap, inlet for drain pipe or tube, and threaded or spigot outlet.

I. Products: Subject to compliance with requirements, provide one of the products specified in each Plumbing Specialties Product Data Sheet at end of this Section.

2.11 ROOF DRAINS

A. General: Size outlet as indicated on drawings.

B. Roof Drains: ASME A112.21.2M, cast-iron body, with combination flashing ring and gravel stop, cast-iron dome except where other dome material is specified, extension collars, underdeck clamp, and sump receiver. Roof drains for installation in cast-in-place concrete decks may be furnished without underdeck clamp and sump receiver. See schedule for dimensions, sump size, dome material, and specific features.

C. Expansion Joints: ASME A112.21.1M, assembly for roof drain outlet, consisting of cast-iron body, with bronze sleeve, packing gland, and packing, of size and end types corresponding to connected piping.
   1. Size: Same as roof drain outlet when connected to roof drain and same as connected piping when installed in piping.

D. Downspout Boots: ASTM A 48, gray-iron casting, with 4-inch round outlet; shop-applied, bituminous coating; and inlet size indicated.

E. Downspout Nozzles: Cast-bronze body with threaded inlet for pipe size indicated, and cast-bronze wall flange with mounting holes.
   1. Finish: Polished bronze.
   2. Finish: Nickel bronze.

F. Products: Subject to compliance with requirements, provide one of the products specified in schedule.

2.12 INTERCEPTORS

A. General: Units of type, operation, flow rate, storage or retention capacity; with integral or field-installed cleanout on outlet; and other features indicated.

B. Grease Interceptors: PDI G-101, having maximum flow capacity of 100 gallons per minute and grease retention capacity of 200 lb.

C. Arrangement: Interior baffles, removable cover, flow control fitting, and cleanout on outlet.
   1. Material: Cast iron or steel with corrosion-resistant coating.
   2. Material: Plastic.

D. Grease Recovery Units: Features include interior chambers, strainers, baffles, skimming devices, power, and other indicated features. See Product Data Sheet at the end of Part 3 of this Section.

E. Oil Interceptors: Features include baffles, removable basket or strainer, removable cover, flow control fitting, and cleanout on outlet.
   1. Material: Cast iron, steel, or plastic, as indicated.

F. Solids Interceptors: Features include settlement chambers; baffles; removable basket, strainer, screens, or other means of cleaning; and removable cover.
   1. Material: Cast iron, steel, stainless steel, or bronze, as indicated.

G. Products: Subject to compliance with requirements, provide one of the products specified in the schedule.

2.13 SLEEVE PENETRATION SYSTEMS

A. Description: UL 1479, through-penetration firestop assembly consisting of sleeve and stack fitting with firestopping plug.
   1. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on 1 end for installation in cast-in-place concrete slabs.
   2. Stack Fitting: ASTM A 48, cast-iron, hubless-pattern, wye branch stack fitting with neoprene O ring at base and cast-iron plug in thermal-release harness in branch. Include PVC protective cap for plug.
      a. Special Coating: Include corrosion-resistant interior coating on fittings for plastic chemical waste and vent stacks.

2.14 FLASHING MATERIALS

A. Lead: ASTM B 749, Type L51121, copper-bearing sheet, at least 4 psf (0.0625-inch thick) for general use, and at least 6 psf (0.0937-inch thick) for burning (welding), except as otherwise indicated.

B. Elastic Membrane: Nonreinforced flexible, black elastic, sheet, 50 to 65-mils thick and complying with the following:
   1. Shore A Hardness: ASTM D 2240, 50 to 70.
   2. Tensile Strength: ASTM D 412, 1200 psi.
   3. Tear Resistance: ASTM D 624, Die C, 20 lb per linear inch.
   4. Ultimate Elongation: ASTM D 412, 250 percent.
   5. Low-Temperature Brittleness: ASTM D 746, minus 30EF (minus 35EC).
   6. Resistance to Ozone Aging: ASTM D 1149, no cracks for 10 percent elongated sample for 100 hours in 50-mPa ozone at 104EF (70EC).
   7. Resistance to Heat Aging: ASTM D 573, maximum hardness increase of 15 points, elongation reduction of 40 percent, and tensile strength reduction of 30 percent, for 70 hours at 212EF (100EC).

C. Copper: ASTM B 370, sheet, 16 oz. per sq. ft. (0.0216-inch thick) except as otherwise indicated.
   1. General Use: Temper H00 (formerly cold-rolled).
   2. Forming Use: Temper 060 (formerly soft).

D. Zinc-Coated Steel: ASTM A 526, sheet, with 0.20 percent copper, G90 hot-dip galvanized, mill phosphatized where indicated for painting; 0.0359-inch thick (20 gage) except as otherwise indicated.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units as required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, Alloy Sn50.

H. Bituminous Coating: SSPC-12, solvent type, bituminous mastic.

PART 3 – EXECUTION

3.1 INSTALLATION OF WATER METER

A. Install water meter according to utility company's written installation instructions and requirements.

B. Size meter and arrange piping and specialties to comply with utility company's requirements.

C. Set meter on 3000-psi minimum, concrete pad, as indicated.

D. Mount meter on wall brackets or meter yoke, as indicated.

E. Mount remote-registration devices in locations indicated. Drill hole in exterior wall and install connecting wire. Seal hole with single-part, neutral-curing silicone sealant specified in other Sections.

3.2 ROUGHING-IN FOR WATER METER

A. Install roughing-in piping and specialties for water meter installation according to utility company's instructions and requirements.

3.3 PIPING SPECIALTY INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated, at each water supply connection to mechanical equipment and systems, and to other equipment and systems as indicated. Comply with plumbing code and authority having jurisdiction. Locate in same room as equipment being connected. Install air-gap fitting on units having atmospheric vent connection and pipe relief outlet drain to nearest floor drain. Do not install bypass around backflow preventer.

B. Install pressure-regulating valves with inlet and outlet shutoff valves and balance cock bypass. Install pressure gage on valve outlet and install valved bypass where indicated.

C. Install strainers on supply side of each control valve, pressure-regulating valve, and solenoid valve, and where indicated.

D. Install hose bibbs with integral or field-installed vacuum breaker.

E. Install wall hydrants with integral or field-installed vacuum breaker.

F. Install trap seal primer valves with valve outlet piping pitched down toward drain trap a minimum of 1/8 inch per foot (1 percent) and connect to floor drain body, trap, or inlet fitting. Adjust valve for proper flow.

G. Install backwater valves in building drain piping as indicated. For interior installation, provide cleanout deck plate (cover) flush with floor and centered over backwater valve cover and of adequate size to remove valve cover for service.

H. Install expansion joints on vertical risers, stacks, and conductors as indicated.

I. Install cleanouts in above-ground piping and building drain piping as indicated, and where not indicated, according to the following:
   1. Size same as drainage piping up to 4-inch size. Use 4-inch size for larger drainage piping except where larger size 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 4 inches and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil or waste stack.

J. Install cleanout deck plates (covers), of types indicated, with top flush with finished floor, for floor cleanouts for piping below floors.

K. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.

L. Install flashing flange and clamping device with each stack and cleanout passing through floors having waterproof membrane.

M. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to the manufacturer's written instructions.

N. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

3.4 FLOOR DRAIN INSTALLATION

A. Install floor drains according to manufacturer's written instructions, in locations indicated.

B. Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor.

C. Set drain elevation depressed below finished slab elevation as listed below to provide proper floor slope to drain:
   1. 5-Foot Drain Area Radius: 1/2-inch depression.
   2. 10-Foot Drain Area Radius: 3/4-inch depression.
   3. 15-Foot Drain Area Radius: 1-inch depression.
   4. 20-Foot Drain Area Radius: 1-1/4-inch depression.
   5. 25-Foot Drain Area Radius: 1-1/2-inch depression.

D. Trap drains connected to sanitary building drain.

E. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

F. Position drains for easy accessibility and maintenance.

3.5 ROOF DRAIN INSTALLATION

A. Install roof drains at low points of roof areas, according to the roof membrane manufacturer's installation instructions.

B. Install drain flashing collar or flange so no leakage occurs between roof drain and adjoining roofing. Maintain integrity of waterproof membranes, where penetrated.

C. Position roof drains for easy accessibility and maintenance.

3.6 INTERCEPTOR INSTALLATION

A. General: Comply with unit manufacturer's written installation instructions and with local authority for trapping and venting.

B. Install units with clear space for servicing.

C. Install waste piping, flow control fitting, vent piping, and accessories as indicated.
   1. Install control panel for grease recovery unit as indicated.

D. Above-Floor Installation: Set unit with bottom resting on floor, except where otherwise indicated.

E. Flush with Floor Installation: Set unit and extension when required, with cover flush with finished floor.

F. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.

G. Pit Installation: Set unit in pit, as indicated.

H. Install cleanout immediately downstream of interceptor units not having integral cleanout on outlet.

3.7 CONNECTIONS

A. Supply Runouts to Fixtures: Install hot- and cold-water supply piping runouts to fixtures of sizes indicated, but not smaller than required by plumbing code.

B. Drainage Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated, but not smaller than required by plumbing code.

C. Locate drainage piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

D. Interceptor Connections: Connect piping, flow control fittings, and accessories as indicated.
   1. Grease Interceptors: Connect inlet and outlet to unit, and flow control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff type unit.
   2. Grease Recovery Units: Connect inlet, outlet, and vent piping; controls; electric power; and factory-furnished accessories.

3. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow control fitting and vent on unit inlet piping; and gravity drawoff and suction piping to oil storage tank.
4. Solids Interceptors: Connect inlet and outlet.

E. Electrical Connections: Power wiring and disconnect switches are specified in Division 26.
1. Grounding: Connect unit components to ground according to the National Electrical Code and Division 26.

3.8 FLASHING INSTALLATION

A. Provide flashing manufactured in a single piece except where large pans, sumps, or other drainage shapes are required.

B. Install 4-psf lead flashing or 16-oz.-per sq. ft. copper, except when another weight or material is specified.

C. Install 6-psf lead flashing or heavier where burning (welding) of lead sheets is required.

D. Solder joints of copper sheets where required.

E. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with membrane waterproofing.
1. Pipe Flashing: Sleeve type, matching pipe size, with minimum sleeve 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.

F. Set flashing on floors and roofs in solid coating of bituminous cement.

G. Secure flashing into sleeve and specialty clamping ring or device.

H. Install flashing for piping passing through roofs with counter flashing or commercially made flashing fittings, according to Division 7 Section “Flashing and Sheet Metal.”

I. Extend flashing up vent pipe passing through roofs and turn down into pipe or secure flashing into cast-iron sleeve having calking recess.

J. Fabricate and install lead sheet flashing and pans, sumps, and other drainage shapes as indicated. Install drain connection when indicated.

K. Fabricate and install copper sheet flashing and pans, sumps, and other drainage shapes as indicated. Install drain connection when indicated.

L. Fabricate and install galvanized-steel sheet flashing and pans, sumps, and other drainage shapes as indicated. Install drain connection when indicated.

M. Fabricate and install elastic-membrane sheet flashing and pans, sumps, and other drainage shapes as indicated. Install drain connection when indicated.

3.9 COMMISSIONING

A. Preparation: Perform the following checks before start-up:

1. Systems tests are complete.
2. Damaged and defective specialties and accessories have been replaced or repaired.
3. There is clear space for servicing of specialties.

B. Before operating systems, perform these steps:
1. Close drain valves, hydrants, and hose bibbs.
2. Open valves to full open position.
3. Remove and clean strainers.
4. Verify drainage and vent piping are clear of obstructions. Flush with water until clear.

C. Starting Procedures: Follow manufacturer's written procedures. If no procedures are prescribed by manufacturer, proceed as follows:
1. Energize circuits for grease recovery units. Start and run units through complete sequence of operations.

3.10 ADJUSTING

A. Adjust operation and correct deficiencies discovered during commissioning.

3.11 DEMONSTRATION

A. Train Owner's maintenance personnel on procedures related to startup and servicing of interceptors.

3.12 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day or when work stops.

END OF SECTION

233100-HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Duct Materials.
2. Insulated flexible ducts.
3. Single wall spiral round ducts.
4. Casings.
5. Ductwork fabrication.
6. Duct cleaning.

B. Related Sections:
1. Section 09 91 00 - Painting and Coating: Execution requirements for Weld priming, weather resistant, paint or coating specified by this section.
2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers, supports and sleeves for placement by this section.
3. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.

1.2 REFERENCES

A. ASTM International:
1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A90/A90M - Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
3. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
4. ASTM A568/A568M - Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
5. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
6. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. A1011/A1011M-07 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
8. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
9. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
10. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. National Fire Protection Association:
   1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
   2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
   3. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

C. Sheet Metal and Air Conditioning Contractors:
   1. SMACNA - Fibrous Glass Duct Construction Standards.
   2. SMACNA - HVAC Air Duct Leakage Test Manual.
   3. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

D. Underwriters Laboratories Inc.:
   1. UL 181 - Factory-Made Air Ducts and Connectors.

1.3 PERFORMANCE REQUIREMENTS

A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Submit duct fabrication drawings, drawn to scale not smaller than inch equals 1 foot, on drawing sheets same size as Contract Documents, indicating:
   1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
   2. Duct layout, indicating pressure classifications and sizes in plan view. For exhaust duct systems, indicate classification of materials handled as defined in this section.
   3. Fittings.
   4. Reinforcing details and spacing.
   5. Seam and joint construction details.
   6. Penetrations through fire rated and other walls.
   7. Terminal unit, coil, and humidifier installations.
   8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

C. Product Data: Submit data for duct materials.

D. Manufacturer's Installation Instructions: Submit special procedures for glass fiber ducts.

E. Manufacturer's Certificate: Certify installation of glass fiber ductwork meet or exceed specified requirements recommended fabrication and installation requirements...

1.5 CLOSEOUT SUBMITTALS

A. Section 01 77 00 and 01 78 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.

B. Construct ductwork to NFPA 90A and NFPA 90B standards.

C. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.8 PRE-INSTALLATION MEETINGS

A. Section 01 31 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.

C. Maintain temperatures during and after installation of duct sealant.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 WARRANTY

A. Section 01 77 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.1 DUCT MATERIALS

A. Galvanized Steel Ducts: ASTM A653/A653M galvanized steel sheet, lock-forming quality, having G90 zinc coating of in conformance with ASTM A90/A90M.

B. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength.

C. Fasteners: Rivets, bolts, or sheet metal screws.

D. Hanger Rod: ASTM A36/A36M; steel; threaded both ends, threaded one end, or continuously threaded.

2.2 SINGLE WALL SPIRAL ROUND DUCTS

A. Product Description: UL 181, Class 1, round spiral lockseam duct constructed of galvanized steel.

B. Duct Coating: Polyvinyl chloride plastic, 4 mil thick on outside and 2 mil thick on inside. Both sides. Temperature range: minus 30 degrees F to 200 degrees F.

C. Construct duct with the following minimum gages:

Diameter	Gauge
3 inches to 14 inches	26
15 inches to 26 inches	24
28 inches to 36 inches	22
38 inches to 50 inches	20
52 inches to 84 inches	18

D. Construct fittings with the following minimum gages:

Diameter	Gauge
3 inches to 14 inches	24
15 inches to 26 inches	22
28 inches to 36 inches	20
38 inches to 50 inches	20
52 inches to 60 inches	18
62 inches to 84 inches	16

2.3 CASINGS

A. Fabricate casings in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and construct for operating pressures indicated.

B. Reinforce access door frames with steel angles tied to horizontal and vertical plenum supporting angles. Furnish hinged access doors where indicated or required for access to equipment for cleaning and inspection. Furnish clear wire glass observation ports, minimum 6 x 6 inch size.

C. Fabricate acoustic casings with reinforcing turned inward. Furnish 16 gage back facing and 22 gage perforated front facing with 3/32 inch diameter holes on 5/32 inch centers. Construct panels 3 inches thick packed with 4.5 lb. /cu ft minimum glass fiber media, on inverted channels of 16 gage.

2.4 DUCTWORK FABRICATION

A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and as indicated on Drawings. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Fabricate and support round ducts with longitudinal seams in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible (Round Duct Construction Standards), and as indicated on Drawings. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

C. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide airfoil turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

E. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

F. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.

G. Seal joints between duct sections and duct seams with welds, gaskets, mastic adhesives, mastic plus embedded fabric systems, or tape.
   1. Sealants, Mastics and Tapes: Conform to UL 181A. Provide products bearing appropriate UL 181A markings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 31 00 - Administrative Requirements: Coordination and project conditions.

B. Verify sizes of equipment connections before fabricating transitions.

3.2 INSTALLATION

A. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Install glass fiber ducts in accordance with SMACNA Fibrous Glass Duct Construction Standards. Obtain manufacturer's inspection and acceptance of fabrication and installation at beginning of installation.

C. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

D. Use crimp joints with or without bead or beaded sleeve couplings for joining round duct sizes 8 inch and smaller.

E. Install duct hangers and supports in accordance with Section 23 05 29.

F. Use double nuts and lock washers on threaded rod supports.

G. Slope underground ducts to plenums or low pump out points at 1: 500. Install access doors for inspection.

H. Connect flexible ducts to metal ducts with adhesive. Liquid adhesive plus tape. draw bands.

I. Set plenum doors 6 to 12 inches above floor. Arrange door swing so fan static pressure holds door in closed position.

J. Casings: Install floor mounted casings on 4 inch high concrete curbs. Refer to Section 03 30 00. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, furnish liner of 18 gage galvanized expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.

K. For outdoor ductwork, protect ductwork, ductwork supports, linings and coverings from weather.

L. Exhaust Outlet Locations:
   1. Minimum Distance from Property Lines: 3 feet.
   2. Minimum Distance from Building Openings: 3 feet.
   3. Minimum Distance from Outside Air Intakes: 10 feet,

3.3 INTERFACE WITH OTHER PRODUCTS

A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with

spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.

B. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

C. Connect air terminal units air outlets and inlets to supply ducts directly or with five foot maximum length of flexible duct. Do not use flexible duct to change direction.

3.4 CONCEALED GREASE DUCT TESTING

A. Prior to concealing, wrapping, or insulating grease ductwork, or placing grease duct in service, perform leakage test in accordance with ICC IMC, in presence of authority having jurisdiction.

B. Perform light test by pulling minimum 100 W light through duct and observing for light leaks at duct joints.

C. Test complete extent of duct installed, including joint at which duct connects to exhaust hood.

3.5 CLEANING

A. Section 01 77 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air flow, clean one half of system completely before proceeding to other half. Protect equipment with potential to be harmed by excessive dirt with temporary filters, or bypass during cleaning.

C. Clean duct systems with high power vacuum machines. Protect equipment with potential to be harmed by excessive dirt with filters, or bypass during cleaning. Install access openings into ductwork for cleaning purposes.

3.6 TESTING

A. For ductwork designed for 3 inches w.c. above ambient, pressure test minimum 25 percent of ductwork after duct cleaning, but before duct insulation is applied or ductwork is concealed.
   1. Test in accordance with SMACNA HVAC Air Duct Leakage Test Manual.
   2. Maximum Allowable Leakage: In accordance with ICC IECC.

3.7 SCHEDULES

A. Ductwork Material Schedule:

AIR SYSTEM	MATERIAL
Supply (Heating Systems)	Steel, Aluminum, Fibrous Glass
Supply (System with Cooling Coils)	Steel, Aluminum, Fibrous Glass

Buried Supply or Return	Steel, PVC Coated Steel, Concrete, Glass Fiber Reinforced Plastic
Return and Relief	Steel, Aluminum
General Exhaust	Steel, Aluminum
Kitchen Hood Exhaust	Steel, Stainless Steel
Dishwasher Exhaust	Steel, Stainless Steel, Glass Fiber Reinforced Plastic
Fume Hood Exhaust	Stainless Steel, Glass Fiber Reinforced Plastic
Outside Air Intake	Steel
Combustion Air	Steel
Evaporative Condenser	Steel
Intake and Exhaust	
Emergency Generation Ventilation	Steel

B. Ductwork Pressure Class Schedule:

AIR SYSTEM	PRESSURE CLASS
Constant Volume Supply	3 inch wg
Variable Volume-Variable Temperature Supply	1 inch wg
Variable Air Volume Supply (downstream of VAV boxes)	1 inch wg
Variable Air Volume Supply (upstream of VAV boxes)	1 inch wg
Supply (Heating Systems)	1 inch wg
Supply (System with Cooling Coils)	2 inch wg
Return and Relief	1/2 inch wg
General Exhaust	1 inch wg
Dishwasher Exhaust	1 inch wg
Fume Hood Exhaust	2 inch wg
Emergency Generation Ventilation	1/2 inch wg

END OF SECTION

SECTION 221316 – DRAINAGE AND VENT SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes drainage and vent piping systems to a point 5 feet outside the building. Systems include the following:
   1. Sanitary and storm drainage and vent systems.

1.2 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working pressure ratings, except where indicated otherwise:
   1. Soil, Waste, and Vent Systems: 10-foot head of water.
   2. Storm Drainage Systems: 10-foot head of water.
   3. Sanitary Sewage, Pumped Piping Systems: 75 psig.
   4. Storm Sewage, Pumped Piping Systems: 75 psig.

1.3 SUBMITTALS

A. Coordination drawings, drawn accurately to scale and coordinating penetrations.

1.4 QUALITY ASSURANCE

A. Comply with the provisions of ASME B31.9 “Building Services Piping” for materials, products, and installation.

B. Provide listing/approval stamp, label, or other marking on piping made to specified standards.

PART 2 – PRODUCTS

2.1 PIPES AND TUBES

A. General: The application of the following pipe, tube, and fitting materials and joining methods required for plumbing piping systems are indicated in Part 3 Article “Pipe and Fittings Applications.”

B. Hard Copper Tube: ASTM B 88, Types L, water tube, drawn temper.

C. Soft Copper Tube: ASTM B 88, Types K, water tube, annealed temper.

D. Copper Drainage Tube: ASTM B 306, Type DWV, drawn temper.

E. Steel Pipe: ASTM A 53, Type S, Grade A, Schedule 40, seamless, galvanized, plain ends.
   1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53 or ASTM A 106, Schedule 40, seamless, galvanized, carbon-steel pipe.

F. Ductile-Iron Pipe: AWWA C151, Classes 50 and 51, mechanical joint and push-on joint.

G. Flanged Ductile-Iron Pipe: AWWA C115, ductile-iron barrel, Class 150 or 300 iron-alloy threaded flanges.

H. Hub and Spigot, Cast-Iron Soil Pipe: ASTM A 74, Service Class.

I. Hubless, Cast-Iron Soil Pipe: CISPI 301.

J. Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe: ASTM D 2661, Schedule 40, plain ends.

K. Acrylonitrile-Butadiene-Styrene (ABS) Cellular Core, Plastic Pipe: ASTM F 628, Schedule 40, plain ends.

L. Poly(Vinyl Chloride) (PVC) Plastic, DWV Pipe: ASTM D 2665, Schedule 40, plain ends.

M. Poly(Vinyl Chloride) (PVC) Cellular Core, Nonpressure, Plastic Pipe: ASTM F 891, Schedule 40, plain ends.

2.2 PIPE FITTINGS AND TUBE FITTINGS

A. Wrought-Copper, Solder-Joint Pressure Fittings: ASME B16.22.

B. Cast-Copper-Alloy, Solder-Joint Pressure Fittings: ASME B16.18.

C. Wrought-Copper, Solder-Joint, Drainage Fittings: ASME B16.29.

D. Cast-Copper-Alloy, Solder-Joint, Drainage Fittings: ASME B16.23.

E. Bronze Flanges: ASME B16.24, Class 150.
   1. Threaded Ends: Threads conforming to ASME B1.20.1.

F. Malleable-Iron Unions: ASME B16.39, Classes 150 and 300, hexagonal stock, with ball-and-socket joint, metal-to-metal bronze seating surfaces, and female threaded ends having threads conforming to ASME B1.20.1.

G. Galvanized, Cast-Iron Threaded Fittings: ASME B16.4, Classes 125 and 250, standard pattern, with threads conforming to ASME B1.20.1.

H. Galvanized, Cast-Iron Threaded Drainage Fittings: ASME B16.12, recessed drainage pattern, with threads conforming to ASME B1.20.1.

I. Cast-Iron Threaded Flanges: ASME B16.1, Classes 125 and 300.

J. Ductile-Iron and Gray-Iron Gasketed Fittings: AWWA C110 standard pattern or ductile-iron AWWA C153 compact pattern, 250 psig minimum pressure rating, with AWWA C104 cement-mortar lining and AWWA C111 rubber gaskets.

K. Ductile-Iron and Gray-Iron Flanged Fittings: AWWA C110, 250-psig minimum pressure rating, with AWWA C104 cement-mortar lining.

L. Ductile-Iron, Flexible Expansion Joints: Compound fitting with combination of flanged and mechanical-joint ends conforming to AWWA C110 or AWWA C153. Units have 2 gasketed ball-joint sections and 1 or more gasketed sleeve sections, rated for 250 psig minimum working pressure and with FDA-approved epoxy interior coating, for offset and expansion indicated.

M. Ductile-Iron Deflection Fittings: Compound coupling fitting with sleeve and flexing sections, gaskets, and restrained-joint ends conforming to AWWA C110 or AWWA C153. Units rated for 250

psig minimum working pressure, and with cement lining or FDA-approved epoxy interior coating, for up to 20-degrees deflection.

N. Ductile-Iron Expansion Joints: 3-piece assembly consisting of telescoping sleeve with gaskets and restrained-type, ductile-iron bell and spigot end sections conforming to AWWA C110 or AWWA C153. Units rated for 250 psig minimum working pressure, and with cement lining or FDA-approved epoxy interior coating, for expansion indicated.

O. Polyethylene Encasement: AWWA C105, 8-mil minimum thickness, tube or sheet.

P. Steel Expansion Joints: Compound galvanized steel pipe fitting consisting of telescoping body and slip-pipe sections, packing ring, packing, limit rods, flanged ends, and chrome-plated finish on slip pipe telescoping section.
   1. Pressure Rating: 150 psig minimum.

Q. Hub and Spigot, Cast-Iron Soil Pipe Fittings: ASTM A 74, Service Class.

R. Hubless, Cast-Iron Soil Pipe Fittings: CISPI 301.

S. Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings: ASTM D 2661, made to ASTM D 3311, socket-type, drain, waste, and vent pipe patterns.

T. Acrylonitrile-Butadiene-Styrene (ABS) Plastic Tubular Fittings: ASTM F 409, accessible and replaceable, solvent-cement and threaded types, drain pattern.

U. Poly(Vinyl Chloride) (PVC) Plastic, DWV Pipe Fittings: ASTM D 2665, made to ASTM D 3311; socket-type; drain, waste, and vent pipe patterns.

V. Poly(Vinyl Chloride) (PVC) Plastic Tubular Fittings: ASTM F 409, accessible and replaceable, solvent-cement and threaded types, drain pattern.

W. Poly(Vinyl Chloride) (PVC) Plastic, Threaded Pipe Fittings: ASTM D 2464, Schedule 80.

X. Poly(Vinyl Chloride) (PVC) Plastic, Schedule 40, Socket-Type Pipe Fittings: ASTM D 2466.

Y. Poly(Vinyl Chloride) (PVC) Plastic, Schedule 80, Socket-Type Pipe Fittings: ASTM D 2467.

2.3 JOINING MATERIALS

A. Solder, brazing, and welding filler metals are specified in other Sections.

B. Cast-Iron Soil Pipe and Fittings: ASTM C 564 neoprene rubber gaskets and lubricant.

C. Ductile-Iron Pipe and Ductile-Iron or Cast-Iron Fittings: The following materials apply:
   1. Push-On Joints: AWWA C111 rubber gaskets and lubricant.
   2. Mechanical Joints: AWWA C111 ductile-iron or gray-iron glands, high-strength steel bolts and nuts, and rubber gaskets.
   3. Flanged Joints: AWWA C115 ductile-iron or gray-iron pipe flanges, rubber gaskets, and high-strength steel bolts and nuts.

D. CISPI Couplings for Hubless Cast-Iron Soil Pipe and Fittings: CISPI 310, having ASTM C 564 neoprene sealing sleeve, with 300 Series stainless-steel corrugated shield-and-clamp assembly.

2.4 VALVES

A. Valves are specified in other Sections.

PART 3 – EXECUTION

3.1 EXCAVATION

A. Excavation, trenching, and backfilling are specified in other Sections.

3.2 PREPARATION OF FOUNDATION FOR BURIED PIPING

A. Grade trench bottom to provide smooth, firm, stable, and rock-free foundation throughout length of piping.

B. Remove unstable, soft, and unsuitable materials at surface on which piping is to be laid and backfill with clean sand or pea gravel to indicated level.

C. Shape bottom of trench to fit bottom of piping. Fill unevenness with tamped-sand backfill. Dig bell holes at each pipe joint to relieve bells of loads and to ensure continuous bearing of pipe barrel on foundation.

3.3 PIPE AND FITTINGS APPLICATIONS

A. General: Use pipe, tube, fittings, and joining methods for piping systems according to the following applications.

B. Soil, Waste, and Vent Piping Below Ground: Use the following:
   1. All: Hub-and-spigot cast-iron soil pipe, hub-and-spigot cast-iron soil pipe fittings, neoprene rubber gaskets, and compression joints.

C. Soil, Waste, and Vent Piping Above Ground: Use the following:
   1. All: Hubless cast-iron soil pipe, hubless cast-iron soil pipe fittings, CISPI-type couplings for hubless cast-iron soil pipe and fittings, and hubless joints.
   2. Acrylonitrile-butadiene-styrene (ABS) plastic pipe; ABS socket-type drain, waste, and vent pipe pattern fittings; and solvent-cemented joints.
   3. Poly(vinyl chloride) (PVC) plastic DWV pipe; PVC socket-type drain, waste, and vent pipe pattern fittings in 5- and 6-inch sizes; PVC socket-type Schedule 40 fittings in 8-inch and larger sizes; and solvent-cemented joints.
   4. 1-1/4 to 4 Inches: Copper drainage tube, wrought-copper or cast-copper-alloy drainage fittings, and soldered joints with Alloy E solder.

D. Storm Drainage Piping Below Ground: Use the following:
   1. All: Hub-and-spigot cast-iron soil pipe, hub-and-spigot cast-iron soil pipe fittings, neoprene rubber gaskets, and compression joints.

E. Storm Drainage Piping Above Ground: Use the following:
   1. All: Hubless cast-iron soil pipe, hubless cast-iron soil pipe fittings, CISPI-type couplings for hubless cast-iron soil pipe and fittings, and hubless joints.
   2. Acrylonitrile-butadiene-styrene (ABS) plastic pipe; ABS socket-type drain, waste, and vent pipe pattern fittings; and solvent-cemented joints.

3. Poly(vinyl chloride) (PVC) plastic DWV pipe; PVC socket-type drain, waste, and vent pipe pattern fittings in 5- and 6-inch sizes; PVC socket-type Schedule 40 fittings in 8-inch and larger sizes; and solvent-cemented joints.

F. Sewage Force Mains Underground: Use the following:
1. 4 to 12 Inches: Ductile-iron pipe, ductile-iron or gray-iron fittings, rubber gaskets, and push-on or mechanical joints.
2. 4 to 12 Inches: Ductile-iron pipe, ductile-iron compact fittings, rubber gaskets, and push-on or mechanical joints.
3. 3 Inches and Smaller: Soft copper tube, Type K, cast-copper-alloy solder-joint pressure fittings and soldered joints with Alloy Sn95 solder.

G. Sewage Force Mains Above Ground: Use the following:
1. 4 to 12 Inches: Steel pipe; galvanized, cast-iron threaded fittings; cast-iron threaded flanges; galvanized, flanged steel expansion joints; malleable-iron unions; and threaded or flanged joints.
2. 4 to 12 Inches: Flanged ductile-iron pipe, flanged ductile-iron or gray-iron fittings, and flanged joints.
3. 4 Inches and Smaller: Hard copper tube, Type L; wrought-copper or cast-copper-alloy pressure fittings; copper unions; bronze flanges; and solder joints with Alloy Sn95 solder.

3.4 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use gate, ball, or butterfly valves.
2. Throttling Duty: Use globe, ball, or butterfly valves.

3.5 PIPING INSTALLATION, GENERAL

A. Basic piping installation requirements are specified in other Sections.

3.6 SERVICE ENTRANCE PIPING

A. Extend building sanitary drain piping and connect to sanitary sewer piping of size and in location indicated for service entrance to building. Install cleanout and extension to grade at connection of building sanitary drain and building sanitary sewer. Sanitary sewerage piping is specified in other Sections.

B. Extend building sanitary drainage force main piping and connect to sanitary sewer piping of size and in location indicated for service entrance to building. Install cleanout (fitting with closure plug or equivalent) inside building. Sanitary sewerage piping is specified in other Sections.
1. Ductile-Iron Force Main: Comply with AWWA C600. Install buried pipe inside building between wall and floor penetrations, and point 5 feet outside building, with restrained joints, including anchoring pipe to wall or floor. Provide supports (thrust blocks) at vertical and horizontal offsets.
   a. Wrap pipe with polyethylene encasement.

C. Extend building storm drain piping and connect to building storm sewer piping of size and in location indicated for service entrance to building. Install cleanout and extension to grade at connection of building storm drain and building storm sewer. Storm sewerage piping is specified in other Sections.

D. Extend building storm drainage force main piping and connect to storm sewer piping of size and in location indicated for service entrance to building. Install cleanout (fitting with closure plug or equivalent) inside building. Storm sewerage piping is specified in other Sections.

1. Ductile-Iron Force Main: Comply with AWWA C600. Install buried pipe inside building between wall and floor penetrations, and point 5 feet outside building, with restrained joints, including anchoring pipe to wall or floor. Provide supports (thrust blocks) at vertical and horizontal offsets.

a. Wrap pipe with polyethylene encasement.

E. Install sleeve and mechanical sleeve seal at service penetrations through foundation wall for watertight installation.

3.7 DRAINAGE AND VENT PIPING INSTALLATION

A. Install cast-iron soil pipe and cast-iron soil pipe fittings according to CISPI 1990 revised and edited edition of "Cast Iron Soil Pipe and Fittings Handbook, Volume I," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

B. Make changes in direction for drainage and vent piping using appropriate Y branches, Y branches with 1/8 bends, and long-sweep 1/4, 1/5, 1/6, 1/8, and 1/16 bends. Sanitary tees and short-sweep quarter bends may be used on vertical stacks of drainage lines where change in direction of flow is from horizontal to vertical. Use long-turn double-Y-branch and 1/8-bend fittings where 2 fixtures are installed back to back or side by side and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. Make no change in direction of flow greater than 90 degrees. Where different sizes of drainage pipes and fittings are connected, use proper size standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.

C. Lay buried building drains beginning at low point of each system, true to grades and alignment indicated, with unbroken continuity of invert. Place hub or bell ends of piping facing upstream. Install required gaskets according to manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in piping and pull past each joint as completed.

D. Install drainage and vent piping at the following minimum slopes, except where another slope is indicated:

1. Sanitary Building Drain: 1/4 inch per foot (2 percent) for piping 3 inches and smaller; 1/8 inch per foot (1 percent) for piping 4 inches and larger.
2. Horizontal Sanitary Drainage Piping: 1/4 inch per foot (2 percent).
3. Storm Building Drain: 1/8 inch per foot (1 percent).
4. Horizontal Storm Drainage Piping: 1/4 inch per foot (2 percent).
5. Vent Piping: 1/8 inch per foot (1 percent).

E. Install force mains at elevations indicated.

F. Install underground plastic drainage piping according to ASTM D 2321.

G. Sleeves are not required for cast-iron soil pipes passing through concrete slab, without membrane waterproofing, on grade.

H. Install ABS drainage pipe and fittings according to ASTM D 2661.

I. Install PVC drainage pipe and fittings according to ASTM D 2665.

3.8 JOINT CONSTRUCTION

A. Basic piping joint construction is specified in other Sections

B. Cast-Iron Soil Pipe and Cast-Iron Soil Pipe Fitting Joints: Make joints according to recommendations in CISPI 1990 revised and edited edition of "Cast Iron Soil Pipe and Fittings Handbook, Volume I," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
   1. Compression Joint: Make with neoprene gasket matching class of pipe and fittings.
   2. Hubless Joint: Make with neoprene gasket and sleeve or clamp.

C. ABS DWV Pipe: Join ABS drainage pipe and fittings according to ASTM D 2661.

D. PVC DWV Pipe: Join PVC drainage pipe and fittings according to ASTM D 2665.

E. ABS to PVC Transition Joints: Make nonpressure transition joint between ABS and PVC drainage components, using fittings, solvent cements, and procedure conforming to ASTM D 3138.

F. Handling of Solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F 402 for safe handling during joining of plastic pipe and fittings with solvent cements.

3.9 INSTALLATION OF VALVES

A. Install valves for duty indicated, where indicated.

B. Shutoff Valves: For shutoff valves 2 inches and smaller, use gate or ball valves; for shutoff valves 2-1/2 inches and larger, use gate or butterfly valves.

C. Drain Valves: Install drain valves on each plumbing equipment item located to drain equipment for service and repair.

D. Check Valves: Install swing check valve on discharge side of each pump and elsewhere as indicated. Use MSS SP-80, Class 125, cast-bronze body for 2-inch and smaller piping and MSS SP-71, Class 125, cast-iron body for 2-1/2-inch and larger piping.

3.10 HANGERS AND SUPPORTS INSTALLATION

A. Hanger and support devices are specified in other Sections

3.11 CONNECTIONS

A. Drainage Runouts to Fixtures: Provide drainage and vent piping runouts, with approved trap, of sizes indicated, but not smaller than required by plumbing code, to plumbing fixtures and drains.

B. Locate drainage piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

C. Mechanical Equipment Connections: Install drain valve and union on each equipment drain connection. Use flanges instead of unions for connections 2-1/2 inches and larger.

3.12 FIELD QUALITY CONTROL

A. Inspect drainage piping as follows:

1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.
2. During progress of installation, notify the plumbing official having jurisdiction at least 24 hours prior to time such inspection must be made. Perform tests specified below in presence of the plumbing official.
   a. Roughing-In Inspection: Arrange for inspection of piping system after system roughing-in, before concealing, and prior to setting fixtures.
   b. Final Inspection: Arrange for final inspection by plumbing official to observe tests specified below and to ensure compliance with requirements of plumbing code.
3. Reinspections: Make required corrections and arrange for reinspection by plumbing official when piping system fails to pass test or inspection.
4. Reports: Prepare inspection reports signed by the plumbing official.

B. Drainage and Vent Piping System Tests: Test drainage and vent systems according to procedures of authority having jurisdiction or, in absence of published procedure, as follows:
1. Test for leaks and defects in new drainage and vent piping systems and parts of existing systems that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
2. Leave uncovered and unconcealed in new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose for testing work that has been covered or concealed before it has been tested and approved.
3. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open-jointed drain tile, test piping of plumbing drainage and venting systems on completion of roughing-in piping installation. Tightly close all openings in piping system and fill with water to point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before inspection starts through completion of inspection. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and their traps filled with water, test connections and prove gastight and watertight. Plug stack openings on roof and building drain where it leaves the building and introduce air into the system equal to pressure of 1-inch water column. Use a U tube or manometer inserted in the trap of a water closet to measure this pressure. Air pressure shall remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.13 CLEANING

A. Clean interior of piping system. Remove dirt and debris as work progresses.

3.14 COMMISSIONING

A. Check plumbing equipment and verify proper settings, adjustments, and operation.

B. Check plumbing specialties and verify proper settings, adjustments, and operation.

C. Energize pumps and verify proper operation.

3.15 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day or when work stops.

C. Exposed ABS or PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of a water-based latex paint.

END OF SECTION

SECTION 223300 – ELECTRIC WATER HEATERS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes electric water heaters and accessories.

1.2 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract.

B. Product Data including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties, and accessories. Indicate dimensions, finishes and coatings, required clearances, methods of assembly of components, and piping and wiring connections.

C. Shop Drawings showing layout of each unit, including tanks, pumps, controls, related accessories, and piping.

D. Setting Drawings with templates and directions for installing foundation bolts, anchor bolts, and other anchorages.

E. Wiring diagrams from manufacturers detailing electrical requirements for electrical power supply wiring to water heaters. Include ladder-type wiring diagrams for interlock and control wiring required for final installation of water heaters and controls. Differentiate between factory-installed and field-installed wiring.

F. Product certificates signed by manufacturers of water heaters certifying that their products comply with specified requirements.

G. Certificates of shop inspection and data report as required by provisions of ASME Boiler and Pressure Vessel Code, when ASME construction is indicated.

H. Field quality-control installation reports.

I. Maintenance data for water heaters to include in operation and maintenance. Include startup instructions.

1.3 QUALITY ASSURANCE

A. ASHRAE Standard: Comply with performance efficiencies prescribed in ASHRAE 90.1, “Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.”

B. ASHRAE Standard: Comply with performance efficiencies prescribed in ASHRAE 90.2, “Energy Efficient Design of New Low-Rise Residential Buildings.”

C. NFPA Standard: Comply with NFPA 70, “National Electrical Code,” for electrical components.

D. Listing and Labeling: Provide electrically operated water heaters, controls, and components specified in this Section that are listed and labeled.

1. The Terms “Listed” and “Labeled”: As defined in National Electrical Code, Article 100.

E. Product Options: Drawings indicate size, profiles, connections, dimensional requirements, and characteristics of water heaters and accessories and are based on specific types and models indicated. Other manufacturers' water heaters and accessories with equal performance characteristics may be considered.

1.4 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.

B. Special Warranty: Submit a written warranty executed by manufacturer agreeing to repair or replace water heaters and accessories that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, tanks and elements. This warranty is in addition to, and not a limitation of, other rights Owner may have against Contractor under Contract Documents.

C. Warranty Period: 5 years after date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

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

B. Household, Storage, Electric Water Heaters:
   a. Bradford White Corp.
   b. Lochinvar Corp.
   c. Patterson-Kelley Co.
   d. Rheem Mfg. Co.; Rheem Water Heater Div.
   e. Rheem Mfg. Co.; Ruud Water Heater Div.
   f. Smith: A.O. Smith Water Products Co.
   g. State Industries, Inc.
   2. Household, Air-to-Water, Heat-Pump, Storage, Electric Water Heaters:
      a. Crispaire Corp.
      b. DEC International, Inc.; Therma-Stor Products Group.
      c. Energy Utilization Systems.
      d. State Industries, Inc.
   3. Household, Water-to-Water, Heat-Pump, Storage, Electric Water Heaters:
      a. Crispaire Corp.
      b. Heat Controller, Inc.
   4. Household, Point-of-Use, Storage, Electric Water Heaters:
      a. Bradford White Corp.
      b. Lochinvar Corp.
      c. Rheem Mfg. Co.; Rheem Water Heater Div.
      d. Rheem Mfg. Co.; Ruud Water Heater Div.
      e. Smith: A.O. Smith Water Products Co.
      f. State Industries, Inc.
   5. Household, Point-of-Use, Small-Capacity, Electric Water Heaters:

a. Bradford White Corp.
b. Lochinvar Corp.
c. Rheem Mfg. Co.; Rheem Water Heater Div.
d. Rheem Mfg. Co.; Ruud Water Heater Div.
e. Smith: A.O. Smith Water Products Co.
f. State Industries, Inc.

6. Point-of-Use, Tankless, Electric Water Heaters:
   a. Chronomite Laboratories, Inc.
   b. Eemax, Inc.
   c. Niagara Industries.
   d. PVI Industries, Inc.
7. Commercial, Point-of-Use, Small-Capacity, Electric Water Heaters:
   a. Lochinvar Corp.
   b. Rheem Mfg. Co.; Rheem Water Heater Div.
   c. Rheem Mfg. Co.; Ruud Water Heater Div.
   d. State Industries, Inc.
8. Commercial, Point-of-Use, Storage, Electric Water Heaters:
   a. Lochinvar Corp.
   b. Rheem Mfg. Co.; Rheem Water Heater Div.
   c. Rheem Mfg. Co.; Ruud Water Heater Div.
   d. Smith: A.O. Smith Water Products Co.
   e. State Industries, Inc.
9. Light-Commercial, Storage, Electric Water Heaters:
   a. Bradford White Corp.
   b. Lochinvar Corp.
   c. Patterson-Kelley Co.
   d. Rheem Mfg. Co.; Rheem Water Heater Div.
   e. Rheem Mfg. Co.; Ruud Water Heater Div.
   f. Smith: A.O. Smith Water Products Co.
10. Commercial, Air-to-Water, Heat-Pump, Storage, Electric Water Heaters:
    a. Crispaire Corp.
    b. DEC International, Inc.; Therma-Stor Products Group.
    c. Energy Utilization Systems.
11. Commercial, Water-to-Water, Heat-Pump, Storage, Electric Water Heaters:
    a. Crispaire Corp.
    b. Heat Controller, Inc.
12. Commercial, Storage, Electric Water Heaters:
    a. Bradford White Corp.
    b. Lochinvar Corp.
    c. Patterson-Kelley Co.
    d. PVI Industries, Inc.
    e. Rheem Mfg. Co.; Rheem Water Heater Div.
    f. Rheem Mfg. Co.; Ruud Water Heater Div.
    g. Smith: A.O. Smith Water Products Co.
    h. State Industries, Inc.
13. Commercial, Electric Booster Heaters:

a. Bradford White Corp.
b. Lochinvar Corp.
c. Rheem Mfg. Co.; Rheem Water Heater Div.
d. Rheem Mfg. Co.; Ruud Water Heater Div.
e. Smith: A.O. Smith Water Products Co.

2.2 WATER HEATERS, GENERAL

A. Specified manufacturer's standard components and features are acceptable where specific product requirements are not indicated.

B. Temperature Control: Adjustable thermostat, except for units where other arrangement is indicated or temperature is regulated by flow-control fitting.

C. Safety Control: Automatic, high-temperature-limit cutoff device or system on commercial units and where indicated. Include automatic low-water cutoff device or system on commercial units where indicated.

D. Interior Finish: Materials that comply with requirements of applicable NSF, AWWA, or FDA and EPA regulatory standards for tasteless and odorless, potable-water-tank linings.

E. Tappings: Factory fabricated of materials compatible with tank. Include tappings for piping connections, relief valves, pressure gage, thermometer, blow down, and controls as required and others as indicated. Attach tappings to tank before testing and labeling. Include tappings and connections as follows:
1. 2-Inch NPS (DN50) and Smaller: Threaded ends.
2. 2-1/2-Inch NPS (DN65) and Larger: Flanged ends.

F. Insulation: Fiberglass, polyurethane foam, or manufacturer's standard that is suitable for operating temperature and required insulating value. Include insulation material that surrounds entire tank except connections and controls.

G. Jacket: Steel, with baked-on enamel finish, except where otherwise specified.

H. Anode Rods: Factory installed, magnesium.

I. Combination Temperature and Pressure Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input and pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into tank.
1. Option: Separate temperature and pressure relief valves are acceptable instead of combination relief valve.
2. Exception: Omit relief valve for tankless water heater. Include pressure relief valve for installation in piping.

2.3 HOUSEHOLD, STORAGE, ELECTRIC WATER HEATERS

A. Description: UL 174, household, storage, electric water heater; with capacity more than 40 gal. (151 L), but not more than 120 gal. (454 L), and input not more than 12 kW.

B. Storage Tank Construction: Steel with 150-psig (1035-kPa) working-pressure rating.

C. Heating Elements: 2 electric, screw-in, immersion type.

D. Heat Traps: Manufactured, factory- or field-installed, cold-type inlet fitting in inlet and hot-type outlet fitting in outlet of household water heater.

E. Drain Valve: ASSE 1005, factory or field installed. Omit when water heater is without drain outlet and include general-duty drain valve in piping.

F. Vacuum Relief Valve: Comply with ASME PTC 25.3. Furnish for installation in piping.
   1. Exception: Omit where water heater has integral vacuum relieving device.

2.4 HOUSEHOLD, HEAT-PUMP, STORAGE, ELECTRIC WATER HEATERS

A. Description: UL 174, household, air-to-water, heat-pump, storage, electric water heater; with capacity more than 40 gal. (151 L), but not more than 120 gal. (454 L), and supplemental input not more than 4.5 kW.

B. Storage Tank Construction: Steel with 150-psig (1035-kPa) working-pressure rating.

C. Heat Exchanger: Air-to-water heat exchanger complying with UL 465 and UL 559, for use with water heaters.

D. Heating Element: Electric, screw-in, immersion type interlocked with heat exchanger.

E. Safety Control: Automatic, high-temperature-limit cutoff.

F. Heat Traps: Manufactured, factory- or field-installed, cold-type inlet fitting in inlet and hot-type outlet fitting in outlet of household water heater.

G. Drain Valve: ASSE 1005, factory or field installed. Omit when water heater is without drain outlet and include general-duty drain valve in piping.

H. Vacuum Relief Valve: Comply with ASME PTC 25.3. Furnish for installation in piping.
   1. Exception: Omit where water heater has integral vacuum relieving device.

I. Description: UL 174, household, water-to-water, heat-pump, storage, electric water heater; with capacity more than 40 gal. (151 L), but not more than 120 gal. (454 L), and supplemental input not more than 4.5 kW; for use with remote, waste-water heat exchanger.

J. Storage Tank Construction: Steel with 150-psig (1035-kPa) working-pressure rating.

K. Heat Exchanger: Manufacturer’s standard water-to-water heat exchanger complying with UL 559, for use with water heaters.

L. Heating Element: Electric, screw-in, immersion type interlocked with heat exchanger.

M. Safety Control: Automatic, high-temperature-limit cutoff.

N. Heat Traps: Manufactured, factory- or field-installed, cold-type inlet fitting in inlet and hot-type outlet fitting in outlet of household water heater.

O. Drain Valve: ASSE 1005, factory or field installed. Omit when water heater is without drain outlet and include general-duty drain valve in piping.

P. Vacuum Relief Valve: Comply with ASME PTC 25.3. Furnish for installation in piping.
   1. Exception: Omit where water heater has integral vacuum relieving device.

2.5 HOUSEHOLD, POINT-OF-USE, STORAGE, ELECTRIC WATER HEATERS

A. Description: UL 174, household, point-of-use, storage, electric water heater; with capacity not less than 6 gal. (22.7 L), but not more than 40 gal. (151 L), and input not more than 12 kW.

B. Storage Tank Construction: Steel with 150-psig (1035-kPa) working-pressure rating.

C. Heating Elements: 2, except when 1 is indicated; electric, screw-in, immersion type.

D. Heat Traps: Manufactured, factory- or field-installed, cold-type inlet fitting in inlet and hot-type outlet fitting in outlet of household water heater.

E. Drain Valve: ASSE 1005, factory or field installed. Omit when water heater is without drain outlet and include general-duty drain valve in piping.

F. Vacuum Relief Valve: Comply with ASME PTC 25.3. Furnish for installation in piping.
   1. Exception: Omit where water heater has integral vacuum relieving device.

2.6 HOUSEHOLD, POINT-OF-USE, SMALL-CAPACITY, ELECTRIC WATER HEATERS

A. Description: UL 174, household, point-of-use, small-capacity, electric water heater; with capacity not less than 1 gal. (3.8 L), but not more than 5 gal. (19 L), and input not more than 6 kW.

B. Storage Tank Construction: Steel or corrosion-resistant metal with 150-psig (1035-kPa) working-pressure rating.

C. Heating Element: Electric, replaceable, immersion type.

D. Heat Traps: Manufactured, factory- or field-installed, cold-type inlet fitting in inlet and hot-type outlet fitting in outlet of household water heater.

E. Drain Valve: ASSE 1005, factory or field installed. Omit when water heater is without drain outlet and include general-duty drain valve in piping.

F. Vacuum Relief Valve: Comply with ASME PTC 25.3. Furnish for installation in piping.
   1. Exception: Omit where water heater has integral vacuum relieving device.

2.7 POINT-OF-USE, TANKLESS, ELECTRIC WATER HEATERS

A. Description: Point-of-use, tankless, electric water heater conforming to applicable requirements of UL 499.

B. Construction: Manufacturer’s standard and without hot-water storage.

C. Working-Pressure Rating: 150 psig (1035 kPa).

D. Electric Heating System: Manufacturer’s standard electric-resistance type.

E. Jacket: Aluminum or steel with baked-on enamel finish, or plastic.

F. Mounting: Bracket or device for wall mounting.

G. Temperature Control: Adjustable thermostat.

H. Safety Control: Automatic, high-temperature-limit cutoff.

2.8 COMMERCIAL, POINT-OF-USE, SMALL-CAPACITY, ELECTRIC WATER HEATERS

A. Description: UL 174, but listed by manufacturer for commercial applications, point-of-use, small-capacity, electric water heater; with capacity not less than 1 gal. (3.8 L), but not more than 5 gal. (19 L), and input not more than 6 kW.

B. Storage Tank Construction: Steel or corrosion-resistant metal with 150-psig (1035-kPa) working-pressure rating.

C. Storage Tank Construction: ASME labeled, steel or corrosion-resistant metal with 150-psig (1035-kPa) working-pressure rating.

D. Heating Element: Electric, replaceable, immersion type.

E. Vacuum Relief Valve: Comply with ASME PTC 25.3. Furnish for installation in piping.
   1. Exception: Omit where water heater has integral vacuum relieving device.

2.9 COMMERCIAL, POINT-OF-USE, STORAGE, ELECTRIC WATER HEATERS

A. Description: UL 174, but listed by manufacturer for commercial applications, or UL 1453, point-of-use, storage, electric water heater; with capacity not less than 6 gal. (22.7 L), but not more than 40 gal. (151 L), and input not more than 12 kW.

B. Storage Tank Construction: Steel with 150-psig (1035-kPa) working-pressure rating.

C. Storage Tank Construction: ASME labeled, steel with 150-psig (1035-kPa) working-pressure rating.

D. Heating Elements: 2, except when 3 is indicated; electric, screw-in, immersion type.

E. Special Requirements: NSF 5 construction.

F. Inlet and Outlet Manifolds: Fabricated by water heater manufacturer and capable of providing balanced flow through water heaters, for multiple-unit installation.

G. Vacuum Relief Valve: Comply with ASME PTC 25.3. Furnish for installation in piping.
   1. Exception: Omit where water heater has integral vacuum relieving device.

2.10 LIGHT-COMMERCIAL, STORAGE, ELECTRIC WATER HEATERS

A. Description: UL 174, but listed by manufacturer for commercial applications, or UL 1453, light-commercial, storage, electric water heater; with capacity more than 40 gal. (151 L), but not more than 120 gal. (454 L), and input not more than 12 kW.

B. Storage Tank Construction: Steel with 150-psig (1035-kPa) working-pressure rating.

C. Storage Tank Construction: ASME labeled, steel with 150-psig (1035-kPa) working-pressure rating.

D. Heating Elements: 2 electric, screw-in, immersion type wired for simultaneous operation.

E. Special Requirements: NSF 5 construction.

F. Inlet and Outlet Manifolds: Fabricated by water heater manufacturer and capable of providing balanced flow through water heaters, for multiple-unit installation.

G. Vacuum Relief Valve: Comply with ASME PTC 25.3. Furnish for installation in piping.
   1. Exception: Omit where water heater has integral vacuum relieving device.

2.11 COMMERCIAL, HEAT-PUMP, STORAGE, ELECTRIC WATER HEATERS

A. Description: UL 1453, commercial, air-to-water, heat-pump, storage, electric water heater; with capacity more than 40 gal. (151 L) and supplemental heating.

B. Storage Tank Construction: ASME labeled, steel with 150-psig (1035-kPa) working-pressure rating.

C. Storage Tank Construction: Steel with 150-psig (1035-kPa) working-pressure rating.

D. Heat Exchanger: Air-to-water heat exchanger complying with UL 465 and UL 559, for use with water heaters.

E. Heating Element: Electric, screw-in or bolt-on, immersion type.

F. Temperature Control: Adjustable immersion thermostats.

G. Temperature Control: Adjustable surface-mounting thermostats.

H. Safety Control: Automatic, high-temperature-limit and low-water cutoffs.

I. Special Requirements: NSF 5 construction.

J. Vacuum Relief Valve: Comply with ASME PTC 25.3. Furnish for installation in piping.
   1. Exception: Omit where water heater has integral vacuum relieving device.

K. Description: UL 1453, commercial, water-to-water, heat-pump, storage, electric water heater; with capacity more than 40 gal. (151 L) and supplemental heating; for use with remote, waste-water heat exchanger.

L. Storage Tank Construction: ASME labeled, steel with 150-psig (1035-kPa) working-pressure rating.

M. Storage Tank Construction: Steel with 150-psig (1035-kPa) working-pressure rating.

N. Heat Exchanger: Manufacturer’s standard water-to-water heat exchanger complying with UL 559, for use with water heaters.

O. Heating Element: Electric, screw-in or bolt-on, immersion type.

P. Temperature Control: Adjustable immersion thermostats.

Q. Temperature Control: Adjustable surface-mounting thermostats.

R. Safety Control: Automatic, high-temperature-limit and low-water cutoffs.

S. Special Requirements: NSF 5 construction.

T. Vacuum Relief Valve: Comply with ASME PTC 25.3. Furnish for installation in piping.
   1. Exception: Omit where water heater has integral vacuum relieving device.

2.12 COMMERCIAL, STORAGE, ELECTRIC WATER HEATERS

A. Description: UL 1453, commercial, storage, electric water heater; with capacity more than 40 gal. (151 L).

B. Storage Tank Construction: ASME labeled, steel with 150-psig (1035-kPa) working-pressure rating.

C. Storage Tank Construction: Steel with 150-psig (1035-kPa) working-pressure rating.

D. Heating Elements: Electric, screw-in or bolt-on, immersion type according to the following:
   1. Up to 9-kW Input: 2 or 3 elements.
   2. More than 9-kW Input: Elements arranged in multiples of 3.

E. Heating Elements: Electric, screw-in or bolt-on, immersion type arranged in multiples of 3.

F. Staging: Not exceeding 18 kW per step.

G. Temperature Control: Adjustable immersion thermostats.

H. Temperature Control: Adjustable surface-mounting thermostats.

I. Safety Control: Automatic, high-temperature-limit and low-water cutoffs.

J. Special Requirements: NSF 5 construction.

K. Inlet and Outlet Manifolds: Fabricated by water heater manufacturer and capable of providing balanced flow through water heaters, for multiple-unit installation.

L. Vacuum Relief Valve: Comply with ASME PTC 25.3. Furnish for installation in piping.
   1. Exception: Omit where water heater has integral vacuum relieving device.

2.13 COMMERCIAL, ELECTRIC BOOSTER HEATERS

A. Description: UL 1453, commercial, electric booster heater capable of heating water to at least 180EF (82EC); with capacity not less than 5 gal. (19 L).

B. Storage Tank Construction: ASME labeled, steel or corrosion-resistant-alloy metal with 150-psig (1035-kPa) working-pressure rating.

C. Heating Elements: Electric, screw-in or bolt-on, immersion type according to the following:
   1. Up to 9-kW Input: 2 or 3 elements.
   2. More than 9-kW Input: Elements arranged in multiples of 3.

D. Heating Elements: Electric, screw-in or bolt-on, immersion type arranged in multiples of 3.

E. Staging: Not exceeding 18 kW per step.

F. Temperature Control: Adjustable thermostat, to setting of at least 180EF (82EC).

G. Safety Controls: Automatic, high-temperature-limit and low-water cutoffs.

H. Jacket: Rectangular shaped with stainless-steel front panel.

I. Special Requirements: NSF 5 construction with legs for floor mounting.

J. Special Requirements: NSF 5 construction with brackets for undercounter mounting.

K. Pressure Regulator: ASSE 1003, water pressure reducing valve. Set at 25-psig- (172.5-kPa-) maximum outlet pressure.

L. Shock Absorber: ASSE 1010, ASME A112.26.1M, or PDI WH 201, Size A water hammer arrester.

M. Gages: 2 combination temperature and pressure type or separate thermometers and pressure gages.

N. Vacuum Relief Valve: Comply with ASME PTC 25.3. Furnish for installation in piping.
   1. Exception: Omit where water heater has integral vacuum relieving device.

PART 3 – EXECUTION

3.1 CONCRETE BASES

A. Install concrete bases of dimensions indicated for water heaters and accessories.

3.2 WATER HEATER INSTALLATION

A. General: Install water heaters on concrete bases. Set and connect units according to manufacturer's written instructions. Install units plumb, level, and firmly anchored in locations indicated. Maintain manufacturer's recommended clearances. Install so controls and devices are accessible for service.

B. Anchor water heaters and storage tanks to substrate.

C. Install seismic restraints as indicated.

D. Install electric booster heaters with thermometer, pressure gage, and pressure regulator on hot-water inlet; and thermometer, pressure gage, and shock absorber on boosted-temperature, hot-water outlet.

E. Install temperature and pressure relief valves in top portion of storage water heater tanks and hot-water storage tanks. Use relief valves with sensing elements that extend into tanks. Extend relief valve outlet with water piping in continuous downward pitch and discharge to closest floor drain.

F. Install pressure relief valves in hot-water-outlet piping for water heaters without storage. Extend relief valve outlet with water piping in continuous downward pitch and discharge to closest floor drain.

G. Install vacuum relief valves in cold-water-inlet piping.

H. Install vacuum relief valves in water heaters and hot-water storage tanks that have copper lining.

I. Install water heater drain piping as indirect waste to spill into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains.

J. Install thermometers on water heater inlet and outlet piping.

K. Install pressure gages on water heater piping when and as indicated.

L. Install inlet and outlet piping manifolds for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through water heaters. Include throttling valves in outlet manifolds and thermometers in inlet and outlet manifolds.

M. Install piping adjacent to water heaters to allow service and maintenance.

N. Arrange for field-applied insulation on equipment and piping not furnished with factory-applied insulation.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
   1. Connect hot- and cold-water piping to units with shutoff valves and unions. Connect hot-water circulating piping to unit with shutoff valve, check valve, and union.
   2. Make connections with dielectric fittings where piping is made of dissimilar metals. Dielectric fittings are specified in other Sections.

B. Electrical Connections: Power wiring and disconnect switches are specified in other Sections. Arrange wiring to allow unit servicing.

C. Grounding: Ground equipment. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 COMMISSIONING

A. Startup Services: Engage a factory-authorized service representative to provide startup service and to demonstrate and train Owner's maintenance personnel as specified below.
   1. Test and adjust operating and safety controls. Replace damaged and malfunctioning controls and equipment.
   2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
   3. Review data in the operation and maintenance manuals.
   4. Schedule training with Owner with at least 7 days' advance notice.

B. Perform the following final checks before startup:
   1. Fill water heaters with water.
   2. Check that piping system tests are complete.
   3. Check for piping connection leaks.
   4. Check for clear relief valve inlets, outlets, and drain piping.
   5. Check operation of pumps and circulators.
   6. Test operation of safety controls, relief valves, and devices.

C. Perform the following startup procedures:
   1. Energize electric circuits.
   2. Adjust operating controls.
   3. Adjust hot-water-outlet temperature settings.

END OF SECTION

SECTION 224000 – PLUMBING FIXTURES

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes plumbing fixtures and trim, fittings, and accessories, appliances, appurtenances, equipment, and supports associated with plumbing fixtures.

1.2 SUBMITTALS

A. Product data for each type of plumbing fixture specified, including fixture and trim, fittings, accessories, appliances, appurtenances, equipment, supports, construction details, dimensions of components, and finishes.

B. Wiring diagrams for field-installed wiring of electrically operated units.

C. Maintenance Data: For plumbing fixtures to include in maintenance manuals.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Useable 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.

B. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.

1. The terms "listed" and "labeled" shall be as defined in the National Electrical Code, Article 100.

C. 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.

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. Design Concept: The drawings indicate types of plumbing fixtures and are based on the specific descriptions, manufacturers, models, and numbers indicated. Plumbing fixtures having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions, operation, color or finish, or other characteristics are minor and do not change the design concept or intended performance as judged by the Owner's Representative. Burden of proof for equality of plumbing fixtures is on the proposer.

1.4 DEFINITIONS

A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Fitting: Device that controls flow of water into or out of 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.

1.5 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials described below matching products installed, packaged with protective covering for storage, and identified with labels clearly describing contents.

1. Faucet Washers and O-rings: Furnish quantity of identical units not less than 10 percent of amount of each installed.
2. Faucet Cartridges and O-rings: Furnish quantity of identical units not less than 5 percent of amount of each installed.
3. Faucet, Laminar-Flow Fittings: Furnish quantity of identical units not less than 10 percent of amount of each installed.
4. Faucet Stops: Furnish quantity of identical units not less than 10 percent of amount of each installed.
5. Supply Stops: Furnish quantity of identical units not less than 5 percent of amount of each installed.
6. Shower Stops: Furnish quantity of identical units not less than 5 percent of amount of each installed.
7. Flushometer Repair Kits: Furnish quantity of identical units not less than 10 percent of amount of each flushometer installed.
8. Provide a hinged-top wood or metal box, or individual metal boxes, having a separate compartment for each type and size of above extra materials.
9. Water Closet Tank Repair Kits: Furnish quantity of identical flush valve units not less than 5 percent of amount of each type installed.
10. Toilet Seats: Furnish quantity of identical units not less than 5 percent of amount of each type toilet seat installed.
11. Filter Cartridges: Furnish quantity of identical filter cartridges not less than 50 percent of amount of each type and size installed.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products in each category, by one of the following listed for that category:

1. Water Closets:
   a. American Standard, Inc.
   b. Eljer; A Household International Co.
   c. Kohler Co.
2. Urinals:
   a. American Standard, Inc.
   b. Eljer; A Household International Co.
   c. Kohler Co.
3. Lavatories:
   a. American Standard, Inc.
   b. Eljer; A Household International Co.

c. Kohler Co.

4. Sinks:
   a. American Standard, Inc.
   b. Crane Plumbing/Fiat Products.
   c. Eljer; A Household International Co.
   d. Elkay Manufacturing Co.
   e. Kohler Co.
   f. Moen Group; Stanadyne Corp.
   g. Universal-Rundle Corp.
5. Service Sinks:
   a. American Standard, Inc.
   b. Crane Plumbing/Fiat Products.
   c. Eljer; A Household International Co.
   d. Elkay Manufacturing Co.
   e. Kohler Co.
   f. Universal-Rundle Corp.
6. Mop Basins:
   a. Aqua Glass Corp.
   b. Crane Plumbing/Fiat Products.
   c. Florestone Products Co., Inc.
   d. Stern-Williams Co., Inc.
   e. Swan Corp.
7. Bath Tubs:
   a. American Standard, Inc.
   b. Eljer; A Household International Co.
   c. Kohler Co.
8. Showers:
   a. American Standard, Inc.
   b. Crane Plumbing/Fiat Products.
   c. Eljer; A Household International Co.
   d. Kohler Co.
9. Whirlpools:
   a. American Standard, Inc.
   b. Eljer; A Household International Co.
   c. Kohler Co.
10. Drinking Fountains:
    a. American Standard, Inc.
    b. Eljer; A Household International Co.
    c. Haws Drinking Faucet Co.
    d. Kohler Co.
11. Water Coolers:
    a. Elkay Manufacturing Co.
    b. Haws Drinking Faucet Co.
    c. Sunroc Corp.
    d. Western Drinking Fountains; Sunroc Corp.
12. Wash Fountains:

a. Acorn Engineering Co.
b. Bradley Corp.
c. International Sanitary Ware Manufacturing Co.

13. Bidets:
    a. American Standard, Inc.
    b. Eljer; A Household International Co.
    c. Kohler Co.
14. Outlet Boxes:
    a. Guy Gray Manufacturing Co., Inc.
    b. Symmons Industries, Inc.
15. Emergency Equipment:
    a. Bradley Corp.
    b. Guardian Equipment.
    c. Haws Drinking Faucet Co.
    d. Speakman Co.
    e. Western Drinking Fountains; Sunroc Corp.
16. Toilet Seats:
    a. Bemis Mfg. Co.
    b. Beneke Div.; Sanderson Plumbing Products, Inc.
    c. Church Seat Co.
    d. Olsonite Corp.
17. Flushometers:
    a. Coyne & Delany Co.
    b. Sloan Valve Co.
    c. Zurn Industries, Inc.; Flush Valve Operations.
18. Bedpan Washers:
    a. American Standard, Inc.
    b. Chicago Faucet Co.
    c. Coyne & Delany Co.
    d. Crane Plumbing/Fiat Products.
    e. Eljer; A Household International Co.
    f. Royal Brass Mfg. Co.
    g. Sloan Valve Co.
    h. T & S Brass and Bronze Works, Inc.
19. Commercial/Industrial Cast-Brass Faucets:
    a. American Standard, Inc.
    b. Chicago Faucet Co.
    c. Crane Plumbing/Fiat Products.
    d. Eljer; A Household International Co.
    e. Kohler Co.
    f. Royal Brass Mfg. Co.
    g. Speakman Co.
    h. T & S Brass and Bronze Works, Inc.
20. Commercial/Residential Cast-Brass and Cast-Brass Underbody Faucets:
    a. American Standard, Inc.
    b. Chicago Faucet Co.

c. Crane Plumbing/Fiat Products
d. Delta Faucet Co.; Div. of Masco Corp.
e. Eljer; A Household International Co.
f. Elkay Manufacturing Co.
g. Kohler Co.
h. Moen Group; Stanadyne Corp.
i. Price Pfister, Inc.
j. Royal Brass Mfg. Co.
k. Speakman Co.
l. Symmons Industries, Inc.
m. T & S Brass and Bronze Works, Inc.

21. Pressure Balance Bath/Shower Faucets:
    a. American Standard, Inc.
    b. Bradley Corp.
    c. Chicago Faucet Co.
    d. Crane Plumbing/Fiat Products.
    e. Delta Faucet Co.; Div. of Masco Corp.
    f. Eljer; A Household International Co.
    g. Elkay Manufacturing Co.
    h. Kohler Co.
    i. Leonard Valve Co.
    j. Moen Group; Stanadyne Corp.
    k. Powers Process Controls; A Unit of Mark Controls Corp.
    l. Price Pfister, Inc.
    m. Royal Brass Mfg. Co.
    n. Speakman Co.
    o. Symmons Industries, Inc.
22. Thermostatic Mixing Valve Bath/Shower Faucets:
    a. Bradley Corp.
    b. Lawler Manufacturing Co., Inc.
    c. Leonard Valve Co.
    d. Powers Process Controls; A Unit of Mark Controls Corp.
    e. Symmons Industries, Inc.
    f. T & S Brass and Bronze Works, Inc.
23. Shower Receptors:
    a. Aqua Glass Corp.
    b. Crane Plumbing/Fiat Products.
    c. Florestone Products Co., Inc.
    d. Stern-Williams Co., Inc.
    e. Swan Corp.
24. Sensor-Operated Faucets and Devices:
    a. Acorn Engineering Co.
    b. Bradley Corp.
    c. Coyne & Delany Co.
    d. Sloan Valve Co.
    e. Speakman Co.

25. Miscellaneous Fittings (Except Faucets):
    a. Aquaflo Corp.
    b. Beaton & Corbin Mfg. Co.
    c. Brass Craft Subsidiary; Masco Co.
    d. Bridgeport Plumbing Products, Inc.
    e. Central Brass Manufacturing Co.
    f. Chicago Faucet Co.
    g. Connecticut Stamping & Bending Co.
    h. Crane Plumbing/Fiat Products.
    i. Eljer; A Household International Co.
    j. Kohler Co.
    k. McGuire Manufacturing Co., Inc.
    l. Price Pfister, Inc.
    m. Royal Brass Mfg. Co.
    n. Sanitary-Dash Manufacturing Co., Inc.
    o. T & S Brass and Bronze Works, Inc.
    p. Teledyne Ansonia.
26. Supports:
    a. Ancon, Inc.
    b. Josam Co.
    c. Smith (Jay R.) Mfg. Co.
    d. Wade Div.; Tyler Pipe.
    e. Zurn Industries, Inc.; Hydromechanics Div.
27. Hot Water Dispensers:
    a. Elkay Manufacturing Co.
    b. In-Sink-Erator Div.; Emerson Electric Co.
    c. Just Manufacturing Co.
    d. KitchenAid, Inc.
28. Disposers:
    a. General Electric Co.
    b. Hotpoint; General Electric Co.
    c. In-Sink-Erator Div.; Emerson Electric Co.
    d. Jenn-Air Co.
    e. KitchenAid, Inc.
    f. Thermador/Waste King; A Masco Co.
29. Water Filters:
    a. EBCO Manufacturing Co.
    b. Filterite Div.; Memtec America Corp.
    c. Filtrine Manufacturing Co.
    d. Halsey Taylor; A Household International Co.
    e. Haws Drinking Faucet Co.
    f. Lawler Manufacturing Co., Inc.
    g. Sunroc Corp.

2.2 FAUCETS

A. Faucets General: Unless otherwise specified, provide faucets that are cast brass with polished chrome-plated finish.

B. Lavatory Faucets: ASME A112.18.1M.

C. Sink Faucet: ASME A112.18.1M.

D. Service Sink Faucet: ASME A112.18.1M, rough chrome finish, cast brass, with stops in shanks, and wall brace, integral vacuum breaker, pail hook, and garden hose thread on spout.

E. Mop Basin Faucet: ASME A112.18.1M, rough chrome finish, cast brass, with stops in shanks; wall brace, integral vacuum breaker, pail hook, and garden hose thread on spout; and hose and bracket.

F. Bathtub Faucet: ASME A112.18.1M.

G. Shower Faucet: ASME A112.18.1M, cast-brass combination single-lever, pressure-balancing mixing valve and escutcheon, and shower head, arm, and flange. Polished chrome-plated finish on all exposed metal.

H. Whirlpool Faucet: ASME A112.18.1M.

I. Bidet Faucets: ASME A112.18.1M.

2.3 FITTINGS, EXCEPT FAUCETS

A. Fittings General: Unless otherwise specified, provide fittings fabricated of brass, with a polished chrome plated finish.

B. Lavatory Supplies and Stops: Loose-key angle stop, having 3/8-inch NPS inlet with wall flange and 3/8-inch by 12-inch long flexible tubing riser outlet.

C. Lavatory Traps: Cast-brass, 1-1/4-inch NPS adjustable P-trap with cleanout, 17-gage tubular waste to wall, and wall flange.

D. Sink Supplies and Stops: Loose-key angle stop, having 1/2-inch NPS inlet with wall flange and 1/2-inch by 12-inch flexible tubing riser outlet.

E. Sink Traps: Cast-brass, 1-1/2-inch or 2-inch NPS adjustable P-trap with cleanout, 17-gage tubular waste to wall, and wall flange.

F. Sink Continuous Wastes: Polished chrome-plated, tubular brass, 1-1/2 inches or 2-inches, 17 gage, with brass nuts on slip inlets, and of configurations indicated.

G. Water Closet Supplies and Stops: Loose-key angle stop, having 1/2-inch NPS inlet with wall flange and 1/2-inch by 12-inch flexible tubing riser outlet with collar.

H. Bathtub Waste and Overflow Fittings: Concealed 1-1/2-inch, 17-gage, polished chrome-plated, tubular brass; lever-operated pop-up bath waste and overflow, spud with universal-type outlet connection suitable for 1-1/2-inch tubing, or 1-1/2-inch solder-joint outlet connection on waste tee.

I. Bathtub Traps: Cast-brass, 1-1/2-inch NPS adjustable P-trap with cleanout, 17 gage tubular waste to wall, and wall flange.

J. Trough-Type Urinal Supplies and Stops: Loose-key angle or straight stop, having 3/4-inch NPS inlet with wall flange.

K. Urinal Traps: 1-1/2-inch NPS adjustable P-trap with cleanout, 17-gage tubular waste to wall, and wall flange.

L. Bidet Supplies and Stops: Loose-key angle stop, having 3/8-inch NPS inlet with wall flange and 3/8-inch by 12-inch-long flexible tubing riser outlet.

M. Bidet Traps: 1-1/4-inch NPS adjustable P-trap with cleanout, 17-gage tubular waste to wall, and wall flange.

N. Fittings installed concealed inside a plumbing fixture or within wall construction may be without chrome plate finish.

O. Escutcheons: Wall flange with set screw.

P. Escutcheons: Polished chrome-plated, sheet steel wall flange with friction clips.

Q. Deep Pattern Escutcheons: Wall flange with set screw or sheet steel wall flange with friction clips, of depth adequate to conceal protruding roughing-in fittings.

2.4 FLUSHOMETERS

A. Provide flushometers compatible with fixtures, with features and of consumption indicated.

B. Construction: Cast-brass body, brass or copper pipe or tubing inlet with wall flange and tailpiece with spud, screwdriver check stop, vacuum breaker, and brass lever handle actuation except where other variations are specified. Type shall be diaphragm operation except where other type is specified.

C. Finish: Exposed metal parts shall be polished chrome-plated, except components installed in a concealed location may be rough brass or unfinished.

2.5 TOILET SEATS

A. General: Provide toilet seats compatible with water closets, and of type, color, and features indicated.

B. Toilet Seats: Extra heavy-duty, commercial/industrial type, elongated, open front, solid plastic, with check hinge.

2.6 SHOWER RECEPTORS

A. Shower Receptors: Provide shower receptors of shape, dimensions, color, and other characteristics specified on the schedule. Where data is not complete, provide receptors with characteristics compatible with enclosures.
   1. Material: Terrazzo.
   2. Material: Plastic (molded stone).

2.7 BEDPAN WASHERS

A. Bedpan Washers, Hand-Control Type: Wall-mounting, hand-held, spray nozzle, with self-closing valve, 4-foot-long rubber or vinyl hose, wall bracket and hook, 1/2-inch loose key supply stop, and wall-mounting vacuum breaker. Finish of metal parts shall be polished chrome-plated.

B. Bedpan Washers, Foot-Control Type: Wall-mounting double pedal valve with long pedals, 1/2-inch loose key stop inlets, top outlet, spray nozzle, with self-closing valve, 4-foot-long rubber or vinyl hose, wall bracket and hook, and wall-mounting vacuum breaker. Finish of metal parts shall be polished chrome-plated.

2.8 DISPOSERS

A. Disposers: Continuous-feed-type food waste disposer conforming to UL 430, 1/2-horsepower motor, 1725 rpm, overload protection, and wall-switch operated; corrosion-resistant construction, with quick-mounting feature, stainless steel sink flange, cushioned suspension, and stainless steel grinding chamber; jam-resistant cutting/shredding mechanism with swivel-mounted impellers on turntable, cast tool steel grinding ring, and cutlery steel undercutter blade; insulated housing for grinding chamber; and anti-splash guard and combination cover/stopper.

2.9 HOT WATER DISPENSERS

A. Hot Water Dispensers: ASSE 1023, instant on-off control on chrome-plated dispenser faucet with removable strainer; steel tank housing with insulated stainless steel inner tank; thermostat control for water temperature up to 190 DegF (88 DegC) with thermal overload protection; and 1/2-gallon minimum tank capacity.

2.10 WATER FILTERS

A. Water Filters: Cartridge type, with stainless steel or plastic housing and mounting bracket. Cartridges shall be replaceable, 10 inches long, activated carbon, wound fiber, or pleated, 10-micron removal rating, and suitable for potable water.

2.11 PLUMBING FIXTURE SUPPORTS

A. Supports: ASME A112.6.1M, categories and types as required for wall-hanging fixtures specified, and wall reinforcement.

B. Support categories are:
   1. Carriers: Supports for wall-hanging water closets and fixtures supported from wall construction. Water closet carriers shall have an additional faceplate and coupling when used for wide pipe spaces. Provide tiling frame or setting gage with carriers for wall-hanging water closets.
   2. Chair Carriers: Supports with steel pipe uprights for wall-hanging fixtures. Urinal chair carriers shall have bearing plates.
   3. Chair Carriers, Heavy Duty: Supports with rectangular steel uprights for wall-hanging fixtures.
   4. Reinforcement: 2-inch by 4-inch wood blocking between studs or 1/4-inch by 6-inch steel plates attached to studs, in wall construction, to secure floor-mounted and special fixtures to wall.

C. Support Types: Provide support of category specified, of type having features required to match fixture.

D. Provide supports specified as part of fixture description, in lieu of category and type requirements above.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Use manufacturer's roughing-in data if roughing-in data are not indicated.

B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Install plumbing fixtures and specified components, in accordance with designations and locations indicated on Drawings.

B. Install supports for plumbing fixtures in accordance with categories indicated, and of type required:
   1. Carriers for following fixtures:
      a. Wall-hanging water closets.
      b. Wall-hanging fixtures supported from wall construction.
   2. Chair carriers for the following fixtures:
      a. Wall-hanging urinals.
      b. Wall-hanging lavatories and sinks.
      c. Wall-hanging drinking fountains and electric water coolers.
   3. Heavy-duty chair carriers for the following fixtures:
      a. Accessible lavatories.
      b. Fixtures where specified.
   4. Reinforcement for the following fixtures:
      a. Floor-mounted lavatories required to be secured to wall.
      b. Floor-mounted sinks required to be secured to wall.
      c. Recessed, box-mounted electric water coolers.

3.3 INSTALLATION OF PLUMBING FIXTURES

A. Install plumbing fixtures level and plumb, in accordance with fixture manufacturers' written installation instructions, roughing-in drawings, and referenced standards.

B. Install floor-mounted, floor-outlet water closets with closet flanges and gasket seals.

C. Install floor-mounted, back-outlet water closets with fittings and gasket seals.

D. Install wall-hanging, back-outlet water closets with support manufacturer's tiling frame or setting gage.

E. Install wall-hanging, back-outlet urinals with gasket seals.

F. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.

G. Fasten floor-mounted fixtures and special fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.

H. Fasten wall-mounted fittings to reinforcement built into walls.

I. Fasten counter-mounting-type plumbing fixtures to casework.

J. Secure supplies behind wall or within wall pipe space, providing rigid installation.

K. Set shower receptors and mop basins in leveling bed of cement grout.

L. Install stop valve in an accessible location in each water supply to each fixture.

M. Install trap on fixture outlet except for fixtures having integral trap.

N. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork. Use deep pattern escutcheons where required to conceal protruding pipe fittings.

O. Seal fixtures to walls, floors, and counters using a sanitary-type, one-part, mildew-resistant, silicone sealant in accordance with sealing requirements specified in other Sections. Match sealant color to fixture color.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Sections. The Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
   1. Install piping connections between plumbing fixtures and piping systems and plumbing equipment specified in other Sections.
   2. Install piping connections indicated between appliances and equipment specified in other sections, direct connected to plumbing piping systems.

3.5 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.

3.6 ADJUSTING AND CLEANING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust disposers, hot water dispensers, and controls. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at drinking fountains, electric water coolers, and faucets, shower valves, and flushometers having controls, to provide proper flow and stream.

D. Replace washers of leaking and dripping faucets and stops.

E. Clean fixtures, fittings, and spout and drain strainers with manufacturers' recommended cleaning methods and materials.

F. Review the data in Operating and Maintenance Manuals.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of fixtures for temporary facilities, except when approved in writing by the Owner.

END OF SECTION

SECTION 230000 – GENERAL REQUIREMENTS FOR HVAC SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes general administrative and procedural requirements for all HVAC work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

1.2 SCOPE OF WORK

A. Provide all labor, material, equipment, and services necessary for and incidental to completion of all work as indicated on the Drawings and/or as specified herein. This includes all incidentals, equipment, appliances, services, hoisting, scaffolding, supports, sleeves, inserts, anchor bolts, tools, supervision, labor, consumable items, fees, licenses, etc., necessary to provide complete and workable systems.

1.3 DRAWING USE AND INTERPRETATION

A. Unless indicated by specific dimensions, drawings are meant to be diagrammatic. Exact equipment locations and routing of utilities shall be governed by field conditions and/or Owner's Representative's instructions.

B. All dimensions which relate to the building shall be taken as construction progresses. All errors incurred as result of the failure to check or verify dimensions, measurements, etc., shall be corrected.

C. The drawings show the general arrangement of utilities, equipment, and accessories. Drawings do not indicate all offsets, fittings, accessories, and changes in elevation, which may be necessary. Make all changes in equipment, locations, etc., to accommodate the work and to avoid obstacles at no increase in contract price. Provide offsets, fittings, and accessories as may be required to meet such conditions.

1.4 SPECIFICATION FORMAT AND CONTENT EXPLANATION

A. 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 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. Streamlined Language: The Specifications generally use the imperative mood and streamlined language. 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 where a colon (:) is used within a sentence or phrase.

1.5 DEFINITIONS

A. General: Basic Contract definitions are included in the conditions of the Contract.

B. Indicated: The term "indicated" refers to graphic representations, notes or schedules on the Drawings, or other Paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.

C. Directed: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean "directed by the Engineer," "requested by the Engineer," and similar phrases.

D. Approved: The term "approved," where used in conjunction with the Engineer's action on the Contractor's submittals, applications, and requests, is limited to the Engineer's duties and responsibilities as stated in the Conditions of the Contract.

E. Regulations: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

F. Furnish: The term "furnish" is used to mean "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations."

G. Install: The term "install" is used to describe operations at project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."

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

I. Installer: An "installer" is the Contractor or an entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

1. The term "experienced," when used with the term "installer," means having a minimum of five previous projects similar in size and scope to this Project, being familiar with the special requirements indicated, and having complied with requirements of the authority having jurisdiction.
2. Trades: Use of titles such as "carpentry" is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades persons of the corresponding generic name.
3. Assignment of Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in the operations to be performed. The specialists must be engaged for those activities, and assignments are requirements over which the Contractor has no choice or option. Nevertheless, the ultimate responsibility of fulfilling Contract requirement remains with the Contractor.
   a. This requirement shall not be interpreted to conflict with enforcement of building codes and similar regulations governing the Work. It is also not intended to interfere with local trade union jurisdictional settlements and similar conventions.

J. The term “concealed”: embedded in masonry or other construction, installed behind wall furring, within partitions or hung ceilings (permanent or removable), in trenches, or in crawl spaces.

K. The term “exposed”: not installed underground or concealed. Equipment in rooms with exposed construction (i.e., mechanical rooms, electrical rooms, janitor’s closets, etc.) are classified as exposed.

L. The term “piping”: piping fittings, flanges, valves, controls, hangers, traps, drains, insulation and items necessary or required in connection with or relating thereto.

M. The “Project Site” is the space available to the contractor for performance of construction activities, either exclusively or in conjunction with other performing other work as part of the Project.

N. Testing Laboratories: A “testing laboratory” is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.6 COMPLETE SYSTEMS

A. General: Provide all materials as required for complete systems, including all parts obviously or reasonably incidental to a complete installation, whether specifically indicated or not. All systems shall be completely assembled, tested, adjusted and demonstrated to be ready for operation prior to Owner’s acceptance.

B. Systems: The systems specified and/or shown on the Drawings are for complete and workable systems. Any deviation from these systems due to a particular manufacturer’s requirements shall be made at no additional cost to the Owner.

1.7 CODES AND REGULATIONS

A. General: Comply with all governing federal, state, and local laws, ordinances, codes, rules, and regulations. Where the Contract Documents exceed these requirements, the Contract Documents shall govern. In no case shall work be installed contrary to or below minimum legal standards.

B. Utilities: Comply with all applicable rules, restrictions, and requirements of the utility companies serving the project site/facilities. Contractor shall be required to contact state regulated “call before you dig” service prior to any excavation work.

C. Non-Compliance: Should any work be performed which is found not to comply with any of the above codes and regulations, provide all work and pay all costs necessary to correct the deficiencies.

1.8 REFERENCE STANDARDS

A. All published standards of the following associations/organizations, as mandated by specific state standards, shall be followed and applied as a minimum.
   1. AABC, Associated Air Balance Council
   2. ACI, American Concrete Institute
   3. AGA, American Gas Association.
   4. AIA, The American Institute of Architects
   5. AISC, American Institute of Steel Construction
   6. AMCA, Air Movement and Control Assoc.
   7. ANSI, American National Standards Institute

8. API, American Petroleum Institute
9. ARI, Air-Conditioning and Refrigeration Institute
10. ASHRAE, American Society of Heating, Refrigerating and Air-Conditioning Engineers
11. ASME, American Society of Mechanical Engineers
12. ASPE, American Society of Plumbing Engineers
13. ASSE, American Society of Sanitary Engineering
14. ASTM, American Society for Testing and Materials
15. AWS, American Welding Society
16. AWWA, American Water Works Assoc.
17. CAGI, Compressed Air and Gas Institute
18. CGA, Compressed Gas Assoc.
19. CISPI, Cast Iron Soil Pipe Institute
20. DIPRA, Ductile Iron Pipe Research Assoc.
21. ETL, ETL SEMKO a Division of Intertek Group
22. FMG, Factory Mutual Global
23. GE-GAP, General Electric Global Assets Protection
24. HEI, Heat Exchange Institute
25. HI, Hydronics Institute
26. ISA, Instrument Society of America
27. MCAA, Mechanical Contractors Association of America
28. MSS, Manufacturers Standardization Society
29. NACE, National Association of Corrosion Engineers International
30. NADCA, National Air Duct Cleaners Association
31. NEC, National Electrical Code (from NFPA)
32. NECA, National Electrical Contractors Assoc.
33. NEMA, National Electrical Manufacturers Assoc.
34. NFPA, National Fire Protection Assoc.
35. NSF, National Sanitation Foundation
36. PDI, Plumbing and Drainage Institute
37. SMACNA, Sheet Metal and Air Conditioning Contractors
38. SSPMA, Sump and Sewage Pump Manufacturers Assoc.
39. STI, Steel Tank Institute
40. SWPA, Submersible Wastewater Pump Assoc.
41. UL, Underwriters Laboratories Inc.
42. WSC, Water Systems Council

B. 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 are subject to change and are believed, but are not assured, to be accurate and up-to-date as of the date of the Contract Documents.
1. CE, Corps of Engineers (U.S. Department of the Army).
2. EPA, Environmental Protection Agency.
3. UFC, United Facilities Criteria.
4. MIL, Military Standardization Documents (U.S. Department of Defense).
5. NIST, National Institute of Standards and Technology (U.S. Department of Commerce).
6. OSHA, Occupational Safety and Health Administration (U.S. Department of Labor).

C. 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. Such standards are made a part of the Contract Documents by reference.

D. Copies of Standards: Each entity engaged in construction on the project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents. Where copies of standards are needed for performance of a required construction activity, the contractor shall obtain copies directly from the publication source.

1.9 QUALITY ASSURANCE

A. Manufacturers' Qualifications: Not less than five years of experience in the actual production of the specified products.

B. Installers' Qualifications:
1. Firm with not less than five years of experience in the installation of mechanical systems and equipment similar in scope and complexity to those required for this Project, and having successfully completed at least ten comparable scale projects.
2. Painting, patching, carpentry, and the like related to or required for Division 23 work shall be performed by craftsman skilled in the appropriate trade.
3. All welding shall be performed by ASME-certified welders.

1.10 INSPECTIONS

A. General: During and upon completion of the work, arrange and pay all associated costs for inspections of all work installed under this Contract, in accordance with the Conditions of the Contract.

B. Inspections Required: As per the laws and regulations of the local and/or state agencies having jurisdiction at the project site.

C. Inspection Agency: Approved by the local and/or state agencies having jurisdiction at the project site.

PART 2 – PRODUCTS

2.1 GENERAL

A. Where Specified: Materials and equipment shall be as specified in subsequent sections of the Project Manual and/or as indicated on the Drawings.

B. General: All materials and equipment to be new, clean, undamaged, and free of defects and corrosion.

C. Acceptable Products: The product will be acceptable only when that product complies with all requirements of the Contract Documents as determined by the Engineer.

D. Common Items: Where more than one of any specific item is required, all shall be of the same type and manufacturer.

E. Listing: All materials and equipment shall be Underwriters' Laboratories (UL) or ETL SEMKO (ETL) listed and labeled where UL or ETL standards and listings exist for the specified materials or equipment.

F. Special Tools: Provide all special tools needed for proper operation, adjustment, and maintenance of equipment.

PART 3 – EXECUTION

3.1 GENERAL

A. The installation of all mechanical work shall be in accordance with the letter and intent of the Contract Documents as determined by the Engineer.

B. Installation Requirements: All materials and equipment shall be installed as recommended by the respective manufacturers, by mechanics experienced and skilled in their particular trade, in a neat and workmanlike manner, in accordance with the standards of the trade, and so as not to void any warranty, UL, or ETL listing.

3.2 DELIVERY STORAGE AND HANDLING

A. Packing and Shipping: Deliver products in original, unopened packaging and properly identified with manufacturer's identification and compliance labels.

B. Storage and Protection: Comply with all manufacturer's written recommendations. Protect all equipment, materials, and work from the weather elements, paint, mortar, construction debris, and damage throughout duration of project.

C. Damaged Products: Do not install damaged products. Arrange for prompt replacement.

3.3 EXAMINATION

A. Conditions Verification: Examine the areas and conditions under which the work is to be performed. Identify and Report any conditions detrimental to the proper and timely completion of the work to the Owner's Representative.

3.4 DIMENSIONS

A. Building Dimensions: Exact locations of building elements shall be based on contractor's field measurements.

B. Limiting Dimensions: Where equipment dimension and clearances are indicated on the Drawings, do not provide equipment larger than equipment dimensions or clearances specified.

C. Verify all dimensions by field measurements.

3.5 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

3.6 CUTTING AND PATCHING

A. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting and patching of mechanical equipment and materials required to:
   1. Uncover Work to provide for installation of non-coordinated and/or improperly installed work.
   2. Remove and replace defective Work.
   3. Remove and replace Work not conforming to requirements of the Contract Documents.
   4. Remove samples of installed Work as specified for testing.
   5. Install equipment and materials in existing structures.
   6. Uncover and restore Work to provide for Engineer observation of concealed Work.

C. Cut, remove, and legally dispose of equipment, components, and materials as indicated. Removal shall include all ancillary items associated with items removed. Remove all items made obsolete by the new work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated to be removed.

E. Provide and maintain temporary dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

F. Patch surfaces and building components using new materials matching existing adjacent materials.

3.7 ADMINISTRATION AND SUPERVISION

A. The Contractor shall supervise the work and shall have at all times some competent person, approved by the Owner, following the work to receive instructions and to act with authority.

3.8 TESTING AND ADJUSTING

A. General: Provide testing equipment, materials, instruments, and personnel to perform all test procedures and adjustments required by the Contract Documents and/or deemed necessary by the Engineer to establish proper performance and installation of systems and equipment. All test instruments to be accurately calibrated and in good working order.

B. Scheduling: Schedule tests at least three days in advance and so as to allow Engineer and Owner representative(s) to witness the test, unless directed otherwise. Do not schedule tests until the system installation is complete and fully operational unless indicated or directed otherwise.

C. Correction/Replacement: After testing, correct any deficiencies and replace materials and equipment shown to be defective or unable to perform at design or rated capacity. Retest without additional cost to the Owner or Contract. Submit finalization report indicating corrective measures taken and satisfactory results of retest.

3.9 SYSTEMS DEMONSTRATION

A. Instruct the Owner's representative(s) in the startup, operation, and maintenance of all systems and equipment in accordance with the Contract Documents.

3.10 CLEANING

A. General: Remove from the project site all waste, rubbish, and construction debris weekly unless indicated otherwise. The premises shall be left clean and free of any debris and unused construction materials, prior to final acceptance.

B. Equipment: Remove all dust, dirt, debris, mortar, rust, and other foreign materials from the interior and exterior of all equipment and enclosures, and wipe down.

C. Utilities: Thoroughly clean all utilities just prior to final inspection.

3.11 TOUCH-UP PAINTING

A. Touch-Up Painting: Restore and refinish to original condition all surfaces of equipment scratched, marred, and/or dented during shipping, handling, or installation. Remove all rust prior to prime and paint as recommended by the manufacturer.

END OF SECTION

SECTION 230004 – COORDINATION WITH OTHER TRADES

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. This section describes the coordination and procedural requirements for Contractors.

B. Definitions:
1. Owners Representative - Architect, Engineer, Construction Manager, General Contractor, Clerk of the works, or any stipulated Agent or Representative of the Owner.
2. GC - General Contractor.
3. MC - Mechanical Contractor/Subcontractor.
4. PC - Plumbing Contractor/Subcontractor.
5. EC - Electrical Contractor/Subcontractor.
6. SM - Sheet Metal Subcontractor.
7. SC - Sprinkler Contractor/Subcontractor.

1.2 COMPLIANCE

A. Cost incurred including those of other contractors and/or Owner due to non-compliance with this Section shall be the responsibility of the non-compliant contractor.

1.3 SUBMITTALS

A. Complete coordinated shop drawing shall be submitted in PDF and ACAD format to the Engineer for their record by the MC. Submitted coordinated shop drawing shall include all signatures required by sign off procedure.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.1 COORDINATION

A. General: Sequence, coordinate, and integrate the installation of all materials and equipment for efficient flow of work in conjunction with the other trades. Review and become familiar with all of the Drawings and work of all the other trades. Report and resolve any discovered discrepancies and/or interferences prior to commencing work.

B. Cooperation: Cooperate with the other Contractors and individual disciplines for placement, anchorage and accomplishment of the work.

C. Chases, Slots, and Openings: Arrange for chases, slots, and openings during the progress of construction, as required to allow for installation of the work.

D. Supports and Sleeves: Coordinate the location installation of required supporting devices and sleeves to be set in concrete and other structural components, as they are constructed.

E. Right-Of-Way:

1. Adjust location of utilities, equipment, etc., to accommodate the work to prevent interferences – both anticipated and encountered.
2. Determine the exact route and location prior to fabrication.
3. Pitched piping has the right-of-way over utilities which do not pitch.
4. Furnish and install ancillary materials and equipment including but not limited to traps, air vents, drains, etc., as required to accommodate offsets, transitions, and changes in direction.

F. Headroom: Install systems, materials, and equipment to maximize headroom unless noted otherwise.

G. Utility Connections: Coordinate connection with underground and overhead utility services. Comply with requirements of governing regulations, utility providers, and controlling agencies. Provide required connection for each service.

3.2 COORDINATED SHOP DRAWINGS

A. The coordination shop drawing process shall occur in the following manner:

1. The MC shall create 3/8-inch scale AutoCAD (2002 or newer) base plans, which shall incorporate and coordinate with structural steel and ceiling system framing supports and show framing members on the shop drawings. This shall include existing building components not shown on Contract Documents.
2. The MC shall require the Sheet Metal Subcontractor to submit AutoCAD shop drawings, as expeditiously as possible, to the Engineer (through normal channels) for review and approval. The shop drawings shall incorporate all ductwork (including top and bottom of duct elevations at a maximum interval of 25 linear feet and at each elevation change), structural steel (building and miscellaneous support steel), equipment, and accessories as shown and/or specified in the contract documents.
3. All roof penetrations, wall, and floor openings shall be coordinated with the structural steel Subcontractor, Supplier, and/or Erector through the Owner's Representative. All conflicts with structural steel members shall be resolved through the Owner's Representative.
4. After review and final approval of the sheet metal shop drawing by the Engineer, the sheet metal Subcontractor shall incorporate all required corrections, additions, and modifications on the AutoCAD ductwork shop drawings.
5. The approved AutoCAD ductwork shop drawings shall be utilized for coordination with all other Contractors or Subcontractors whose involvement is mandated. The SM shall submit the AutoCAD ductwork shop drawings (hard copy and electronic files) to the MC to initiate the "coordination" process. The MC shall review the drawings for accuracy and completeness prior to distribution.
6. The MC shall forward with transmittal the ductwork shop drawings (hard copy and electronic files) to the PC for coordination of the plumbing work. The MC shall forward a copy of the transmittal to the Owner's Representative.
7. The PC shall (upon receipt of drawings from the MC) superimpose his scope of work on the AutoCAD ductwork shop drawings illustrating all plumbing equipment, piping, and hangers.
8. The PC shall include invert of pipes, elevations (top and bottom) and pipe sizes including insulation at a maximum of 25-foot intervals and at each elevation change.
9. Any conflicts between the plumbing and ductwork shall be clouded by the PC on the AutoCAD ductwork shop drawing file.
10. PC shall request coordination meeting to resolve the conflicts as clouded on the coordinated shop drawings. PC shall provide clouded shop drawing at the coordination meeting. All conflicts that arise between the plumbing and ductwork shall be resolved through and by the Owner's Representative.

11. The PC and/or the SM shall correct and shall complete the AutoCAD drawings depicting all resolutions.
12. When it is ascertained that no conflicts exist between the ductwork and plumbing work, the PC shall forward the final ductwork/plumbing coordinated drawings (hard copy and electronic files) to the MC with transmittal and provide the Owner's Representative with a copy of the transmittal.
13. The MC shall (upon receipt of drawings from the PC) superimpose all heating and air conditioning piping, equipment, hangers, and insulation including elevations (top and bottom) and pipe sizes (including insulation) on the AutoCAD drawings.
14. Any conflicts between the ductwork/plumbing/mechanical work shall be clouded by the MC on the AutoCAD shop drawing file.
15. MC shall request coordination meeting to resolve the conflicts as clouded on the coordinated shop drawings. MC shall provide clouded shop drawing at the coordination meeting. All conflicts that arise between the MC, SM, and PC shall be resolved through and by the Owner's Representative.
16. The MC, PC, and SM shall correct and complete the AutoCAD drawings depicting all resolutions.
17. When it is ascertained that no conflicts exist between the MC, SM, and PC, the MC shall forward the final ductwork/plumbing/mechanical coordinated drawings (hard copy and electronic files) to the EC with transmittal and provide the Owner's Representative with a copy of the transmittal.
18. The EC shall (upon receipt of drawings from the MC) superimpose all electrical equipment including but not limited to light fixtures, conduit, and hangers on the AutoCAD drawings.
19. The EC shall include elevations of light fixtures, electrical conduit, and conduit sizes.
20. Any conflicts with the ductwork/plumbing/mechanical/electrical work shall be clouded by the EC on the AutoCAD shop drawing file.
21. EC shall request coordination meeting to resolve any conflicts as clouded on the coordinated shop drawings. EC shall provide clouded coordinated shop drawing at the coordination meeting. All conflicts that arise between the EC, MC, PC, and SM shall be resolved through and by the Owner's Representative.
22. The EC and/or the SM, PC, and MC shall correct and complete the AutoCAD drawings depicting all resolutions.
23. When it is ascertained that no conflicts exist between the EC, MC, PC, and SM, the EC shall forward the final ductwork/plumbing/mechanical/electrical coordinated drawings (hard copy and electronic file) to the SC with transmittal and provide the Owner's Representative with a copy of the transmittal.
24. The SC shall (upon receipt of drawings from the EC) superimpose all sprinkler equipment, piping, hangers, and sprinkler heads as required by the contract documents and the appropriate codes.
25. The SC shall include elevations of piping and piping sizes.
26. Any conflicts with the ductwork/plumbing/mechanical/electrical/sprinkler work shall be clouded by the SC on the AutoCAD shop drawings.
27. The SC shall request coordination meeting to resolve any conflicts as clouded on the coordinated shop drawings. SC shall provide clouded coordinated shop drawing at the coordination meeting. All conflicts that arise between the SC, EC, MC, PC, and/or SM shall be resolved through and by the Owner's Representative.
28. The SC and/or EC, MC, PC, and SM shall complete the AutoCAD drawings depicting all resolutions.

29. When it is ascertained that no conflicts exist between the SC, EC, MC, PC, and SM, the SC shall forward the final ductwork/plumbing/mechanical/electrical/sprinkler coordination drawing to the MC with transmittal, and provide the Owner's Representative with a copy of the transmittal.
30. Sign Off:
    a. The MC shall provide the final coordinated shop drawing to the Engineer and the Owner's Representative. The final coordinated shop drawing shall contain signatures from SM, PC, MC, EC, and SC on each sheet.
    b. Upon completion of the coordination process by all Contractors and Subcontractors as described above, they shall sign off on all drawings in ink indicating company, name, and date of sign-off and signature of company representative.
    c. Each contractor signature shall certify that each Contractor has shown their respective work on the drawings and have resolved all points of conflict and interference with other Contractors and Subcontractors.

3.3 COORDINATION MEETINGS

A. During the coordination process, separate meetings apart from project meetings concerning the progress and schedules may be called by the Owner's Representative when required or at the request of one or more of the coordinating Contractors.
   1. The Owner's Representative shall contact the Contractors and make all required arrangements (e.g., time, place, etc.).
   2. All Contractors shall place emphasis and importance on equipment purchases so as to not delay approvals, shop drawings, and the coordinated drawings.

3.4 SCHEDULE OF COORDINATED SHOP DRAWINGS

A. The MC and SM shall complete the ductwork shop drawings within 2 weeks after award of contract (or authorization to proceed).

B. Turn-around time for each Contractor shall be 2 weeks maximum.

3.5 "AS BUILT" DRAWINGS

A. At the completion of the project, "As Built" corrections shall be made to each AutoCAD drawing by each of the aforementioned Contractors and returned to the Owner's Representative for the Owner's permanent files and records. These "As Builts" do <u>not</u> remove the obligation of "As Builts" and record drawings as outlined under other sections of the specifications <u>unless</u> the Owner's Representative elects to do so.

END OF SECTION

SECTION 230500 – BASIC MECHANICAL MATERIALS AND METHODS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following basic materials and methods to complement other Division 23 Sections.
   1. Piping installation instructions common to most piping systems.
   2. Dielectric fittings.
   3. Flexible connectors.
   4. Mechanical sleeve seals.
   5. Sleeves.
   6. Escutcheons.
   7. Fire Stopping.
   8. Identifying devices and labels.
   9. Grout.
   10. Interior concrete housekeeping pads.
   11. Installation requirements common to equipment specification sections.
   12. Touch-up painting.
   13. Removals.
   14. Repairs.

B. Pipe, pipe fittings and joining materials, and methods are specified in Division 23 piping system sections.

1.2 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, crawl spaces, 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. NP: Nylon plastic.
   4. HDPE: High Density Polyethylene plastic.

5. PVC: Polyvinyl chloride plastic.

G. Existing: Condition present prior to award of this contract.

1.3 SUBMITTALS

A. Product Data: For all materials specified within this section

B. Fire Rated Penetration Listing Details: Submit Underwriters Laboratory (UL) penetration listing details specific to the penetrations required by the project along with fire stopping material data.

C. Quality Control Submittals: Fire stopping certificates specified in Quality Assurance below.

1.4 QUALITY ASSURANCE

A. Fire Stopping: Fire stopping installer shall be certified by the fire stopping manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Protect piping, flanges, fittings, and piping specialties to prevent pipe end damage. Maintain end caps through shipping, storage, and handling.

B. Store plastic pipes in locations not subject to direct sunlight.

C. Protect all stored materials from moisture and dirt. Elevate above grade and support to prevent sagging and bending. Do not exceed structural capacity of floor if stored inside.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where identifying devices are to be applied.

B. Install identifying devices before concealment.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Dielectric Components:
a. Watts Water Technologies, Inc.
b. Grinnell Corp.; Grinnell Supply Sales Co.
c. Victaulic Co. of America.
2. Metal, Flexible Connectors:
a. Engineered Flexible Products.
b. Flexicraft Industries.
c. Grinnell Corp.; Grinnell Supply Sales Co.
d. Mercer Rubber Co.
e. Metraflex Co.

3. Mechanical Sleeve Seals:
    a. Calpico, Inc.
    b. Metraflex Co.
    c. Proco Products, Inc.
    d. Thunderline/Link-Seal.
4. Fire-Stopping Sealant:
    a. Dow Corning Corp.
    b. 3M Corp.
    c. Hilti Corp.
5. Pipe Escutcheons:
    a. Chicago Specialty Mfg. Co.
    b. Sanitary-Dash Mfg. Co.
    c. Grinnell.
6. Identifying Devices:
    a. Craftsmark Identification Systems.
    b. Seton Identification Products.
    c. W.H. Brady Company.

2.1 DIELECTRIC FITTINGS

A. General: Assembly or fitting with insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.

B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.

C. Insulating Material: Suitable for system fluid, pressure, and temperature.

D. Dielectric-Flange Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers. Dielectric flange kit materials shall be compatible with system fluid, temperature, and pressure.

E. Dielectric Couplings: ARE NOT ALLOWED

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining, and 300 psig (2070 kPa) minimum working pressure at 225 DegF (107 DegC). Coordinate end selection with piping system specifications.

2.2 FLEXIBLE CONNECTORS

A. General: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections. Include 125 psig (860 kPa) minimum working-pressure rating at 220 DegF unless higher working pressure or temperature is indicated. Coordinate end selection with piping system specifications.

B. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors (non-potable applications only): Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.

2.3 MECHANICAL SLEEVE SEALS

A. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with stainless steel bolts and pressure plates, which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical isolation.

2.4 SLEEVES

A. General: The following materials are for wall, floor, slab, and roof penetrations.

B. Pipe:
   1. Steel Sheet Metal: 0.0359-inch (0.9-mm) minimum thickness, galvanized, round tube closed with welded longitudinal joint.
   2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, and plain ends. Provide integral waterstop where indicated.
   3. Cast Iron: Cast or fabricated pipe equivalent to ductile-iron pressure pipe with plain ends and integral waterstop.
   4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
      a. Underdeck Clamp: Clamping ring with set screws.

C. Ductwork
   1. All sleeves shall be per SMACNA.

2.5 ESCUTCHEONS

A. General: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
   1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
   2. OD: Completely cover opening.
   3. Stamped Steel: One piece, with set screw and chrome-plated finish.
   4. Stamped Steel: Split plate with concealed hinge, set screw, and chrome-plated finish.

2.6 FIRE STOPPING

A. UL listed material specific to the UL penetration listing detail.

2.7 IDENTIFYING DEVICES AND LABELS

A. Equipment Nameplates: Metal nameplate with operational data engraved or die-stamped; permanently fastened to equipment.
   1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.

B. Stick-on Pipe Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl complying with ASME A13.1.

C. Stick-on Duct Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl complying with ASME A13.1.

D. Stick-on Flow Marker: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl, 2-inch wide band, color coded complying with ASME A13.1.

E. Rigid Pipe Markers: Manufacturer's standard preprinted, color coded, rigid plastic with flow arrows and fluid medium designed to be applied to piping systems without the need of adhesives. For markers up to 6 inches, markers shall wrap completely around the pipe, and their own tension shall secure them in place. For markers over 6 inches, markers shall be provided with nylon ties to secure marker to piping system Markers comply with ANSI/ASME A13.1.

F. Valve Tags: Stamped or engraved 0.032-inch- (0.8-mm-) thick, polished brass, 1-1/2-inches (40-mm) diameter with 1/4-inch (6-mm) piping system abbreviation letters and 1/2-inch (13-mm) sequenced numbers. Include 5/32-inch (4-mm) hole and brass, wire-link or beaded chain, or brass S-hook fastener.

G. Framed Valve Schedule: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include appropriate mounting hardware. Valve schedule shall be 8-1/2-inch by 11-inch with a minimum font height of 12 point. Frame shall be extruded aluminum with ASTM C1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass. Schedule shall include valve number, piping system, system abbreviation as shown on valve tag, location of valve (room or space), and normal operating position (open, closed or modulating). Indicate valves utilized for emergency shut off or other special purposes.

H. Access Panel Markers: 1/16-inch- (2-mm-) thick, engraved plastic-laminate markers, with abbreviated terms and numbers corresponding to concealed valve. Provide 1/8-inch (3-mm) center hole for attachment.

I. Plastic Equipment Markers: ASME A13.1, color-coded, laminated plastic. Include lettering identifying name, equipment service, design capacity, pressure drop, entering and leaving conditions, and RPM indicated on the Contract Documents. Size shall be 2-1/2 by 4 inches (65 by 100 mm) for control devices, dampers, and valves; and 4-1/2 by 6 inches (115 by 150 mm) for equipment. Identifying names and/or abbreviations shall match those indicated on the Contract Documents.

2.8 GROUT

A. Non-shrink, Non-metallic Grout: ASTM C1107, Grade B, post-hardening, volume-adjusting, dry, non-staining, non-corrosive, non-gaseous, hydraulic-cement grout recommended for interior and exterior applications. Design mix shall be 5000-psig (34.5-MPa), 28-day compressive strength.

2.9 INTERIOR CONCRETE HOUSEKEEPING PADS

A. Concrete: 3000-psig (20.7-MPa), 28-day compressive-strength concrete.

B. Form work: 14-gauge galvanized steel frame

C. Dowels: #4 rebar

D. Reinforcement: 6 by 6 – W 2.9 by W 2.9 wire metal mesh at center

PART 3 – EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. General: Install piping as described below unless piping sections specify otherwise.

B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install components with pressure and temperature ratings equal to or greater than system operating pressure and temperature.

D. Install piping free of sags and bends. Install fittings for changes in direction and branch connections. Install fittings, couplings, and accessories according to manufacturer's written instructions.

E. Install piping at parallel and perpendicular to building walls. Diagonal runs are prohibited unless otherwise indicated. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

F. In areas of exposed piping, install piping to maximize headroom. In areas with ceilings, install piping to maximize clearance between ceiling and pipe. Allow sufficient space for ceiling panel removal.

G. Install piping to allow application of insulation plus 1-inch (25-mm) clearance around insulation.

H. Install pipe escutcheons for pipe penetrations of walls, partitions, floors, and ceilings.

I. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, threaded nipple, and chained cap.

J. Install line size manual shutoff valve at each connection to each piece of equipment.

K. Install piping so that accessories are accessible for operation, maintenance, repair, and replacement.

L. Install piping with sufficient clearance to allow for expansion and contraction.

M. Sleeves are not required for core drilled holes through interior solid concrete walls and floors above grade exterior solid concrete walls and existing underground solid concrete walls. Floors in mechanical equipment areas or other wet areas shall be provided with a sleeve with waterstop.

N. Install sleeves for pipes passing through walls, partitions, and 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 (50 mm) above finished floor level. In floors with water stop, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring.
   2. Build sleeves into new walls and slabs as walls and slabs are being constructed.
   3. Install sleeves in non-fired rated assemblies large enough to provide 1/2-inch (12.7-mm) annular clear space between sleeve and pipe or pipe insulation.
   4. Install sleeves in fire rated assemblies per ASTM E814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

O. Interior Wall and Floor Pipe Penetrations: Sleeves shall be steel pipe except steel sheet metal shall be used for gypsum wall penetrations.

P. Water Proof Floor and Roof Pipe Penetrations: For pipes penetrating floors and roofs with membrane waterproofing, install stack sleeve fitting. Secure flashing between clamping flanges. Seal space outside of sleeve fittings with non-shrink, non-metallic grout. Provide Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant between sleeve and pipe.

Q. Aboveground, Exterior-Wall, Pipe Penetrations:
   1. Masonry Wall: Provide steel pipe wall sleeve. Seal space outside of sleeve with non-shrink, non-metallic grout. Provide Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant between sleeve and pipe.
   2. Non-Masonry or Non-Concrete Walls: Provide wall plate matching surrounding construction. Fill gap between wall opening and pipe with mineral wool. Provide Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant between wall plate and wall.

R. Underground, Exterior-Wall, Pipe Penetrations: Provide cast-iron or galvanized steel sleeves with integral waterstop except for existing walls. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for annular clear space between pipe and sleeve for installing mechanical sleeve seals. Annular clear space shall be per mechanical sleeve seal manufacturer's written recommendation. Assemble and install mechanical sleeve seals according to manufacturer's written instructions.

S. Verify final equipment locations for roughing-in.

T. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
   1. Threaded Steel Pipe Joints: Thread pipe with tapered pipe threads in accordance with ANSI B2.1, and ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than 3 threads exposed. 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
   2. Welded Steel Pipe Joints: Weld pipe joints in accordance with applicable ASME Codes and AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe."
   3. Flanged Steel Pipe Joints: Clean flange faces and install gaskets. Align flange surfaces parallel. Use suitable lubricants on bolt threads. Tighten bolts to torque specified by manufacturer of flange and flange bolts to provide uniform compression of gaskets.
   4. Grooved Steel Pipe Joints: Install per grooved piping manufacturer's written installation instructions.
   5. Copper Pipe Joints: Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
   6. Gasket Materials: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.
   7. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
   8. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
   9. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:
      a. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.

b. ABS Piping: ASTM D2235 and ASTM D2661.
c. CPVC Piping: ASTM D2846 and ASTM F493.
d. PVC Pressure Piping: ASTM D2672.
e. PVC Nonpressure Piping: ASTM D2855.
f. PVC to ABS Nonpressure Transition Fittings: Procedure and solvent cement according to ASTM D3138.

10. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D2657 procedures and manufacturer's written instructions.
    a. Plain-End Pipe and Fittings: Use butt fusion.
    b. Plain-End Pipe and Socket Fittings: Use socket fusion.

U. Piping Connections: Make connections according to the following unless otherwise indicated:
1. Remake leaking joints using new materials.
2. Install unions in piping, 2 inches NPS (DN50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
3. Install flanges, in piping 2-1/2 inches NPS (DN65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
4. Piping Systems: Install dielectric fittings to connect piping materials of dissimilar metals.

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to provide maximum possible headroom if mounting heights are not indicated.

B. Install equipment level and plumb, parallel, and perpendicular to other building systems and components unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting and without interference(s) to other installations.

D. Extend grease fittings to accessible locations.

3.3 FIRE STOPPING

A. Fire Stopping: At penetrations through fire-rated walls, partitions, barriers, ceilings, roofs, or floors, the fire rated integrity shall be maintained. Provide manufacturer's standard fire-stopping sealant with accessory materials having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E814 by Underwriters Laboratory, Inc., or other testing and inspecting agency acceptable to authorities having jurisdiction.

3.4 LABELING AND IDENTIFYING

A. Piping Systems: Install pipe markers on all piping of each system (insulated and un-insulated) including pipe sizes, fluid medium, and direction of flow arrows.
1. Interior, non-metal jacketed piping systems: Provide stick-on markers. Install flow marker 360 degrees at each end of each pipe marker.
2. Interior metal jacketed and exterior piping systems: Provide rigid markers for markers on piping over 6 inches provide nylon ties. Provide stick-on size marker attached to rigid marker.
3. Markers shall be spaced at a maximum of 25-foot (7.5-m) intervals along each run. In addition to the 25-foot intervals, provide markers at the following locations:

a. Near each valve and control device.
b. Near each branch excluding short takeoffs for fixtures and terminal units.
c. Near locations where pipes pass through walls, floors, ceilings, or enter non-accessible enclosures.
d. At access doors, manholes, and similar access points that permit view of concealed piping.
e. Near major equipment items and other points of origination and termination.

B. Valve Tags
1. Install on all valves and control devices (factory and field installed) except check valves. List tagged valves in valve schedule.
2. Provide framed valve schedule(s) where directed by Owner's representative.

C. Install plastic equipment marker on all equipment provided under this contract.

D. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers. Duct markers shall identify service and direction of flow. Locate markers at maximum intervals of 50 feet (15 m) near points where ducts enter and exit the space, and on ducts located behind all access doors.

E. Provide additional mechanical identification materials and devices to supplement field or factory supplied nameplates that have become visually blocked by work of this or other Divisions.

F. Clean faces of identification devices and glass frames of valve charts.

3.5 TOUCH-UP PAINTING

A. Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 GROUTING

A. Install nonmetallic, non-shrink, grout for mechanical equipment base bearing surfaces, pump, and other equipment base plates and anchors. Mix and cure grout according to manufacturer's written instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placing of grout.

E. Place grout to provide smooth bearing surface for equipment base.

F. Place grout, completely filling equipment bases.

G. Place grout around anchors.

3.7 INTERIOR CONCRETE HOUSEKEEPING PADS

A. Provide concrete housekeeping pads for all floor mounted equipment. Provide a 6-inch tall, 3000 psi concrete pad having 6 by 6 – W2.9 by W 2.9 wire metal mesh at center. Extend pad a minimum of 4 inches greater than equipment footprint in all directions. Provide a smooth trowel finish on top surface of pad.

B. Provide 14-gauge galvanized steel frame around entire perimeter of pad having a 3/4-inch chamfer at all corners and at all edges. Frame to extend 1/2 inch over top of pad and 1 inch beneath bottom surface of pad. All corners to be welded.

C. Anchor pad to existing or new concrete floor with #4 rebar dowels set at a minimum 12 inches on center in each direction having the last 2 inches of dowel bent at a 90-degree angle.

1. Existing floors: Drill 1-inch diameter bores into the existing concrete floor at a minimum depth of 2 inches to accept dowels. Fasten dowels within bores with epoxy grout.
2. Newly poured floors: Provide rebar dowels embedded to a depth of 2 inches below floor surface having the last 2 inches of dowel bent at a 90-degree angle.

D. Prior to pouring concrete pad, place manufacture's recommended galvanized steel anchor bolts into pad using the equipment template provided.

E. Provide 5000-psi level grout bedding beneath equipment prior to setting and final tightening of fasteners.

3.8 REMOVALS

A. Disconnect and remove work where indicated on the Contract Documents in its entirety.

B. Removal: Remove indicated equipment, piping, ductwork, insulation, and associated components from Project site and dispose of in a legal manner. Provide Owner's right of first refusal for all equipment removed.

C. Where work is indicated to be abandoned in place, cut and remove pipe or ductwork a minimum of 2 inches (50 mm) beyond the wall, floor, ceiling, or roof. Patch surface to match existing finish of adjacent construction.

D. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

3.9 REPAIRS

A. If existing or new work is damaged or disturbed, remove damaged sections and install new products of equal capacity and quality.

END OF SECTION

SECTION 230513 – ELECTRICAL REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 – GENERAL

1.1 SUMMARY

A. This section specifies the basic requirements for electrical components, which are furnished with mechanical equipment (factory or field installed).

1.2 REFERENCES

A. The following references shall be applicable:
1. NEMA Standards MG 1: Motors and Generators.
2. NEMA Standards ICS 2: Industrial Control Devices, Controllers, and Assemblies.
3. NEMA Standard 250: Enclosures for Electrical Equipment.
4. NEMA Standard KS 1: Enclosed Switches.
5. Comply with National Electrical Code (NFPA 70).

1.3 SUBMITTALS

A. Factory furnished electrical component product data submittal requirements are specified within the individual equipment specification sections.

1.4 QUALITY ASSURANCE

A. Electrical components and materials shall be UL or ETL labeled.

PART 2 – PRODUCTS

2.1 MOTORS

A. Electrical Characteristics shall meet the following unless otherwise indicated:
1. Frequency Rating: 60 Hz.
2. Voltage Rating: Determined by voltage of circuit to which motor is connected for the following motor voltage ratings (utilization voltages):
a. 120V circuit: 115V motor rating.
b. 208V circuit: 200V motor rating.
c. 240V circuit: 230V motor rating.
d. 480V circuit: 460V motor rating.

B. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
1. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.

C. Service Factor: 1.15 for poly-phase motors and 1.35 for single-phase motors unless otherwise indicated.

D. Temperature rating: Rated for 104 DegF (40 DegC) environment.

E. Temperature rise: Rated for maximum of 194 DegF (90 DegC) rise for continuous duty at full load, Class B insulation except for inverter-duty rated motors, which shall use Class F insulation.

F. Starting capability: Frequency of starts as required to meet automatic control system sequence of operation and not less than 5 evenly timed starts per hour.

G. Capacity: Sufficient to start and operate connected loads without exceeding name plate ratings.

H. Motor construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B" except "C" where required for high starting torque.
   1. Bearings:
      a. Regreasable except permanently sealed motor.
      b. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
   2. Mounting:
      a. Horizontal: foot mounted.
      b. Vertical: base mounted.
   3. Enclosure Type: See individual equipment specifications for enclosure type.
   4. Lifting Lug: lifting eye or lug for all motors exceeding 50 pounds.
   5. Stamped Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, efficiency, special features, and similar information.
   6. All motors 1 horsepower and larger shall be premium efficiency, constant speed, rpm as specified, squirrel cage unless otherwise required to meet driven equipment's maximum starting duty. Minimum full-load nominal efficiencies per IEEE Standard 112, Test Method B, shall be equal to or greater than those listed in the following tables.

I. Polyphase Motors:
   1. General: Squirrel-cage induction-type conforming to the following requirements except as otherwise indicated.
   2. Variable Speed Motors for Use with Solid-State Drives: Energy efficient, invertor ready, design B units with ratings, characteristics, and features coordinated with drive manufacturer.
   3. Bearings: Suitable for radial and thrust loading of the application.
   4. Severe Duty Motors: Minimum 1.25 service factor. Provide motors with regreasable bearings and equipped with capped relief vents. Insulate windings with nonhygroscopic material.
   5. Motors for Reduced Inrush Starting: Coordinate with reduced inrush controller type and with characteristics of driven equipment load. Provide required wiring leads in motor terminal box to suit control method.

J. Single-Phase Motors:
   1. Energy Efficient Motors: One of the following types as selected to suit the starting torque and other requirements of the specific motor application.
      a. Permanent Split Capacitor.
      b. Split-Phase Start, Capacitor-Run.
      c. Capacitor-Start, Capacitor-Run.
      d. Shaded-Pole.
      e. Capacitor Start, Induction Run.
   2. Internal Thermal Overload Protection for Motors: Protection shall automatically open the power supply circuit to the motor or a control circuit. Protection shall operate when winding temperature exceeds a safe value calibrated to the temperature rating of the motor insulation. Motor shall automatically reset when motor temperature returns to normal range.

3. Bearings: Belt connected motors or other motors with high radial forces on motor shaft shall be ball bearing type. Sealed, prelubricated sleeve bearings may be used for other single-phase motors.

2.2 STARTERS, DISCONNECTS AND ACCESSORIES

A. Motor Starter Characteristics:

1. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and startup condition. Minimum size starter shall be NEMA Size 1.

B. Manual Disconnect Switches:

1. Fusible switches: Fused, each phase; general duty; horsepower rated; non-teasible quick-make, quick-break mechanism; dead front line side shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro silver plated current carrying parts; hinged doors; operating lever arranged for locking in the "OPEN" position; arc quenchers; capacity; and characteristics as required by equipment manufacturer.
2. Non-fusible switches: Horsepower rated toggle switch type; quantity of poles and voltage rating as required by equipment manufacturer.

C. Magnetic Starters:

1. Hand-off-auto, selector switches and pilot lights.
2. Trip-free thermal overload relays, each phase.
3. Interlocks, switches, contacts, and similar devices as required for coordination with control requirements.
4. Built-in control circuit transformer, sized by manufacturer. Provide with minimum two normally-open and two normally-closed spare auxiliary contacts.
5. Externally operated manual reset.
6. High voltage and low voltage protection in all three phases.
7. Internal Thermal Overload Protection for Motors: Protection shall automatically open control circuit. Protection shall operate when winding temperature exceeds safe value calibrated to the temperature rating of the motor insulation.

D. Starter Enclosures:

1. NEMA rated as required for environment in which equipment is to be installed.
2. Interlock covers of combination starters with operating handle providing access to inside of enclosure only when disconnect is in "OFF" position. Provide means to attach multiple padlocks for locking external operating handle in either the "ON" or "OFF" position.
3. Provide red colored RESET Button in cover of starter.
4. Provide and secure wiring diagram corresponding to motor and control wiring of associated equipment on inside of each magnetic and combination starter.
5. Manual starter shall have means for externally locking operating mechanism in "OFF" position.

E. Factory Installed Motor Connections:

1. Flexible conduit, except where plug-in electrical cords are specifically indicated.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Motors: Install field-installed motors in accordance with manufacturer's published instructions and the following:
   1. Direct Connected Motors: Mount securely in accurate laser alignment.
   2. Belt Drive Motors: Use adjustable motor mounting bases. Align pulleys and install belts. Use belts identified by the manufacturer and tension belts in accordance with manufacturer recommendations.
   3. Bearings: Provide extended lube lines for regreasable motors.

B. Motor Controllers (starters, Disconnects and Drives): Install field-installed starters, disconnects and drives in accordance with manufacturer's published instructions and the following:
   1. Locate controllers within sight of motors controller.
   2. Mounting: For control equipment at walls, bolt units to wall or mount on light-weight structural steel channels bolted to the wall. For controllers not at walls, provide freestanding racks fabricated of structural steel members and light-weight slotted structural steel channels. Use feet consisting of 3/8-inch thick steel plates, 6-inch square, bolted to the floor. Use feet for welded attachment of 1-1/2-inch thick steel plates, 6-inch square, bolted to the floor. Use feet for welded attachment of 1-1/2-inch by 1-1/2-inch by 1/4-inch vertical angle pots not over 3 feet on centers. Connect the posts with horizontal lightweight slotted steel channels and bolt the control equipment to the channels.
   3. Clearances: All motor controllers shall be installed per NEC requirements.

3.2 ACCEPTANCE

A. The right is reserved by the Owner's Representative to reject any motor, which, in his opinion, either under test or in actual service is found to be overloaded, develops excessive mechanical noise, magnetic hum, or otherwise operates unsatisfactorily within the speed range and load specified. The contractor shall adjust or if necessary replace any such deflected motor with one satisfactory to the Owner or Owner's Representative without any extra cost to the Owner.

END OF SECTION

SECTION 230529 – SUPPORTS AND ANCHORS

PART 1 – GENERAL

1.1 SUMMARY

A. This section specifies mechanical hangers, support, and anchors and includes the following:
   1. Horizontal-piping hangers and supports.
   2. Vertical-piping clamps.
   3. Hanger-rod attachments.
   4. Building attachments.
   5. Saddles and shields.
   6. Spring hangers and supports.
   7. Miscellaneous materials.
   8. Pipe alignment guides.
   9. Anchors.
   10. Equipment supports.

1.2 SUBMITTALS

A. Product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.

B. Assembly-type shop drawings for each type of support and anchor indicating dimensions, weights, required clearances, and methods of assembly of components.

C. Details of trapeze hangers and upper attachments for piping 4 inches in diameter and over. Include the number and size of pipe lines to be supported on each type of trapeze hanger.

D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

1.3 QUALITY ASSURANCE

A. NFPA Compliance: Hangers and supports shall comply with NFPA Standard No. 13 when used as a component of a fire protection system.

B. MSS Compliance: Provide hangers, supports, and components conforming to the latest requirements of MSS Standard Practices SP-58 and SP-69.

C. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code-Steel."
   1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

D. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

E. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.
   1. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

PART 2 – PRODUCTS

2.1 MANUFACTURED UNITS

A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.
   1. Components include galvanized coatings where installed for piping and equipment that will not have a field-applied finish.
   2. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

B. Thermal-Hanger Shield Inserts: 100-psi (690kPa) average compressive strength, waterproofed calcium silicate, encased with sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.

C. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

2.2 PIPE HANGERS AND SUPPORTS

A. Pipe Insulation Shields: Fabricated of steel, with a minimum of 180 degrees unless otherwise indicated. Shields for use with hangers and supports with the exception of combination clevis type hangers shall be in accordance with the following schedule:

PIPE OR TUBING SIZE (INCHES)	**SHIELD LENGTH (INCHES)**	**SHIELD GAGE**
Up to 2	12	18
3 and 4	12	16
6	18	16
8 & up	24	12

B. Pipe Covering Protection Saddles: 3/16-inch thick steel of sufficient depth for the insulation thickness specified, notched so that saddle contact with the pipe is approximately 50 percent of the total axial cross section. Saddles for pipe 12 inches in size and larger shall have a center support.

C. Pipe Hangers: Height adjustable standard duty clevis type with cross bolt and nut. Pipe spreaders or spacers shall be used on cross bolts of clevis hangers when supporting piping 10 inches ips and larger.

D. Adjustable Floor Rests and Base Flanges: Steel.

E. Hanger Rods: Galvanized, mild low carbon steel, fully threaded with two nuts at each end for positioning rod and hanger and locking each in place.

F. Riser Clamps: Malleable iron or steel.

G. Rollers: Cast Iron.

H. Restraints, Anchors, and Supports for Grooved End Piping System: As recommended by the grooved end fitting manufacturer.

2.3 FASTENERS

A. Sleeve Anchors (Group II, Type 3, Class 3): Molly's Div. /USM Corp. Parasleeve Series, Ramset's Dynabolt Series, or Red Head/Phillips AN1405, HN-1614, FS-1411 Series.

B. Wedge Anchors (Zinc Plated, Group II, Type 4, Class 1): Hilti's Kwik Bolt Series, Molly's Div. /USM Corp. Parabolt PB Series, Ramset's Trubolt T Series, or Red Head/Phillips WS-3822.

C. Self-Drilling Anchors (Group III, Type 1): Ramset's RD Series, or Red Head/Phillips Series S-14.

D. Non-Drilling Anchors (Group VIII, Type 1): Ramset's Dynaset DS Series, Hilti's HDI Series, or Red Head/Phillips J Series.

E. Stud Anchors (Group VIII, Type 2): Red Head/Phillips JS-38 Series.

F. Continuous Slotted Type Concrete Insert, Galvanized:
   1. Load Rating:
      a. 800 pounds/feet: Kindorf's D-986.
      b. 1500 pounds/feet: Kindorf's D-980.
      c. 3000 pounds/feet: Hohmann & Barnard's Inc. Type CS-H.
      d. 4500 pounds/feet: Hohmann & Barnard's Inc. Type CS-HD.

G. Threaded Type Concrete Insert: Galvanized ferrous castings, internally threaded to receive 3/4-inch diameter machine bolts.

H. Wedge Type Concrete Insert: Galvanized box-type ferrous castings, internally threaded to receive 3/4-inch bolts having special wedge shaped heads.

I. Bolts, Nuts, Washers, Lags, and Screws: Medium carbon steel, size and type to suit application, galvanized for high humidity locations, and treated wood, plain finish for other interior locations. Except where shown otherwise on the Drawings, furnish type, size, and grade required for proper installation of the Work.

2.4 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A36/A36M, steel plates, shapes, and bars, black, and galvanized.

B. Bolts and Nuts: ASME B18.10 or ASTM A183, steel, hex-head, track bolts, and nuts.

C. Washers: ASTM F844, steel, plain, flat washers.

D. Grout: ASTM C 1107, Grade B, nonshrink, nonmetallic.
   1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is nonstaining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.
   2. Design Mix: 5000-psi (34.5MPa), 28-day compressive strength.
   3. Water: Potable.
   4. Packaging: Premixed and factory-packaged.

E. Pipe Alignment Guides: Factory fabricated, of cast semi-steel or heavy fabricated steel consisting of bolted two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe.
   1. Length of guides: As recommended by manufacturer to allow indicated travel.

PART 3 – EXECUTION

3.1 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Install hangers, supports, clamps, and attachments to support piping properly from building structure; comply with MSS SP-69 and SP-89. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.

B. Do not hang or support one pipe from another or from ductwork.

C. Support all insulated horizontal piping conveying refrigerants or other fluids below ambient temperature by means of hangers or supports with insulation shields installed outside of the insulation.

D. Space hangers or supports for horizontal piping on maximum center distances as listed in the following hanger schedules except as otherwise specified or noted on the Drawings.

PIPE MATERIAL	MAXIMUM SPACING (FEET)
Copper Pipe	12
Copper tubing, 1-1/4 inches and smaller	6
Copper tubing, 1-1/2 inches and larger	10
CPVC pipe or tubing 1-1/4 inches and smaller	3
CPVC pipe and tubing 1-1/2 inches and larger	4
PVC pipe	4
Steel Pipe	12

E. For Steel Pipe Gas Lines: Space hangers or supports on maximum centers of 6 feet for 1/2-inch pipe size; 8 feet for 3/4- and 1-inch pipe sizes, and 10 feet for 1-1/4-inch pipe size above.

F. For Grooved End Steel Pipe:

PIPE SIZE (INCHES)	MAXIMUM SPACING (FEET)
1-1/2 and under	7
2 through 4	10
5 and over	12

1. No pipe length shall be left unsupported between any two coupling joints.

G. For Directional Changes: Install a hanger or support close to the point of change of direction of all pipe runs in either a horizontal or vertical plane.

H. For Concentrated Loads: Install additional hangers or supports, spaced as required and directed, at locations where concentrated loads such as in-line pumps, valves, fittings, or accessories occur to support the concentrated loads.

I. For Branch Piping Runs and Runouts over 5 feet in Length: Install a minimum of one hanger and additional hangers if required by the hanger spacing schedules.

J. Parallel Piping Runs: Where several pipe lines run parallel in the same plane and in close proximity to each other, trapeze hangers may be submitted for approval. Base hanger spacing for trapeze type hangers on the smaller size of pipe being supported. Design the entire hanger assembly based on a safety factor of five for the ultimate strength of the material being used.

K. Support floor drain traps from the overhead construction with hangers of type and design as required and approved. Overhead supports are not required for floor drain traps installed directly below earth supported concrete floors.

L. Size hanger rods in accordance with the following:

PIPE OR TUBING SIZE (INCHES)	SINGLE ROD HANGER SIZE (INCHES)		DOUBLE ROD HANGER SIZE (INCHES)	
	PIPE	TUBING	PIPE	TUBING
Up to 2	3/8	1/4	3/8	1/4
2-1/2 and 3	1/2	3/8	3/8	1/4
4 and 5	5/8	1/2	1/2	3/8
6	3/4	1/2	5/8	1/2
8, 10 and 12	7/8	5/8	3/4	5/8

M. Size hanger rods, for piping over 12 inches in size and multiple line supports based on a safety factor of five for the ultimate strength of the materials being used.

N. Secure hanger rods as follows: Install one nut under clevis, angle, or steel member; one nut on top of clevis, angle or steel member; one nut inside insert or on top of upper hanger attachment and one nut and washer against insert or on lower side of upper hanger attachment. A total of four nuts are required for each road, two at upper hanger attachment and two at hanger.

O. Vertical Piping:

1. Support vertical risers of piping systems by means of heavy duty hangers installed close to base of pipe risers and by riser clamps with extension arms at intermediate floors with the distance between clamps not to exceed 25 feet unless otherwise specified. Support pipe risers in vertical shafts equivalent to the aforementioned. Install riser clamps above floor slabs with the extension arms resting on floor slabs. Provide adequate clearances for risers that are subject to appreciable expansion and contraction caused by operating temperature ranges.
2. Support extension arms of riser clamps, secured to risers to be insulated for cold service, 4 inches above floor slabs to allow room for insulating and vapor sealing around riser clamps.
3. Install intermediate supports between riser clamps on a maximum 6-foot centers for copper tubing risers 1-1/4 inches in size and smaller, installed in finished rooms or spaces other than mechanical equipment machine or steam service rooms or penthouse mechanical equipment rooms.
4. Floor Supports: Install adjustable yoke rests with base flanges for the support of piping unless otherwise indicated on the Drawings. Install supports in a manner, which will not be detrimental to the building structure.

P. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts.

Q. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

R. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

S. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9 “Building Services Piping” is not exceeded.

3.2 UPPER HANGER ATTACHMENTS

A. General:

1. In all cases, secure upper hanger attachments to overhead structural steel, steel bar joists, or other suitable structural members.
2. Do not attach hangers to steel decks which are not to receive concrete fill.
3. Do not attach hangers to precast concrete plank decks less than 2-3/4 inches thick.
4. Do not use flat bars or bent rods as upper hanger attachments.

B. Attachment to Steel Frame Construction: Provide intermediate structural steel members where required by pipe support spacing. Select steel members for use as intermediate supports based on a minimum safety factor of five.

1. Do not use drive-on beam clamps.
2. Do not support piping over 4 inches in size from steel bar joists. Secure upper hanger attachments to steel bar joists at panel points of joists.
3. Do not drill holes in main structural steel members.

4. "C" clamp type of upper hanger attachments with restraining straps may be used as upper hanger attachments for the support of piping up to a maximum of 3 inches in size and a temperature from 50 DegF to 200 DegF.

C. Attachment to Concrete Filled Steel Deck (Total thickness, 2-1/2 inches or more): Where necessary, attach hangers to the deck with welding studs (except at roof decks), thru-bolts with fish plates or tee hangers. Do not support a load in excess of 250 pounds from any single welded stud, and thru-bolts with fish plates or tee hangers shall not be used to support piping over 3 inches in size.

D. Attachment to Cast-In-Place Concrete:
1. Secure to overhead construction by means of cast-in-place concrete inserts.
2. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches (100 mm) thick.
3. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches (100 mm) thick.

E. Attachment to Existing Cast-In-Place Concrete:
1. For piping up to a maximum of 4 inches in size, secure hangers to overhead construction with self-drilling type expansion shields and machine tools.
2. Secure hangers to wall or floor construction with single unit expansion shields or self-drilling type expansion shields and machine bolts.
3. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches (100 mm) thick.

F. Attachment to Cored Precast Concrete Decks (Flexicore, Dox Plank, Spancrete, etc.): Secure attachments to structural steel wherever possible. When fill is applied over decks, thru-bolts and fish plates may be used to support piping up to a maximum of 4 inches in size; mechanically-expanded rod hangers or toggle bolts may be installed in cells for the support of piping up to a maximum of 2-1/2 inches in size.

G. Attachment to Hollow Block or Tile Filled Concrete Decks: Secure hangers to structural steel wherever possible. Inserts may also be used by omitting a block and pouring a solid concrete block with a cast-in-place insert where required.

H. Attachment to Waffle Type Concrete Decks: Provide cast-in-place inserts where required. When fill is applied over deck, thru-bolts and fish plates may be used.

I. Attachment to Precast Concrete Tee Construction:
1. Secure hangers to tees by any of the following methods:
   a. Tee hanger inserts between adjacent flanges.
   b. Thru bolts and fish plates, except at roof deck without concrete fill.
   c. Dual unit expansion shields in webs of tees. Install shields as high as possible in the webs.
2. Exercise extreme care in the field drilling of holes to avoid damage to reinforcing.
3. Do not use powder driven fasteners.

J. Attachment to Wood Construction: Secure hangers to the sides (only) of wood members by means of malleable iron side beam connectors or malleable iron or steel side beam brackets. Do not secure hanger attachments to nailing strips resting on top of steel beams.

1. Secure side beam connectors to wood members with two No. 18 by 1-1/2-inch long wood screws, or two No. 16 by 1-1/2-inch long drive screws. Do not support piping over 1-1/2 inches in size from side beam connectors. Do not hammer in wood screws.
2. Secure side beam brackets to wood members with steel bolts or lag screws. Do not use lag screws in wooden members having a nominal thickness (beam face) under 2 inches in size. Install bolts or lag screws in the sides of timber or a joist at the mid-point or above, not less than 2-1/2 inches from the lower edge when supporting branch lines and not less than 3 inches from the lower edge when supporting mains. Install heavy gage steel washers under all nuts.
3. Secure side beam brackets to wooden beams or joists with lag screws or bolts of size as follows:

PIPE SIZE (INCHES)	LAG SCREW SIZE (INCHES)	BOLT DIAMETER (INCHES)
2 and under	3/8 diameter by 1-3/4	3/8
2-1/2 and 3	1/2 diameter by 2	1/2
4 and 5	Use bolt	5/8

a. Do not support piping larger than 3 inches with lag screws. Predrill holes for lag screws 1/8 inch in diameter less than the root diameter of the lag screw thread.
b. The minimum width of the lower face of wood beams or joints in which lag screws of size as specified may be used is as follows:

LAG SCREW DIAMETER (INCHES)	NOMINAL WIDTH OF BEAM FACE (INCHES)
3/8	2
1/2	3

3.3 TRAPEZES

A. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A36 steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

3.4 ANCHORS, RESTRAINTS, RIGID SUPPORTS, STAYS, AND SWAY BRACES

A. Install pipe anchors, restraints, and sway braces, at locations noted on the Drawings. Design anchors so as to permit piping to expand and contract freely in opposite directions away from anchor points. Install anchors independent of all hangers and supports and in a manner which will not affect the structural integrity of the building.

B. In grooved end piping systems, install restraints, anchors, and rigid supports as recommended by the manufacturer of the grooved end fittings to ensure proper support and alignment of the piping under operating and testing pressures (maximum hanger or support spacing as previously specified).

1. Horizontal piping: Maintain a constant pitch without sages, humps, or lateral deflections.
2. Branch piping: Install perpendicular to main piping and/or risers.
3. Vertical piping: Install in plumb without deflections.

4. Vertical piping: Support rigidly or anchored at both top and bottom and wherever necessary to prevent movement and/or shearing forces at branch connections.

3.5 PIPING IN TUNNELS

A. Support piping in tunnels on adjustable stanchions, fabricated in accordance with details on the Drawings unless otherwise indicated. Install, secure, and be responsible for the proper locations of all cast-in-place inserts and stanchion supports in ample time so as not to delay construction work. Secure tops of stanchions to overhead construction as required and approved.

3.6 COMBINATION CLEVIS HANGER, PIPE INSULATION SHIELD, AND VAPOR BARRIER JACKETED HIGH DENSITY INSULATING SADDLES

A. Install a combination clevis hanger, pipe insulation shield, and vapor barrier jacketed high density insulating saddles at all points of support for piping or tubing to be insulated for cold service. Furnish companion high density vapor barrier jacketed saddle pieces of the same material, thickness, and length for installation over the top 180-degree surface of pipe or tubing at each point of support where an insulated clevis hanger is utilized.

3.7 PIPE INSULATION SHIELDS

A. Install a pipe insulation shield at all points of support for piping insulated with cold service insulation. Center shields on all hangers and supports, and install in such a manner so as not to cut, puncture, or press into the insulation or in any manner be detrimental to the vapor barrier.

3.8 PIPE COVERING PROTECTION SADDLES

A. Install pipe covering protection saddles at all points of support for steel piping 6 inches in size and larger, insulated with hot service insulation. Weld saddles to piping to insure movement with pipe.

3.9 FIBROUS GLASS REINFORCED PLASTIC PIPE (FRP) SUPPORTS

A. Provide inserts between supports and FRP as detailed.

3.10 INSTALLATION OF ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and with AWS Standards D1.1.

C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions to control movement to compensators.

D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.11 INSTALLATION OF PIPE ALIGNMENT GUIDES

A. Install pipe alignment guides on piping that adjoins expansion joints and elsewhere as indicated.

B. Anchor to building substrate.

3.12 EQUIPMENT SUPPORTS

A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.

B. Grouting: Place grout under supports for piping and equipment.

3.13 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.

B. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds 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 touch-up of field-painted surfaces.
   1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

C. Ferrous Metals: Clean galvanized 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 Structure Painting Council.
   1. Blast steel surfaces clean as recommended by the paint system manufacturer and in accordance with requirements of SSPC specification SSPC-SP 10.
   2. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
   3. 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.

D. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum 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.

E. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

F. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, 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.
   4. Finish welds at exposed connections so that no roughness shows after finishing and so that contours of welded surfaces match adjacent contours.

3.14 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

END OF SECTION

SECTION 230593 – TESTING, ADJUSTING, AND BALANCING

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
   1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
   2. Adjusting total HVAC systems to provide indicated quantities.
   3. Measuring electrical performance of HVAC equipment.
   4. Setting quantitative performance of HVAC equipment.
   5. Verifying that automatic control devices are functioning properly.
   6. Measuring sound and vibration.
   7. Reporting results of the activities and procedures specified in this Section.

1.2 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.

C. 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.

D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

E. Report Forms: Test data sheets for recording test data in logical order.

F. 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.

G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

I. 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.

J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

K. Test: A procedure to determine quantitative performance of a system or equipment.

L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.

M. AABC: Associated Air Balance Council.

N. AMCA: Air Movement and Control Association.

O. CTI: Cooling Tower Institute.

P. NEBB: National Environmental Balancing Bureau.

Q. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.3 SUBMITTALS

A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.

B. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3 of this Section.

C. Strategies and Procedures Plan: Within 60 days from the Contractor's Notice to Proceed, submit 2 copies of the testing, adjusting, and balancing strategies and step-by-step procedures as specified in Part 3 "Preparation" Article below. Include a complete set of report forms intended for use on this Project.

D. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.

E. Warranty: Submit 2 copies of special warranty specified in the "Warranty" Article below.

1.4 QUALITY ASSURANCE

A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by either AABC or NEBB.

B. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Engineer's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:
   a. Submittal distribution requirements.
   b. Contract Documents examination report.
   c. Testing, adjusting, and balancing plan.
   d. Work schedule and Project site access requirements.
   e. Coordination and cooperation of trades and subcontractors.
   f. Coordination of documentation and communication flow.

C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.

D. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing" or standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

E. Testing, Adjusting, and Balancing Reports: Use standard forms from SMACNA's "HVAC Systems--Testing, Adjusting, and Balancing."

F. Testing, Adjusting, and Balancing Reports: Use testing, adjusting, and balancing Agent's standard forms approved by the Architect.

G. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.

H. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.5 PROJECT CONDITIONS

A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire testing, adjusting, and balancing period. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

B. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

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 testing, adjusting, and balancing activities.

B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.

C. Perform testing, adjusting, and balancing after the required leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.7 WARRANTY

A. General Warranty: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Guarantee: Provide a guarantee on AABC'S "National Standards" forms stating that AABC will assist in completing the requirements of the Contract Documents or NEBB will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified Agent 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 Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.

1. 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 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.

D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

E. Examine system and equipment test reports.

F. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

G. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

H. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

I. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.

J. Examine strainers for clean screens and proper perforations, and remove temporary screens.

K. Examine 3-way valves for proper installation for their intended function of diverting or mixing fluid flows.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.

N. Examine equipment for installation and for properly operating safety interlocks and controls.

O. Examine automatic temperature system components to verify the following:
   1. Dampers, valves, and other controlled devices operate by the intended controller.
   2. Dampers and valves are in the position indicated by the controller.
   3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
   4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
   5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
   6. Sensors are located to sense only the intended conditions.
   7. Sequence of operation for control modes is according to the Contract Documents.
   8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
   9. Interlocked systems are operating.
   10. Changeover from heating to cooling mode occurs according to design values.

P. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION

A. Prepare a testing, adjusting, and balancing 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 design conditions for system operations can be met.

3.3 GENERAL TESTING AND BALANCING PROCEDURES

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC national standards or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Cut insulation, ducts, and pipes, 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 the insulation Specifications for this Project.

C. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

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. For variable-air-volume systems, develop a plan to simulate diversity.

C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

E. Verify that motor starters are equipped with properly sized thermal protection.

F. Check dampers for proper position to achieve desired airflow path.

G. Check for airflow blockages.

H. Check condensate drains for proper connections and functioning.

I. Check for proper sealing of air-handling unit components.

3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES

A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems. Additional procedures are required for other systems. These additional procedures are specified in other articles in this Section.

B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the 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, do not measure 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 air-handling unit component.
      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.
5. Adjust fan speed to obtain design cfm. Replace or adjust to pulleys 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 no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.

C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to within 10 percent of design airflow.
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 submains 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 submains and branch ducts to within 10 percent of design airflows.

D. Measure terminal outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading.

E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.
1. Adjust each outlet in the same room or space to within specified tolerances of design 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 DUAL-DUCT SYSTEMS' ADDITIONAL PROCEDURES

A. Set mixing boxes at full-cold airflow position for setting the fan volume, after verifying that the cooling coil is capable of full-system airflow.

B. Measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate mixing-box controls and to overcome resistance in the ducts and outlets downstream from mixing box.
1. If insufficient static pressure exists, increase the airflow at the fan.

C. Test and adjust the constant-volume mixing boxes as follows:
1. Verify both hot and cold operations by adjusting the thermostat and observing the air temperature and volume changes.
2. Verify sufficient inlet static pressure before making volume adjustments.
3. Adjust mixing box to design airflows within specified tolerances. Measure the airflow by Pitot-tube traverse readings, totaling the airflow of the outlets; or by measuring static pressure at mixing-box taps if provided by the box manufacturer.

D. Remeasure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate mixing-box controls and to overcome resistance in the ducts and outlets downstream from mixing box.

E. Adjust variable-air-volume, dual-duct systems in the same way as constant-volume dual-duct systems, and adjust each mixing-box maximum- and minimum-airflow settings.

3.7 VARIABLE-AIR-VOLUME SYSTEMS' ADDITIONAL PROCEDURES

A. Compensating for Diversity: When the total airflow of all terminal units is more than the fan design airflow volume, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the design 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 the terminal unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge duct losses.
   3. Measure total system airflow. Adjust to within 10 percent of design airflow.
   4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use the 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 the 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 adequate static pressure is maintained at the most critical unit.
   8. Record the final fan performance data.

C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
   1. Balance systems similar to constant-volume air systems.
   2. Set terminal units and supply fan at full-airflow condition.
   3. Adjust inlet dampers of each terminal unit to design airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
   4. Readjust fan airflow for final maximum readings.
   5. Measure operating static pressure at the sensor that controls the supply fan, if one is installed, and verify operation of the static-pressure controller.
   6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.

7. 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 the outlets balanced for maximum airflow.
8. Measure 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.

D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum design airflow by setting the required number of terminal units at minimum airflow. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
2. Adjust supply fan to maximum design airflow with the variable-airflow controller set at maximum airflow.
3. Set terminal units being tested at full-airflow condition.
4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to design airflow. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
5. Adjust terminal units for minimum airflow.
6. Measure static pressure at the sensor.
7. Measure 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.

3.8 MULTIZONE SYSTEMS' ADDITIONAL PROCEDURES

A. Set unit at full flow through the cooling coil if coil has that capacity.

B. Adjust each zone damper to design airflow.

3.9 FUNDAMENTAL 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 design 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.

3.10 HYDRONIC SYSTEMS' BALANCING PROCEDURES

A. Determine 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. Verify with the pump manufacturer that this will not damage pump. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on the manufacturer's pump curve at zero flow and confirm that the pump has the intended impeller size.
   2. Check system resistance. With all valves open, read pressure differential across the pump and mark the pump manufacturer's head-capacity curve. Adjust pump discharge valve until design water flow is achieved.
   3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on the 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 design flow.

E. Adjust balancing stations to within specified tolerances of design flow rate as follows:
   1. Determine the balancing station with the highest percentage over design flow.
   2. Adjust each station in turn, beginning with the station with the highest percentage over design flow and proceeding to the station with the lowest percentage over design 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.

3.11 VARIABLE-FLOW HYDRONIC SYSTEMS' ADDITIONAL PROCEDURES

A. Balance systems with automatic 2- and 3-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.12 PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS' ADDITIONAL PROCEDURES

A. Balance the primary system crossover flow first, and then balance the secondary system.

3.13 HEAT EXCHANGERS

A. Measure water flow through all circuits.

B. Adjust water flow to within specified tolerances.

C. Measure inlet and outlet water temperatures.

D. Measure inlet steam pressure. Check the setting and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves.

E. Record safety valve settings.

F. Verify operation of steam traps.

3.14 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 of motor.
   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.

3.15 CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of design flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
   1. Evaporator water entering and leaving temperatures, pressure drop, and water flow.
   2. Condenser water entering and leaving temperatures, pressure drop, and water flow.
   3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by the chiller manufacturer.
   4. Power factor if factory-installed instrumentation is furnished for measuring kW.
   5. The kW input if factory-installed instrumentation is furnished for measuring kW.
   6. Capacity: Calculate in tons of cooling.
   7. Air-Cooled Chillers: Verify condenser-fan rotation and record fan data, including number of fans and entering- and leaving-air temperatures.

3.16 COOLING TOWERS

A. Shut off makeup water for the duration of the test, and then make sure the makeup and blow-down systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:
   1. Measure condenser water flow to each cell of the cooling tower.
   2. Measure entering- and leaving-water temperatures.
   3. Measure wet- and dry-bulb temperatures of entering air.
   4. Measure wet- and dry-bulb temperatures of leaving air.
   5. Measure condenser water flow rate recirculating through the cooling tower.
   6. Measure cooling tower pump discharge pressure.
   7. Adjust water level and feed rate of makeup-water system.

3.17 CONDENSING UNITS

A. Verify proper rotation of fans and measure entering- and leaving-air temperatures. Record compressor data.

3.18 BOILERS

A. Measure and record entering- and leaving-water temperatures and water flow.

3.19 HEAT-TRANSFER COILS

A. Water Coils: Measure and record the following data for each coil:
   1. Entering and leaving water temperatures.
   2. Water flow rate.
   3. Water pressure drop.
   4. Dry-bulb temperatures of entering and leaving air.
   5. Wet-bulb temperatures of entering and leaving air for cooling coils.
   6. Airflow.
   7. Air pressure drop.

B. Electric-Heating Coils: Measure and record the following data for each coil:
   1. Nameplate data.
   2. Airflow.
   3. Entering and leaving air temperatures at full load.
   4. Voltage and amperage input of each phase at full load and at each incremental stage.
   5. Calculated kW at full load.
   6. Fuse or circuit-breaker rating for overload protection.

C. Steam Heating Coils: Measure and record following data for each coil:
   1. Nameplate data.
   2. Airflow.
   3. Entering- and leaving-air temperatures at full load.
   4. Voltage and amperage input of each phase at full load and at each incremental stage.
   5. Calculated kW at full load.
   6. Fuse or circuit-breaker rating for overload protection.

3.20 TEMPERATURE TESTING

A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure and record indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied. Also measure and record outside air, wet- and dry-bulb temperatures concurrently with above.

3.21 FUME HOODS

A. Determine total airflow into the room where the fume hood is located and balance systems to ensure adequate air supply to all hoods.
   1. Set fume-hood door opening at position of normal use.
   2. Energize the exhaust fan and adjust airflow to provide the indicated average fume-hood face velocity at hood opening.
   3. Measure exhaust airflow volume by measuring airflow by Pitot-tube duct traverse.
   4. Measure air velocity using Pitot-tube traverse method.
   5. Record each face velocity measurement taken at 4- to 6-inch (100- to 150-mm) increments over the entire hood door opening.
   6. Calculate the average face velocity by averaging all velocity measurements.
   7. Calculate the airflow volume of exhaust-hood face velocity by multiplying the calculated average face velocity by the opening area. Compare this quantity with exhaust volume at exhaust fan and report duct leakage.
   8. Measure airflow volume supplied by makeup fan. Verify that the makeup system supplies the proper amount of air to keep the space at the indicated pressure with the exhaust systems in all operating conditions.
   9. Retest for average face velocity. Adjust hood baffles, fan drives, and other parts of the system to provide the indicated average face velocity and the indicated auxiliary air-supply percentages.
   10. Retest and adjust the systems until fume-hood performance complies with Contract Documents.

3.22 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. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Verify free travel and proper operation of control devices such as damper and valve operators.

F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.

G. Confirm interaction of electrically operated switch transducers.

H. Confirm interaction of interlock and lockout systems.

I. Verify main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or non-grounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.23 TOLERANCES

A. Set HVAC system airflow and water flow rates within plus or minus 10 percent.

3.24 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, 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.

3.25 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-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 the instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to the certified field report data, include the following:
   1. Pump curves.
   2. Fan curves.
   3. Manufacturers' test data.
   4. Field test reports prepared by system and equipment installers.
   5. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
   1. Title page.
   2. Name and address of testing, adjusting, and balancing Agent.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer's name and address.
   7. Contractor's name and address.
   8. Report date.

9. Signature of testing, adjusting, and balancing Agent who certifies the report.
10. Summary of contents, including the following:
    a. Design versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
11. Nomenclature sheets for each item of equipment.
12. Data for terminal units, including manufacturer, type size, and fittings.
13. Notes to explain why certain final data in the body of reports vary from design values.
14. Test conditions for fans and pump performance forms, including the following:
    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings, including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches (mm), and bore.
    i. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).
    j. Number of belts, make, and size.
    k. Number of filters, type, and size.
2. Motor Data: Include the following:
    a. Make and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches (mm), and bore.
    f. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).

3. Test Data: Include design and actual values for the following:
    a. Total airflow rate in cfm (L/s).
    b. Total system static pressure in inches wg (Pa).
    c. Fan rpm.
    d. Discharge static pressure in inches wg (Pa).
    e. Filter static-pressure differential in inches wg (Pa).
    f. Preheat coil static-pressure differential in inches wg (Pa).
    g. Cooling coil static-pressure differential in inches wg (Pa).
    h. Heating coil static-pressure differential in inches wg (Pa).
    i. Outside airflow in cfm (L/s).
    j. Return airflow in cfm (L/s).
    k. Outside-air damper position.
    l. Return-air damper position.
    m. Vortex damper position.

G. Apparatus-Coil Test Reports: For apparatus coils, include the following:
1. Coil Data: Include the following:
    a. System identification.
    b. Location.
    c. Coil type.
    d. Number of rows.
    e. Fin spacing in fins per inch (mm o.c.).
    f. Make and model number.
    g. Face area in sq. ft. (sq. m).
    h. Tube size in NPS (DN).
    i. Tube and fin materials.
    j. Circuiting arrangement.
2. Test Data: Include design and actual values for the following:
    a. Airflow rate in cfm (L/s).
    b. Average face velocity in fpm (m/s).
    c. Air pressure drop in inches wg (Pa).
    d. Outside-air, wet- and dry-bulb temperatures in DegF (DegC).
    e. Return-air, wet- and dry-bulb temperatures in DegF (DegC).
    f. Entering-air, wet- and dry-bulb temperatures in DegF (DegC).
    g. Leaving-air, wet- and dry-bulb temperatures in DegF (DegC).
    h. Water flow rate in gpm (L/s).
    i. Water pressure differential in feet of head or psig (kPa).
    j. Entering-water temperature in DegF (DegC).
    k. Leaving-water temperature in DegF (DegC).
    l. Refrigerant expansion valve and refrigerant types.
    m. Refrigerant suction pressure in psig (kPa).
    n. Refrigerant suction temperature in DegF (DegC).
    o. Inlet steam pressure in psig (kPa).

H. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to the manufacturer's factory startup equipment reports, include the following:

1. Unit Data: Include the following:
   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer's serial number.
   f. Fuel type in input data.
   g. Output capacity in Btuh (kW).
   h. Ignition type.
   i. Burner-control types.
   j. Motor horsepower and rpm.
   k. Motor volts, phase, and hertz.
   l. Motor full-load amperage and service factor.
   m. Sheave make, size in inches (mm), and bore.
   n. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).
2. Test Data: Include design and actual values for the following:
   a. Total airflow rate in cfm (L/s).
   b. Entering-air temperature in DegF (DegC).
   c. Leaving-air temperature in DegF (DegC).
   d. Air temperature differential in DegF (DegC).
   e. Entering-air static pressure in inches wg (Pa).
   f. Leaving-air static pressure in inches wg (Pa).
   g. Air static-pressure differential in inches wg (Pa).
   h. Low-fire fuel input in Btuh (kW).
   i. High-fire fuel input in Btuh (kW).
   j. Manifold pressure in psig (kPa).
   k. High-temperature-limit setting in DegF (DegC).
   l. Operating set point in Btuh (kW).
   m. Motor voltage at each connection.
   n. Motor amperage for each phase.
   o. Heating value of fuel in Btuh (kW).

I. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data: Include the following:
   a. System identification.
   b. Location.
   c. Coil identification.
   d. Capacity in Btuh (kW).
   e. Number of stages.
   f. Connected volts, phase, and hertz.
   g. Rated amperage.
   h. Airflow rate in cfm (L/s).

i. Face area in sq. ft. (sq. m).
j. Minimum face velocity in fpm (m/s).

2. Test Data: Include design and actual values for the following:
   a. Heat output in Btuh (kW).
   b. Airflow rate in cfm (L/s).
   c. Air velocity in fpm (m/s).
   d. Entering-air temperature in DegF (DegC).
   e. Leaving-air temperature in DegF (DegC).
   f. Voltage at each connection.
   g. Amperage for each phase.

J. Fan Test Reports: For supply, return, and exhaust fans, include the following:
   1. Fan Data: Include the following:
      a. System identification.
      b. Location.
      c. Make and type.
      d. Model number and size.
      e. Manufacturer's serial number.
      f. Arrangement and class.
      g. Sheave make, size in inches (mm), and bore.
      h. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).
   2. Motor Data: Include the following:
      a. Make and frame type and size.
      b. Horsepower and rpm.
      c. Volts, phase, and hertz.
      d. Full-load amperage and service factor.
      e. Sheave make, size in inches (mm), and bore.
      f. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).
      g. Number of belts, make, and size.
   3. Test Data: Include design and actual values for the following:
      a. Total airflow rate in cfm (L/s).
      b. Total system static pressure in inches wg (Pa).
      c. Fan rpm.
      d. Discharge static pressure in inches wg (Pa).
      e. Suction static pressure in inches wg (Pa).

K. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
   1. Report Data: Include the following:
      a. System and air-handling unit number.
      b. Location and zone.
      c. Traverse air temperature in DegF (DegC).
      d. Duct static pressure in inches wg (Pa).
      e. Duct size in inches (mm).
      f. Duct area in sq. ft. ((sq. m)).
      g. Design airflow rate in cfm (L/s).
      h. Design velocity in fpm (m/s).

i. Actual airflow rate in cfm (L/s).
j. Actual average velocity in fpm (m/s).
k. Barometric pressure in psig (Pa).

L. Air-Terminal-Device Reports: For terminal units, include the following:
1. Unit Data: Include the following:
a. System and air-handling unit identification.
b. Location and zone.
c. Test apparatus used.
d. Area served.
e. Air-terminal-device make.
f. Air-terminal-device number from system diagram.
g. Air-terminal-device type and model number.
h. Air-terminal-device size.
i. Air-terminal-device effective area in sq. ft. ((sq. m)).
2. Test Data: Include design and actual values for the following:
a. Airflow rate in cfm (L/s).
b. Air velocity in fpm (m/s).
c. Preliminary airflow rate as needed in cfm (L/s).
d. Preliminary velocity as needed in fpm (m/s).
e. Final airflow rate in cfm (L/s).
f. Final velocity in fpm (m/s).
g. Space temperature in DegF (DegC).

M. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
1. Unit Data: Include the following:
a. System and air-handling unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.
2. Test Data: Include design and actual values for the following:
a. Airflow rate in cfm (L/s).
b. Entering-water temperature in DegF (DegC).
c. Leaving-water temperature in DegF (DegC).
d. Water pressure drop in feet of head or psig (kPa).
e. Entering-air temperature in DegF (DegC).
f. Leaving-air temperature in DegF (DegC).

N. Packaged Chiller Reports: For each chiller, include the following:
1. Unit Data: Include the following:
a. Unit identification.
b. Make and model number.
c. Manufacturer's serial number.
d. Refrigerant type and capacity in gal. (L).
e. Starter type and size.
f. Starter thermal protection size.

2. Condenser Test Data: Include design and actual values for the following:
    a. Refrigerant pressure in psig (kPa).
    b. Refrigerant temperature in DegF (DegC).
    c. Entering-water temperature in DegF (DegC).
    d. Leaving-water temperature in DegF (DegC).
    e. Entering-water pressure in feet of head or psig (kPa).
    f. Water pressure differential in feet of head or psig (kPa).
3. Evaporator Test Reports: Include design and actual values for the following:
    a. Refrigerant pressure in psig (kPa).
    b. Refrigerant temperature in DegF (DegC).
    c. Entering-water temperature in DegF (DegC).
    d. Leaving-water temperature in DegF (DegC).
    e. Entering-water pressure in feet of head or psig (kPa).
    f. Water pressure differential in feet of head or psig (kPa).
4. Compressor Test Data: Include design and actual values for the following:
    a. Make and model number.
    b. Manufacturer's serial number.
    c. Suction pressure in psig (kPa).
    d. Suction temperature in DegF (DegC).
    e. Discharge pressure in psig (kPa).
    f. Discharge temperature in DegF (DegC).
    g. Oil pressure in psig (kPa).
    h. Oil temperature in DegF (DegC).
    i. Voltage at each connection.
    j. Amperage for each phase.
    k. The kW input.
    l. Crankcase heater kW.
    m. Chilled water control set point in DegF (DegC).
    n. Condenser water control set point in DegF (DegC).
    o. Refrigerant low-pressure-cutoff set point in psig (kPa).
    p. Refrigerant high-pressure-cutoff set point in psig (kPa).
5. Refrigerant Test Data: Include design and actual values for the following:
    a. Oil level.
    b. Refrigerant level.
    c. Relief valve setting in psig (kPa).
    d. Unloader set points in psig (kPa).
    e. Percentage of cylinders unloaded.
    f. Bearing temperatures in DegF (DegC).
    g. Vane position.
    h. Low-temperature-cutoff set point in DegF (DegC).

O. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:
1. Unit Data: Include the following:
    a. Unit identification.
    b. Location.

c. Unit make and model number.
d. Manufacturer's compressor serial numbers.
e. Compressor make.
f. Compressor model and serial numbers.
g. Refrigerant weight in lb (kg).
h. Low ambient temperature cutoff in DegF (DegC).

2. Test Data: Include design and actual values for the following:
a. Inlet-duct static pressure in inches wg (Pa).
b. Outlet-duct static pressure in inches wg (Pa).
c. Entering-air, dry-bulb temperature in DegF (DegC).
d. Leaving-air, dry-bulb temperature in DegF (DegC).
e. Condenser entering-water temperature in DegF (DegC).
f. Condenser leaving-water temperature in DegF (DegC).
g. Condenser water temperature differential in DegF (DegC).
h. Condenser entering-water pressure in feet of head or psig (kPa).
i. Condenser leaving-water pressure in feet of head or psig (kPa).
j. Condenser water pressure differential in feet of head or psig (kPa).
k. Control settings.
l. Unloader set points.
m. Low-pressure-cutout set point in psig (kPa).
n. High-pressure-cutout set point in psig (kPa).
o. Suction pressure in psig (kPa).
p. Suction temperature in DegF (DegC).
q. Condenser refrigerant pressure in psig (kPa).
r. Condenser refrigerant temperature in DegF (DegC).
s. Oil pressure in psig (kPa).
t. Oil temperature in DegF (DegC).
u. Voltage at each connection.
v. Amperage for each phase.
w. The kW input.
x. Crankcase heater kW.
y. Number of fans.
z. Condenser fan rpm.
aa. Condenser fan airflow rate in cfm (L/s).
bb. Condenser fan motor make, frame size, rpm, and horsepower.
cc. Condenser fan motor voltage at each connection.
dd. Condenser fan motor amperage for each phase.

P. Cooling Tower or Condenser Test Reports: For cooling towers or condensers, include the following:
1. Unit Data: Include the following:
a. Unit identification.
b. Make and type.
c. Model and serial numbers.
d. Nominal cooling capacity in tons (kW).
e. Refrigerant type and weight in lb (kg).
f. Water-treatment chemical feeder and chemical.

g. Number and type of fans.
h. Fan motor make, frame size, rpm, and horsepower.
i. Fan motor voltage at each connection.
j. Sheave make, size in inches (mm), and bore.
k. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).
l. Number of belts, make, and size.

2. Pump Test Data: Include design and actual values for the following:
   a. Make and model number.
   b. Manufacturer's serial number.
   c. Motor make and frame size.
   d. Motor horsepower and rpm.
   e. Voltage at each connection.
   f. Amperage for each phase.
   g. Water flow rate in gpm (L/s).
3. Water Test Data: Include design and actual values for the following:
   a. Entering-water temperature in DegF (DegC).
   b. Leaving-water temperature in DegF (DegC).
   c. Water temperature differential in DegF (DegC).
   d. Entering-water pressure in feet of head or psig (kPa).
   e. Leaving-water pressure in feet of head or psig (kPa).
   f. Water pressure differential in feet of head or psig (kPa).
   g. Water flow rate in gpm (L/s).
   h. Bleed water flow rate in gpm (L/s).
4. Air Data: Include design and actual values for the following:
   a. Duct airflow rate in cfm (L/s).
   b. Inlet-duct static pressure in inches wg (Pa).
   c. Outlet-duct static pressure in inches wg (Pa).
   d. Average entering-air, wet-bulb temperature in DegF (DegC).
   e. Average leaving-air, wet-bulb temperature in DegF (DegC).
   f. Ambient wet-bulb temperature in DegF (DegC).

Q. Heat-Exchanger/Converter Test Reports: For steam and hot-water heat exchangers, include the following:
1. Unit Data: Include the following:
   a. Unit identification.
   b. Location.
   c. Service.
   d. Make and type.
   e. Model and serial numbers.
   f. Ratings.
2. Steam Test Data: Include design and actual values for the following:
   a. Inlet pressure in psig (kPa).
   b. Condensate flow rate in lb/h (kW).
3. Primary Water Test Data: Include design and actual values for the following:
   a. Entering-water temperature in DegF (DegC).
   b. Leaving-water temperature in DegF (DegC).

c. Entering-water pressure in feet of head or psig (kPa).
d. Water pressure differential in feet of head or psig (kPa).
e. Water flow rate in gpm (L/s).

4. Secondary Water Test Data: Include design and actual values for the following:
a. Entering-water temperature in DegF (DegC).
b. Leaving-water temperature in DegF (DegC).
c. Entering-water pressure in feet of head or psig (kPa).
d. Water pressure differential in feet of head or psig (kPa).
e. Water flow rate in gpm (L/s).

R. Pump Test Reports: For pumps, include the following data. Calculate impeller size by plotting the shutoff head on pump curves.
1. Unit Data: Include the following:
a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model and serial numbers.
f. Water flow rate in gpm (L/s).
g. Water pressure differential in feet of head or psig (kPa).
h. Required net positive suction head in feet of head or psig (kPa).
i. Pump rpm.
j. Impeller diameter in inches (mm).
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.
2. Test Data: Include design and actual values for the following:
a. Static head in feet of head or psig (kPa).
b. Pump shutoff pressure in feet of head or psig (kPa).
c. Actual impeller size in inches (mm).
d. Full-open flow rate in gpm (L/s).
e. Full-open pressure in feet of head or psig (kPa).
f. Final discharge pressure in feet of head or psig (kPa).
g. Final suction pressure in feet of head or psig (kPa).
h. Final total pressure in feet of head or psig (kPa).
i. Final water flow rate in gpm (L/s).
j. Voltage at each connection.
k. Amperage for each phase.

S. Boiler Test Reports: For boilers, include the following:
1. Unit Data: Include the following:
a. Unit identification.
b. Location.
c. Service.

d. Make and type.
e. Model and serial numbers.
f. Fuel type and input in Btuh (kW).
g. Number of passes.
h. Ignition type.
i. Burner-control types.
j. Voltage at each connection.
k. Amperage for each phase.

2. Test Data: Include design and actual values for the following:
   a. Operating pressure in psig (kPa).
   b. Operating temperature in DegF (DegC).
   c. Entering-water temperature in DegF (DegC).
   d. Leaving-water temperature in DegF (DegC).
   e. Number of safety valves and sizes in NPS (DN).
   f. Safety valve settings in psig (kPa).
   g. High-limit setting in psig (kPa).
   h. Operating-control setting.
   i. High-fire set point.
   j. Low-fire set point.
   k. Voltage at each connection.
   l. Amperage for each phase.
   m. Draft fan voltage at each connection.
   n. Draft fan amperage for each phase.
   o. Manifold pressure in psig (kPa).

T. Instrument Calibration Reports: For instrument calibration, include the following:
   1. Report Data: Include the following:
      a. Instrument type and make.
      b. Serial number.
      c. Application.
      d. Dates of use.
      e. Dates of calibration.

3.26 ADDITIONAL TESTS

A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION

SECTION 230700 – MECHANICAL INSULATION

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes pipe, duct, and equipment insulation.

1.2 DEFINITIONS

A. Hot Surfaces: Normal operating temperatures of 100 DegF or higher.

B. Dual-Temperature Surfaces: Normal operating temperatures that vary from hot to cold.

C. Cold Surfaces: Normal operating temperatures less than 75 DegF.

D. Thermal Resistivity: "r-values" represent the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees (DegF) between two exposed faces required to cause one Btu to flow through one square foot of material, in one hour, at a given mean temperature.

E. Density: Is expressed in lb/sq.ft.

1.3 SUBMITTALS

A. Product data for each type of mechanical insulation identifying k-value, thickness, and accessories.

B. Manufacturer's installation instructions.

C. Schedule of materials and thickness for each piece of equipment.

D. Samples of each type of insulation and jacket. Identify each sample describing product and intended use. Submit the following sizes of sample materials:
   1. Board and Block Insulation: 12-inch square section.
   2. Pre-Formed Pipe Insulation: 12 inches long, 2-inch NPS.

1.4 QUALITY ASSURANCE

A. Fire Performance Characteristics: Conform to the following characteristics for insulation including facings, cements, and adhesives, when tested according to ASTM E 84, by UL or other testing or inspecting organization acceptable to the authority having jurisdiction. Label insulation with appropriate markings of testing laboratory.
   1. Interior Insulation: Flame spread rating of 25 or less and a smoke developed rating of 50 or less.
   2. Exterior Insulation: Flame spread rating of 75 or less and a smoke developed rating of 150 or less.

B. Field-Constructed Mock-Up: Before installation, erect mock-up of size and at locations indicated to demonstrate workmanship quality. Include method of attachment and finishing for each.
   1. Interior and exterior equipment.
   2. Interior and exterior duct systems.

3. Interior and exterior piping systems.
4. Retain and protect mock-ups during construction as a standard for judging completed unit of Work.
5. Remove mock-ups from Project site when directed.
6. Accepted mock-ups may become part of completed unit of Work.

1.5 SEQUENCING AND SCHEDULING

A. Schedule insulation application after testing of piping and duct systems.

B. Schedule insulation application after installation and testing of heat trace tape.

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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Glass Fiber:
   a. CertainTeed Corporation.
   b. Knauf Fiberglass GmbH.
   c. Manville.
   d. Owens-Corning Fiberglas Corporation.
   e. USG Interiors, Inc. - Thermafiber Division.
2. Flexible Elastomeric Cellular:
   a. Armstrong World Industries, Inc.
   b. Halstead Industrial Products.
   c. IMCOA.
   d. Rubatex Corporation.
3. Calcium Silicate:
   a. Manville.
   b. Owens-Corning Corporation.
4. Open Weave Glass Cloth Membrane:
   a. Perma Glas-Mesh Corp.
5. Vinyl-Acrylic Mastic:
   a. Childers Products Co.

2.2 GLASS FIBER

A. Material: Inorganic glass fibers, bonded with a thermosetting resin.

B. Jacket: All-purpose, factory-applied, laminated glass-fiber-reinforced, flame-retardant Kraft paper and aluminum foil having self-sealing lap.

C. Board: ASTM C612, Class 2, semi-rigid jacketed board.
1. Thermal Conductivity: 0.25 average maximum at 75 DegF mean temperature.
2. Density: 12 pcf average maximum.

D. Blanket: ASTM C553, Type II, Class F-1, jacketed flexible blankets.
   1. Thermal Conductivity: 0.30 average maximum at 75 DegF mean temperature.

E. Preformed Pipe Insulation: ASTM C547, Class 1, rigid pipe insulation, jacketed.
   1. Thermal Conductivity: 0.27 average maximum at 75 DegF mean temperature.
   2. Density: 10 average maximum.

F. Adhesive: Produced under the UL Classification and follow-up service.
   1. Type: Non-flammable, solvent-based.
   2. Service Temperature Range: Minus 20 to 180 DegF.

G. Vapor Barrier Coating: Waterproof coating recommended by insulation manufacturer for outside service.

2.3 FLEXIBLE ELASTOMERIC CELLULAR

A. Material: Flexible expanded closed-cell structure with smooth skin on both sides.
   1. Tubular Materials: ASTM C534, Type I.
   2. Sheet Materials: ASTM C534, Type II.

B. Thermal Conductivity: 0.27 average maximum at 75 DegF.

C. Coating: Water based latex enamel coating recommended by insulation manufacturer.

2.4 CALCIUM SILICATE

A. Material: ASTM C533, Type I; inorganic, hydrous calcium silicate, non-asbestos fibrous reinforcement; incombustible.

B. Form: Molded flat block, curved block, grooved block, and preformed pipe sections as appropriate for surface.

C. Thermal Conductivity: 0.60 at 500 DegF.

D. Dry Density: 15.0 pcf maximum.

E. Compressive Strength: 60 psi minimum at 5 percent deformation.

F. Fire Performance Characteristics: Provide materials identical to those whose fire performance characteristics have been determined, per test method indicated below, by UL or other testing and inspecting organization acceptable to authorities having jurisdiction.
   1. Test Method: ASTM E84.
   2. Flame Spread: 0.
   3. Smoke Developed: 0.

2.5 INSULATING CEMENTS

A. Mineral Fiber: ASTM C195.
   1. Thermal Conductivity: 1.0 average maximum at 500 DegF mean temperature.
   2. Compressive Strength: 10 psi at 5 percent deformation.

B. Expanded or Exfoliated Vermiculite: ASTM C196.
   1. Thermal Conductivity: 1.10 average maximum at 500 DegF mean temperature.
   2. Compressive Strength: 5 psi at 5 percent deformation.

C. Mineral Fiber, Hydraulic-Setting Insulating and Finishing Cement: ASTM C449.
   1. Thermal Conductivity: 1.2 average maximum at 400 DegF mean temperature.
   2. Compressive Strength: 100 psi at 5 percent deformation.

2.6 ADHESIVES

A. Flexible Elastomeric Cellular Insulation Adhesive: Solvent-based, contact adhesive recommended by insulation manufacturer.

B. Lagging Adhesive: MIL-A-3316C, non-flammable adhesive in the following Classes and Grades:
   1. Class 1, Grade A for bonding glass cloth and tape to unfaced glass fiber insulation, sealing edges of glass fiber insulation, and bonding lagging cloth to unfaced glass fiber insulation.
   2. Class 2, Grade A for bonding glass fiber insulation to metal surfaces.

2.7 JACKETS

A. General: ASTM C921, Type 1, except as otherwise indicated.

B. Foil and Paper Jacket: Laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
   1. Water Vapor Permeance: 0.02 perm maximum, when tested according to ASTM E96.
   2. Puncture Resistance: 50 beach units minimum, when tested according to ASTM D781.

C. PVC Jacketing: High-impact, ultra-violet-resistant PVC, 20-mils thick, roll stock ready for shop or field cutting and forming to indicated sizes.
   1. Adhesive: As recommended by insulation manufacturer.

D. PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil-thick, high-impact, ultra-violet-resistant PVC.
   1. Adhesive: As recommended by insulation manufacturer.

E. Aluminum Jacket: ASTM B209, 3003 Alloy, H-14 temper, roll stock ready for shop or field cutting and forming to indicated sizes or factory cut and rolled to indicated sizes.
   1. Finish and Thickness: Smooth finish, 0.010-inch thick.
   2. Finish and Thickness: Corrugated finish, 0.010-inch thick.
   3. Finish and Thickness: Stucco embossed finish, 0.016-inch thick.
   4. Finish and Thickness: Painted finish, 0.016-inch thick.
   5. Moisture Barrier: 1-mil, heat-bonded polyethylene and Kraft paper.
   6. Elbows: Preformed 45-degree and 90-degree, short- and long-radius elbows, same material, finish, and thickness as jacket.

F. Stainless-Steel Jacket: ASTM A167, Type 304 or 316, 0.10-inch thick, No. 2B finish, and roll stock ready for shop or field cutting and forming to indicated sizes or factory cut and rolled to indicated sizes.
   1. Moisture Barrier: 1-mil, heat-bonded polyethylene and Kraft paper.
   2. Elbows: Gore type, for 45-degree and 90-degree elbows in same material, thickness, finish as jackets.

2.8 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Woven glass fiber fabrics, plain weave, presized a minimum of 8 ounces per square yard.
   1. Tape Width: 4 inches.
   2. Cloth Standard: MIL-C-20079H, Type I.
   3. Tape Standard: MIL-C-20079H, Type II.

B. Bands: 3/4-inch wide, in one of the following materials compatible with jacket:
   1. Stainless Steel: Type 304, 0.020-inch thick.
   2. Galvanized Steel: 0.005-inch thick.
   3. Aluminum: 0.007-inch thick.
   4. Brass: 0.01-inch thick.
   5. Nickel-Copper Alloy: 0.005-inch thick.

C. Wire: 14-gage nickel copper alloy, 16-gage, soft-annealed stainless steel, or 16-gage, soft-annealed galvanized steel.

D. Corner Angles: 28-gage, 1-inch by 1-inch aluminum, adhered to 2-inch by 2-inch Kraft paper.

E. Anchor Pins: Capable of supporting 20 pounds each. Provide anchor pins and speed washers of sizes and diameters as recommended by the manufacturer for insulation type and thickness.

2.9 SEALING COMPOUNDS

A. Vapor Barrier Compound: Water-based, fire-resistive composition.
   1. Water Vapor Permeance: 0.08 perm maximum.
   2. Temperature Range: Minus 20 to 180 DegF.

B. Weatherproof Sealant: Flexible-elastomer-based, vapor-barrier sealant designed to seal metal joints.
   1. Water Vapor Permeance: 0.02 perm maximum.
   2. Temperature Range: Minus 50 to 250 DegF.
   3. Color: Aluminum.

PART 3 – EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean, dry, and remove foreign materials such as rust, scale, and dirt.

B. Mix insulating cements with clean potable water. Mix insulating cements contacting stainless-steel surfaces with demineralized water.
   1. Follow cement manufacturer's printed instructions for mixing and portions.

3.2 INSTALLATION, GENERAL

A. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each mechanical system.

B. Select accessories compatible with materials suitable for the service. Select accessories that do not corrode, soften, or otherwise attack the insulation or jacket in either the wet or dry state.

C. Install vapor barriers on insulated pipes, ducts, and equipment having surface operating temperatures below 60 DegF.

D. Install insulation only after systems to be insulated have been tested and approved.

E. Apply insulation material, accessories, and finishes according to the manufacturer's printed instructions.

F. Install insulation with smooth, straight, and even surfaces.

G. Seal joints and seams to maintain vapor barrier on insulation requiring a vapor barrier.

H. Seal penetrations for hangers, supports, anchors, and other projections in insulation requiring a vapor barrier.

I. Seal Ends: Except for flexible elastomeric insulation, taper ends at 45 degree angle and seal with lagging adhesive. Cut ends of flexible elastomeric cellular insulation square and seal with adhesive.

J. Apply adhesives and coatings at manufacturer's recommended coverage-per-gallon rate.

K. Keep insulation materials dry during application and finishing.

L. Install board and block materials with a minimum dimension of 12 inches and a maximum dimension of 48 inches.

M. Items Not Insulated: Unless otherwise indicated do not apply insulation to the following systems, materials, and equipment:
   1. Fibrous glass ducts.
   2. Metal ducts with duct liner.
   3. Factory-insulated flexible ducts.
   4. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
   5. Flexible connectors for ducts and pipes.
   6. Vibration control devices.
   7. Testing laboratory labels and stamps.
   8. Nameplates and data plates.
   9. Access panels and doors in air distribution systems.
   10. Below grade piping.
   11. Piping specialties including air chambers, unions, strainers, check valves, plug valves, and flow regulators.
   12. Return air ductwork concealed in spaces which are used as return air plenums need not be insulated, unless otherwise noted.

3.3 PIPE INSULATION INSTALLATION, GENERAL

A. Tightly butt longitudinal seams and end joints. Bond with adhesive.

B. Stagger joints on double layers of insulation.

C. Apply insulation continuously over fittings, valves, and specialties except as otherwise indicated.

D. Apply insulation with a minimum number of joints.

E. Apply insulation with integral jackets as follows:
   1. Pull jacket tight and smooth.
   2. Cover circumferential joints with butt strips, at least 3 inches wide, and of same material as insulation jacket. Secure with adhesive along both edges of butt strip and space 4 inches on center.
   3. Longitudinal Seams: Overlap seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
   4. Vapor Barrier Coatings: Where vapor barriers are indicated, apply on seams and joints and at ends butt to flanges, unions, valves, and fittings.
   5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor barrier coating.
   6. Repair damaged insulation jackets, except metal jackets, by applying jacket material around damaged jacket. Adhere and seal. Extend patch at least 2 inches in both directions beyond damaged insulation jacket and around the entire circumference of the pipe.

F. Roof Penetrations: Apply insulation for interior applications to a point even with the top of the roof flashing. Seal with vapor barrier coating. Apply insulation for exterior applications butted tightly to interior insulation ends. Extend metal jacket for exterior insulation outside roof flashing at least 2 inches below top of roof flashing. Seal metal jacket to roof flashing with vapor barrier coating.

G. Exterior Wall Penetrations: For penetrations of below grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor barrier coating.

H. Exterior Wall Penetrations: For penetrations of below grade exterior walls, extend metal jacket for exterior insulation through penetration to a point 2 inches from interior surface of wall inside the building. Seal ends of metal jacket with vapor barrier coating. Secure metal jacket ends with metal band. At point where insulation metal jacket contacts mechanical sleeve seal, insert cellular glass preformed pipe insulation to allow sleeve seal tightening against metal jacket. Tighten and seal sleeve to jacket to form a watertight seal.

I. Interior Walls and Partitions Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions. Apply an aluminum jacket with factory-applied moisture barrier over insulation. Extend 2 inches from both surfaces of wall or partition. Secure aluminum jacket with metal bands at both ends. Seal ends of jacket with vapor barrier coating. Seal around penetration with joint sealer.

J. Fire-Rated Walls and Partitions Penetrations: Terminate insulation at penetrations through fire-rated walls and partitions. Seal insulation ends with vapor barrier coating. Seal around penetration with firestopping or fire-resistant joint sealer.

K. Floor Penetrations: Terminate insulation underside of floor assembly and at floor support at top of floor.

L. Flanges, Fittings, and Valves - Interior Exposed and Concealed: Coat pipe insulation ends with vapor barrier coating. Apply premolded, precut, or field-fabricated segments of insulation around flanges, unions, valves, and fittings. Make joints tight. Bond with adhesive.
   1. Use same material and thickness as adjacent pipe insulation.
   2. Overlap nesting insulation by 2 inches or 1-pipe diameter, whichever is greater.
   3. Apply materials with adhesive, fill voids with mineral fiber insulating cement. Secure with wire or tape.

4. Insulate elbows and tees smaller than 3 inches pipe size with premolded insulation.
5. Insulate elbows and tees 3 inches and larger with premolded insulation or insulation material segments. Use at least 3 segments for each elbow.
6. Cover insulation, except for metal jacketed insulation, with PVC fitting covers and seal circumferential joints with butt strips.
7. Cover insulation, except for metal jacketed insulation with 2 layers of lagging adhesive to a minimum thickness of 1/16 inch. Install glass cloth between layers. Overlap adjacent insulation by 2 inches in both directions from joint with glass cloth and lagging adhesive.

M. Hangers and Anchors: Apply insulation continuously through hangers and around anchor attachments. For cold surface piping, extend insulation anchor legs a minimum of 12 inches and taper and seal insulation ends.
1. Inserts and Shields: Cover hanger inserts and shields with jacket material matching adjacent pipe insulation.
2. Special Treatment at Hanger Locations: At hanger locations on insulated piping 2 inches and larger, install high density rigid fiber glass pipe support blocks. On piping up to and including 5 inches, install one block at each hanger, directly on the bottom of the pipe. For 6-, 8-, and 10-inch piping, install two (2) blocks at each hanger oriented 30 degrees from each side of the bottom. For piping 12 inches and larger, orientate blocks at both the 30 degrees positions and directly on the bottom. Install blocks inside cut out section of pipe insulation, being careful not to damage the vapor barrier jacketing. Any jacketing so damaged should be repaired with matching vapor barrier tape.

3.4 BELOW GROUND PIPE INSULATION INSTALLATION

A. General: The following are additional requirements for insulation applied to piping installed below ground.

B. Coat bore surfaces of insulation materials with insulating cement of type recommended by insulation manufacturer. Apply enough cement to fill surface cells. Do not use adhesives for this coating.

C. Secure insulation with a minimum of 2 stainless-steel bands for each section of insulation.

D. Terminate insulation at anchor blocks.

E. Apply insulation continuously through sleeves and manholes, except as specified above for exterior wall penetrations.

F. Finishing: Apply 3 coats of asphaltic mastic to a finish thickness of 3/16 inch over insulation materials. Apply 10 by 10 mesh glass cloth between coats. Overlap edges of glass cloth by 2 inches.

3.5 GLASS FIBER PIPE INSULATION INSTALLATION

A. Bond insulation to pipe with lagging adhesive.

B. Seal exposed ends with lagging adhesive.

C. Seal seams and joints with vapor barrier compound.

3.6 FLEXIBLE ELASTOMERIC CELLULAR PIPE INSULATION INSTALLATION

A. Slip insulation on the pipe before making connections wherever possible. Seal joints with adhesive. Where the slip-on technique is not possible, cut one side longitudinally and apply to the pipe. Seal seams and joints with adhesive.

B. Valves, Fittings, and Flanges: Cut insulation segments from pipe or sheet insulation. Bond to valve, fitting, and flange and seal joints with adhesive.

1. Miter cut materials to cover soldered elbows and tees.
2. Fabricate sleeve fitting covers from flexible elastomeric cellular insulation for screwed valves, fittings, and specialties. Miter cut materials. Overlap adjoining pipe insulation.

3.7 CALCIUM SILICATE PIPE INSULATION INSTALLATION

A. Secure insulation with stainless-steel bands spaced at 12-inch intervals.

B. Apply 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 16-gage soft-annealed stainless-steel wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

C. Finishing: Apply a skim coat of mineral fiber, hydraulic-setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on 1 layer of glass cloth or glass tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth finish.

D. Metal Jacket: Where indicated, apply metal jacket over finished insulation as specified in this Section for installation of metal jackets.

3.8 EQUIPMENT INSULATION INSTALLATION, GENERAL

A. Groove and score insulation materials as required to fit as closely as possible to the equipment and to fit contours of equipment. Stagger end joints.

B. Insulation Thicknesses Greater than 2 Inches: Install insulation in multiple layers with staggered joints.

C. Bevel insulation edges for cylindrical surfaces for tight joint.

D. Secure sections of insulation in place with wire or bands spaced at 9-inch centers except for flexible elastomeric cellular insulation.

E. Protect exposed corners with corner angles under wires and bands.

F. Manholes, Handholes, and Information Plates: Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.

G. Removable Insulation: Install insulation on components that require periodic inspecting, cleaning, and repairing for easy removal and replacement without damage to adjacent insulation.

H. Pumps: Where insulation is indicated, fabricate galvanized steel boxes lined with insulation. Fit boxes around pumps and coincide joints in box with the splits in the pump casings. Fabricate joints with outward bolted flanges.

I. Finishing: Except for flexible elastomeric cellular insulation, apply 2 coats of vapor barrier compound to a minimum thickness of 1/16 inch. Install a layer of glass cloth embedded between layers.

3.9 GLASS FIBER EQUIPMENT INSULATION INSTALLATION

A. Secure insulation with anchor pins and speed washers.

B. Space anchors at maximum intervals of 18 inches in both directions and not more than 3 inches from edges and joints.

C. Apply a smoothing coat of insulating and finishing cement to finished insulation.

3.10 FLEXIBLE ELASTOMERIC CELLULAR EQUIPMENT INSULATION INSTALLATION

A. Install sheets of the largest manageable size.

B. Apply full coverage of adhesive to the surfaces of the equipment and to the insulation.

C. Butt insulation joints firmly together and apply adhesive to insulation edges at joints.

3.11 DUCT INSULATION

A. Install block and board insulation as follows:
   1. Adhesive and Band Attachment: Secure block and board insulation tight and smooth with at least 50 percent coverage of adhesive. Install bands spaced 12 inches apart. Protect insulation under bands and at exterior corners with metal corner angles. Fill joints, seams, and chipped edges with vapor barrier compound.
   2. Speed Washers Attachment: Secure insulation tight and smooth with speed washers and welded pins. Space anchor pins 18 inches apart each way and 3 inches from insulation joints. Apply vapor barrier coating compound to insulation in contact, open joints, breaks, punctures, and voids in insulation.

B. Blanket Insulation: Install tight and smooth. Secure to ducts having long sides or diameters as follows:
   1. Smaller than 24 Inches: Bonding adhesive applied in 6-inch-wide transverse strips on 12-inch centers.
   2. 24 Inches and Larger: Anchor pins spaced 12 inches apart each way. Apply bonding adhesive to prevent sagging of the insulation.
   3. Overlap joints 3 inches.
   4. Seal joints, breaks, and punctures with vapor barrier compound.
   5. Minimize compression during installation.

3.12 JACKETS

A. Foil and Paper Jackets (FP): Install jackets drawn tight. Install lap or butt strips at joints with material same as jacket. Secure with adhesive. Install jackets with 1-1/2-inch laps at longitudinal joints and 3-inch-wide butt strips at end joints.
   1. Seal openings, punctures, and breaks in vapor barrier jackets and exposed insulation with vapor barrier compound.
   2. Provide PVC fitting covers.

B. Interior Exposed Insulation: Install continuous stainless-steel jackets.

C. Interior Exposed Insulation: Install continuous aluminum jackets.

D. Interior Exposed Insulation: Install continuous PVC jackets.

E. Interior Exposed Insulation: Install continuous glass cloth jackets.

F. Exterior Exposed Insulation: Install continuous aluminum jackets and seal all joints and seams with waterproof sealant.

G. Exterior Exposed Insulation: Install continuous stainless-steel jackets and seal all joints and seams with waterproof sealant.

H. Exterior Exposed Insulation: Install continuous PVC jackets and seal all joints and seams with waterproof sealant.

I. Install metal jacket with 2-inch overlap at longitudinal and butt joints. Overlap longitudinal joints to shed water. Seal butt joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel draw bands 12 inches on center and at butt joints.

J. Install the PVC jacket with 1-inch overlap at longitudinal and butt joints and seal with adhesive.

K. Install glass cloth jacket directly over insulation. On insulation with a factory applied jacket, install the glass cloth jacket over the factory applied jacket. Install jacket drawn smooth and tight with a 2-inch overlap at joints. Embed glass cloth between (2) 1/16-inch-thick coats of lagging adhesive. Completely encapsulate the insulation with the jacket, leaving no exposed raw insulation.

L. Special Protection for Ductwork Exposed to the Weather:
   1. Rectangular: Weatherproof with a durable asbestos-free water based vinyl-acrylic mastic, applied in 2 coats. Apply the first tack coat at a rate of 2 gallons per 100 square feet. While still wet, lay an open weave glass cloth membrane and embed with all fabric seams overlapped 2 inches minimum. Apply a finish coat at a coverage of 4 gallons per 100 square feet, fully covering the cloth membrane so that the minimum dry film thickness is 1/16 inch. Trowel, spray, or wet brush to a smooth, even finish. Install the insulation on the top of the ductwork with a positive pitch to drain off all water and prevent ponding on the top surfaces.
   2. Round: Weatherproof with a high impact, UV resistant polyvinyl chloride jacketing, 20 mil thickness minimum. Cut to the proper size from roll stock, including a 3- to 4-inch overlap for both longitudinal and circumferential joints. Install over duct insulation, avoiding "fishmouths," and secure longitudinal overlap with either outward clinching staples or stainless steel tack fasteners. Tape all joints with matching PVC tape. Position all longitudinal overlaps at either the 4:30 or 7:30 position to shed water. Secure jacketing with aluminum banding on 24-inch centers.
   3. Weatherproof outdoor ductwork ONLY when the outdoor temperature is 40 DegF or greater.

3.13 FINISHES

A. Flexible Elastomeric Cellular Insulation: After adhesive has fully cured, apply 2 coats of protective coating to exposed insulation.

3.14 APPLICATIONS

A. General: Materials and thicknesses are specified in schedules at the end of this Section.

B. Interior Piping Systems: Unless otherwise indicated, insulate the following piping systems:
   1. Chilled water.
   2. Refrigerant and brine.
   3. Heating hot water.
   4. Steam and condensate.
   5. Diesel engine coolant.
   6. Diesel engine exhaust.
   7. Cooling coil condensate.

C. Exterior Piping Systems: Unless otherwise indicated, insulate the following piping systems:
   1. Chilled water.
   2. Refrigerant and brine.
   3. Heating hot water.
   4. Steam and condensate.
   5. Diesel engine coolant.
   6. Diesel engine exhaust.

D. Equipment: Unless otherwise indicated, insulate the following indoor equipment:
   1. Domestic cold water equipment, tanks, and pumps.
   2. Domestic hot water equipment, tanks, and water heaters.
   3. Low temperature brine equipment, tanks, pumps, and heat exchangers, 0 to 34 DegF.
   4. Chilled water equipment, tanks, pumps, and heat exchangers.
   5. Heating hot water equipment, tanks, pumps, and heat exchangers.
   6. Steam and condensate equipment, tanks, pumps, and heat exchangers.
   7. Boiler flues and breechings.
   8. Refrigerated drinking water equipment, tanks, pumps, and heat exchangers.

E. Duct Systems: Unless otherwise indicated, insulate the following duct systems:
   1. Interior supply, return and outside air ductwork.
   2. Exterior exposed supply and return ductwork.
   3. Interior exposed and concealed supply fans, air handling unit casings and outside air plenums.
   4. Interior range hood exhaust ductwork.
   5. Interior oven and dishwasher exhaust ductwork.

3.15 PIPE INSULATION SCHEDULES

A. General: Abbreviations used in the following schedules include:
   1. Field-Applied Jackets: P - PVC, K - Foil and Paper, A-Aluminum, SS - Stainless Steel.
   2. Pipe Sizes: NPS - Nominal Pipe Size.

B. Domestic Cold Water, Cooling Coil Condensate, and Storm Water All Sizes (Interior): 1/2-inch-thick glass fiber insulation with vapor barrier. Field-applied jacket is not required.
   1. Interior Chilled Water:

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
1-1/2 or less	Glass Fiber	1-1/2	Yes	None

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
2 or greater	Glass Fiber	1-1/2	Yes	None

2. Interior Refrigerant and Brine:

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
1-1/2 or less	Glass Fiber	1	Yes	None
2 or greater	Glass Fiber	1-1/2	Yes	None

3. Exterior Refrigerant and Brine:

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
1-1/2 or less	Glass Fiber Flexible Elastomeric	1 1	Yes Yes	(P) (A) (SS) None
2 or greater	Glass Fiber Flexible Elastomeric	1-1/2 1-1/2	Yes Yes	(P) (A) (SS) None

4. Interior Heating Hot Water:

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
1-1/2 or less	Glass Fiber	1-1/2	No	None
2 or greater	Glass Fiber	2	No	None

5. Interior Steam And Condensate

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
1-1/2 or less	Glass Fiber	1-1/2	No	None
2 or greater	Glass Fiber	3	No	None

6. Exterior Heating Hot Water:

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
1-1/2 or less	Glass Fiber	1	No	(A) (SS)
2 or greater	Glass Fiber	2	No	(A) (SS)

7. Exterior Steam and Condensate:

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
1-1/2 or less	Glass Fiber	1-1/2	No	(A) (SS)
2 or greater	Glass Fiber	3	No	(A) (SS)

a. NOTE: Install Over Freeze Protection Heat Tracing.

8. Interior Diesel Engine Coolant:

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
1-1/2 or less	Glass Fiber	1	No	None
2 or greater	Glass Fiber	2	No	None

9. Interior Diesel Engine Exhaust (Including Silencer)

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
2 or less	Calcium Silicate	2-1/2	No	(A) (SS)
2-1/2 to 4	Calcium Silicate	3	No	(A) (SS)
5 or greater	Calcium Silicate	3-1/2	No	(A) (SS)

3.16 EQUIPMENT INSULATION SCHEDULES

A. General: Abbreviations used in the following schedules include:
1. Field-Applied Jackets: P - PVC, K - Foil and Paper, A-Aluminum, SS - Stainless Steel.
2. Interior Exposed Brine Equipment, Tanks, Pumps, and Heat Exchangers:

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
Glass Fiber	Block	4	Yes	(A) (SS)

3. Interior Exposed Chilled Water Equipment, Tanks, Pumps, and Heat Exchangers:

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
Glass Fiber	Block	2-1/2	Yes	(A) (SS)

4. Interior Exposed Refrigerated Drinking Water Equipment, Tanks, Pumps, and Heat Exchangers:

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
Glass Fiber	Block	2	Yes	(P)

5. Interior Exposed Heating Hot Water Equipment, Tanks, Pumps, and Heat Exchangers:

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
Glass Fiber	Block or Board	2	No	(A) (SS)
Calcium Silicate	Block	2	No	(A) (SS)

6. Interior Exposed Steam And Condensate Equipment, Tanks, Pumps, and Heat Exchangers (250 to 350 DegF):

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
Glass Fiber	Block or Board	4	No	(A) (SS)
Calcium Silicate	Block	4	No	(A) (SS)

7. Interior Exposed Boiler Flues and Breechings:

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
Calcium Silicate	Block	4	No	(A) (SS)

3.17 DUCT SYSTEMS INSULATION SCHEDULE

A. General: Abbreviations used in the following schedules include:
   1. Field-Applied Jackets: P - PVC, K - Foil and Paper, A-Aluminum, SS - Stainless Steel.
   2. Interior Concealed HVAC Supply, Return And Outside Air Ducts and Plenums

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
Glass Fiber	Blanket	1-1/2	Yes	None

3. Interior Exposed HVAC Supply, Return And Outside Air Ducts and Plenums:

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
Glass Fiber	Board - Rect.	1-1/2	Yes	None

4. Exterior Concealed HVAC Supply, Return Ducts, and Plenums:

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
Glass Fiber	Board - Rect.	2	Yes	None
Glass Fiber	Pipe - Round	2-1/2	Yes	None
Flexible Elastomeric	Sheet	2-1/2	Yes	None

5. Interior Exposed HVAC Supply Fans, Air Handling Units, Casings, and Plenums:

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
Glass Fiber	Board	2	Yes	None

6. Interior Exposed Range Hood Exhaust Ducts:

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
Calcium Silicate	Board	As Required for 1-Hour Rating	No	(SS)

7. Interior Concealed Range Hood Exhaust Ducts:

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
Calcium Silicate	Board	As Required for 1-Hour Rating	No	None

8. Interior Exposed Oven and Dishwasher Exhaust Ducts:

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
Glass Fiber	Board	2	No	(SS)
Calcium Silicate	Board	2	No	(SS)

9. Interior Concealed Oven and Dishwasher Exhaust Ducts:

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQUIRED	FIELD-APPLIED JACKET
Glass Fiber	Board	2	No	None

END OF SECTION

SECTION 230951 – MOTORS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes basic requirements for factory-installed and field-installed motors.

1.2 SUBMITTALS

A. Product Data: Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, grounding lug; and coatings.

B. Factory Test Reports: For specified tests.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Listing and Labeling: Provide motors specified in this Section that are listed and labeled.
1. Terms "Listed and Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
3. Motors shall be UL labeled:
a. Motors shall conform to NEMA Standards MGI, Motors and Generators.

PART 2 – PRODUCTS

2.1 BASIC MOTOR REQUIREMENTS

A. Basic requirements apply to mechanical equipment motors, unless otherwise indicated.

B. Motors 1/2 HP and Larger: Polyphase.

C. Motors smaller than 1/2 HP: Single phase.

D. Frequency Rating: 60 Hz.

E. Voltage Rating: Determined by voltage of circuit to which motor is connected.

F. Service Factor: According to NEMA MG 1, unless otherwise indicated.

G. Capacity and Torque Characteristics: Rated for continuous duty and sufficient to start, accelerate, and operate connected loads at designated speeds, in indicated environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

H. Enclosure: Open dripproof, unless otherwise indicated.

2.2 POLYPHASE MOTORS

A. Description: NEMA MG 1, medium induction motor.
   1. Design Characteristics: NEMA MG 1, Design B, unless otherwise indicated.
   2. Energy-Efficient with minimum efficiency as scheduled in accordance with ANSI/IEEE 112-1984-IEEE standard test procedure for polyphase induction motors and generators.
   3. Stator: Copper windings, unless otherwise indicated. Multispeed motors have separate winding for each speed.
   4. Rotor: Squirrel cage, unless otherwise indicated.
   5. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.
   6. Temperature Rise: Match insulation rating, unless otherwise indicated.
   7. Insulation: Class F unless otherwise indicated.

B. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for indicated controller, with required motor leads brought to motor terminal box to suit control method.

C. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Inverter duty rated.
   2. Critical vibration frequencies are not within operating range of controller output.
   3. Temperature Rise: Match rating for Class B insulation.
   4. Insulation: Class H.
   5. Thermal Protection: Where indicated, conform to NEMA MG 1 requirements for thermally protected motors.

D. Rugged-Duty Motors: Where indicated, motors are totally enclosed with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings are insulated with non-hygroscopic material. External finish is chemical-resistant paint over corrosion-resistant primer.

E. Source Quality Control: Perform the following routine tests according to NEMA MG 1:
   1. Measurement of winding resistance.
   2. No-load readings of current and speed at rated voltage and frequency.
   3. Locked rotor current at rated frequency.
   4. High-potential test.
   5. Alignment.

2.3 SINGLE-PHASE MOTORS

A. Type: As indicated or selected by manufacturer from one of the following, to suit starting torque and other requirements of specific motor application.
   1. Permanent-split capacitor.
   2. Split-phase start, capacitor run.
   3. Capacitor start, capacitor run.

B. Shaded-Pole Motors: Do not use, unless motors are smaller than 1/20 HP.

C. Thermal Protection: Where indicated or required, internal protection automatically opens power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature

rating of motor insulation. Thermal protection device automatically resets when motor temperature returns to normal range, unless otherwise indicated.

D. Bearings: Ball-bearing type for belt-connected motors and other motors with high radial forces on motor shaft. Sealed, prelubricated sleeve bearings for other single-phase motors.

PART 3 – EXECUTION

3.1 ADJUSTING

A. Use adjustable motor mounting bases for belt-driven motors.

B. Align pulleys and install belts.

C. Tension according to manufacturer's written instructions.

END OF SECTION

233100-HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Duct Materials.
2. Insulated flexible ducts.
3. Single wall spiral round ducts.
4. Casings.
5. Ductwork fabrication.
6. Duct cleaning.

B. Related Sections:
1. Section 09 91 00 - Painting and Coating: Execution requirements for Weld priming, weather resistant, paint or coating specified by this section.
2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers, supports and sleeves for placement by this section.
3. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.

1.2 REFERENCES

A. ASTM International:
1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A90/A90M - Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
3. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
4. ASTM A568/A568M - Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
5. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
6. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. A1011/A1011M-07 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
8. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
9. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
10. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. National Fire Protection Association:
   1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
   2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
   3. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

C. Sheet Metal and Air Conditioning Contractors:
   1. SMACNA - Fibrous Glass Duct Construction Standards.
   2. SMACNA - HVAC Air Duct Leakage Test Manual.
   3. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

D. Underwriters Laboratories Inc.:
   1. UL 181 - Factory-Made Air Ducts and Connectors.

1.3 PERFORMANCE REQUIREMENTS

A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Submit duct fabrication drawings, drawn to scale not smaller than inch equals 1 foot, on drawing sheets same size as Contract Documents, indicating:
   1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
   2. Duct layout, indicating pressure classifications and sizes in plan view. For exhaust duct systems, indicate classification of materials handled as defined in this section.
   3. Fittings.
   4. Reinforcing details and spacing.
   5. Seam and joint construction details.
   6. Penetrations through fire rated and other walls.
   7. Terminal unit, coil, and humidifier installations.
   8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

C. Product Data: Submit data for duct materials.

D. Manufacturer's Installation Instructions: Submit special procedures for glass fiber ducts.

E. Manufacturer's Certificate: Certify installation of glass fiber ductwork meet or exceed specified requirements recommended fabrication and installation requirements...

1.5 CLOSEOUT SUBMITTALS

A. Section 01 77 00 and 01 78 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.

B. Construct ductwork to NFPA 90A and NFPA 90B standards.

C. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.8 PRE-INSTALLATION MEETINGS

A. Section 01 31 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.

C. Maintain temperatures during and after installation of duct sealant.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 WARRANTY

A. Section 01 77 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.1 DUCT MATERIALS

A. Galvanized Steel Ducts: ASTM A653/A653M galvanized steel sheet, lock-forming quality, having G90 zinc coating of in conformance with ASTM A90/A90M.

B. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength.

C. Fasteners: Rivets, bolts, or sheet metal screws.

D. Hanger Rod: ASTM A36/A36M; steel; threaded both ends, threaded one end, or continuously threaded.

2.2 SINGLE WALL SPIRAL ROUND DUCTS

A. Product Description: UL 181, Class 1, round spiral lockseam duct constructed of galvanized steel.

B. Duct Coating: Polyvinyl chloride plastic, 4 mil thick on outside and 2 mil thick on inside. Both sides. Temperature range: minus 30 degrees F to 200 degrees F.

C. Construct duct with the following minimum gages:

Diameter	Gauge
3 inches to 14 inches	26
15 inches to 26 inches	24
28 inches to 36 inches	22
38 inches to 50 inches	20
52 inches to 84 inches	18

D. Construct fittings with the following minimum gages:

Diameter	Gauge
3 inches to 14 inches	24
15 inches to 26 inches	22
28 inches to 36 inches	20
38 inches to 50 inches	20
52 inches to 60 inches	18
62 inches to 84 inches	16

2.3 CASINGS

A. Fabricate casings in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and construct for operating pressures indicated.

B. Reinforce access door frames with steel angles tied to horizontal and vertical plenum supporting angles. Furnish hinged access doors where indicated or required for access to equipment for cleaning and inspection. Furnish clear wire glass observation ports, minimum 6 x 6 inch size.

C. Fabricate acoustic casings with reinforcing turned inward. Furnish 16 gage back facing and 22 gage perforated front facing with 3/32 inch diameter holes on 5/32 inch centers. Construct panels 3 inches thick packed with 4.5 lb. /cu ft minimum glass fiber media, on inverted channels of 16 gage.

2.4 DUCTWORK FABRICATION

A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and as indicated on Drawings. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Fabricate and support round ducts with longitudinal seams in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible (Round Duct Construction Standards), and as indicated on Drawings. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

C. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide airfoil turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

E. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

F. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.

G. Seal joints between duct sections and duct seams with welds, gaskets, mastic adhesives, mastic plus embedded fabric systems, or tape.
   1. Sealants, Mastics and Tapes: Conform to UL 181A. Provide products bearing appropriate UL 181A markings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 31 00 - Administrative Requirements: Coordination and project conditions.

B. Verify sizes of equipment connections before fabricating transitions.

3.2 INSTALLATION

A. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Install glass fiber ducts in accordance with SMACNA Fibrous Glass Duct Construction Standards. Obtain manufacturer's inspection and acceptance of fabrication and installation at beginning of installation.

C. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

D. Use crimp joints with or without bead or beaded sleeve couplings for joining round duct sizes 8 inch and smaller.

E. Install duct hangers and supports in accordance with Section 23 05 29.

F. Use double nuts and lock washers on threaded rod supports.

G. Slope underground ducts to plenums or low pump out points at 1: 500. Install access doors for inspection.

H. Connect flexible ducts to metal ducts with adhesive. Liquid adhesive plus tape. draw bands.

I. Set plenum doors 6 to 12 inches above floor. Arrange door swing so fan static pressure holds door in closed position.

J. Casings: Install floor mounted casings on 4 inch high concrete curbs. Refer to Section 03 30 00. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, furnish liner of 18 gage galvanized expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.

K. For outdoor ductwork, protect ductwork, ductwork supports, linings and coverings from weather.

L. Exhaust Outlet Locations:
   1. Minimum Distance from Property Lines: 3 feet.
   2. Minimum Distance from Building Openings: 3 feet.
   3. Minimum Distance from Outside Air Intakes: 10 feet,

3.3 INTERFACE WITH OTHER PRODUCTS

A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with

spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.

B. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

C. Connect air terminal units air outlets and inlets to supply ducts directly or with five foot maximum length of flexible duct. Do not use flexible duct to change direction.

3.4 CONCEALED GREASE DUCT TESTING

A. Prior to concealing, wrapping, or insulating grease ductwork, or placing grease duct in service, perform leakage test in accordance with ICC IMC, in presence of authority having jurisdiction.

B. Perform light test by pulling minimum 100 W light through duct and observing for light leaks at duct joints.

C. Test complete extent of duct installed, including joint at which duct connects to exhaust hood.

3.5 CLEANING

A. Section 01 77 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air flow, clean one half of system completely before proceeding to other half. Protect equipment with potential to be harmed by excessive dirt with temporary filters, or bypass during cleaning.

C. Clean duct systems with high power vacuum machines. Protect equipment with potential to be harmed by excessive dirt with filters, or bypass during cleaning. Install access openings into ductwork for cleaning purposes.

3.6 TESTING

A. For ductwork designed for 3 inches w.c. above ambient, pressure test minimum 25 percent of ductwork after duct cleaning, but before duct insulation is applied or ductwork is concealed.
   1. Test in accordance with SMACNA HVAC Air Duct Leakage Test Manual.
   2. Maximum Allowable Leakage: In accordance with ICC IECC.

3.7 SCHEDULES

A. Ductwork Material Schedule:

AIR SYSTEM	MATERIAL
Supply (Heating Systems)	Steel, Aluminum, Fibrous Glass
Supply (System with Cooling Coils)	Steel, Aluminum, Fibrous Glass

Buried Supply or Return	Steel, PVC Coated Steel, Concrete, Glass Fiber Reinforced Plastic
Return and Relief	Steel, Aluminum
General Exhaust	Steel, Aluminum
Kitchen Hood Exhaust	Steel, Stainless Steel
Dishwasher Exhaust	Steel, Stainless Steel, Glass Fiber Reinforced Plastic
Fume Hood Exhaust	Stainless Steel, Glass Fiber Reinforced Plastic
Outside Air Intake	Steel
Combustion Air	Steel
Evaporative Condenser	Steel
Intake and Exhaust	
Emergency Generation Ventilation	Steel

B. Ductwork Pressure Class Schedule:

AIR SYSTEM	PRESSURE CLASS
Constant Volume Supply	3 inch wg
Variable Volume-Variable Temperature Supply	1 inch wg
Variable Air Volume Supply (downstream of VAV boxes)	1 inch wg
Variable Air Volume Supply (upstream of VAV boxes)	1 inch wg
Supply (Heating Systems)	1 inch wg
Supply (System with Cooling Coils)	2 inch wg
Return and Relief	1/2 inch wg
General Exhaust	1 inch wg
Dishwasher Exhaust	1 inch wg
Fume Hood Exhaust	2 inch wg
Emergency Generation Ventilation	1/2 inch wg

END OF SECTION

SECTION 233113 – METAL DUCTS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes rectangular, round, and flat-oval metal ducts and plenums for heating, ventilating, and air-conditioning systems in pressure classes from minus 2- to plus 10-inch wg (minus 500 to plus 2490 Pa).

1.2 DEFINITIONS

A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C168. In this Section, these values are the result of the formula Btu x in./h x sq. ft. x DegF or W/m x K at the temperature differences specified. Values are expressed as Btu or W.

1.3 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select and size air-moving and -distribution equipment and other components of air system. Changes to layout or configuration of duct system must be specifically approved in writing by Engineer. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.4 SUBMITTALS

A. Product Data: For duct liner and sealing materials.

B. Shop Drawings: Show details of the following:
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Duct layout indicating pressure classifications and sizes on plans.
   3. Fittings.
   4. Reinforcement and spacing.
   5. Seam and joint construction.
   6. Penetrations through fire-rated and other partitions.
   7. Terminal unit, coil, and humidifier installations.
   8. Hangers and supports, including methods for building attachment, vibration isolation, seismic restraints, and duct attachment.

C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
   1. Ceiling suspension assembly members.
   2. Other systems installed in same space as ducts.
   3. Ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
   4. Coordination with ceiling-mounted items, including lighting fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.

D. Welding Certificates: Copies of certificates indicating welding procedures and personnel comply with requirements in “Quality Assurance” Article.

E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

F. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

1.5 QUALITY ASSURANCE

A. Welding Standards: Qualify welding procedures and welding personnel to perform welding processes for this Project according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports; AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members; and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," unless otherwise indicated.

C. Comply with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems," unless otherwise indicated.

D. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Chapter 3, "Duct System," for range hood ducts, unless otherwise indicated.

E. Mockups: Before installing duct systems, erect mockups representing system pressure classifications higher than 2-inch wg (500 Pa). Build mockups to comply with the following requirements, using materials indicated for completed Work:
   1. Locate mockups in the locations and of the size indicated or, if not indicated, as directed by Architect. Mockup may be a representative section of the actual duct system.
   2. Include the minimum number of each of the following features and fittings:
      a. Five transverse joints.
      b. One access door.
      c. Two typical branch connections, each with at least one elbow.
      d. Two typical flexible duct or flexible connector connections for each duct and apparatus.
   3. Perform tests specified in "Field Quality Control" Article. Modify mockup construction and perform additional tests as required to achieve specified minimum acceptable results.
   4. Obtain Engineer's approval of mockups before starting Work.
   5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work. When directed, demolish and remove mockups from Project site.
   6. Approved mockups in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver sealant and firestopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle sealant and firestopping materials according to manufacturer's written recommendations.

C. Deliver and store stainless-steel sheets with mill-applied adhesive protective paper maintained through fabrication and installation.

PART 2 – PRODUCTS

2.1 SHEET METAL MATERIALS

A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A653/A653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.

B. PVC-Coated Galvanized Steel: UL 181, Class 1 listing. Lock-forming-quality, galvanized, sheet steel with ASTM A653/A653M, G90 (Z275) coating designation; factory-applied, 4-mil (0.10-mm) PVC coating on exposed surfaces of ducts and fittings (exterior of ducts and fittings for underground applications and interior of ducts and fittings for fume-handling applications) and with factory-applied, 2-mil (0.05-mm) PVC coating on reverse side of ducts and fittings.

C. Carbon-Steel Sheets: ASTM A366/A366M, cold-rolled sheets; commercial quality; with oiled, exposed matte finish.

D. Stainless Steel: ASTM A480/A480M, Type 316, sheet form with No. 4 finish for surfaces of ducts exposed to view; and Type 304, sheet form with No. 1 finish for concealed ducts.

E. Aluminum Sheets: ASTM B209 (ASTM 209M), Alloy 3003, Temper H14, sheet form with standard, one-side bright finish for ducts exposed to view and with mill finish for concealed ducts.

F. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for 36-inch (900-mm) length or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 DUCT LINER

A. General: Comply with NFPA 90A or NFPA 90B and NAIMA's "Fibrous Glass Duct Liner Standard."

B. Materials: ASTM C1071 with coated surface exposed to airstream to prevent erosion of glass fibers.
   1. Thickness: 1/2 inch (13 mm).
   2. Thickness: 1 inch (25 mm).
   3. Thickness: 1-1/2 inches (38 mm).
   4. Thermal Conductivity (k-Value): 0.26 at 75 DegF (0.037 at 24 DegC) mean temperature.
   5. Fire-Hazard Classification: Maximum flame-spread rating of 25 and smoke-developed rating of 50, when tested according to ASTM C411.
   6. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and ASTM C916.
   7. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
      a. Tensile Strength: Indefinitely sustain a 50-pound (23-kg) tensile, dead-load test perpendicular to duct wall.
      b. Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch (3 mm) into airstream.
      c. Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.

2.3 SEALANT MATERIALS

A. Joint and Seam Sealants, General: The term “sealant” is limited to materials of adhesive or mastic nature.
   1. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant, formulated with a minimum of 66 percent solids.
   2. Flanged Joint Mastics: One-part, acid-curing, silicone, elastomeric joint sealants, complying with ASTM C920, Type S, Grade NS, Class 25, Use O.

2.4 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for building materials.
   1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
   2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

B. Hanger Materials: Galvanized, sheet steel or round, threaded steel rod.
   1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rod or galvanized rods with threads painted after installation.
   2. Straps and Rod Sizes: Comply with SMACNA’s “HVAC Duct Construction Standards--Metal and Flexible” for sheet steel width and thickness and for steel rod diameters.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A36/A36M.
   1. Supports for Galvanized-Steel Ducts: Galvanized steel shapes and plates.
   2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
   3. Supports for Aluminum Ducts: Aluminum support materials, unless materials are electrolytically separated from ductwork.

2.5 RECTANGULAR DUCT FABRICATION

A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized, sheet steel, according to SMACNA’s “HVAC Duct Construction Standards--Metal and Flexible.” Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
   1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
   2. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

B. Fabricate range hood exhaust ducts with 0.0598-inch- (1.5-mm-) thick, carbon-steel sheet for concealed ducts and 0.0500-inch- (1.3-mm-) thick stainless steel for exposed ducts. Weld and flange seams and joints. Comply with NFPA 96.

C. Fabricate dishwasher hood exhaust ducts with 0.0500-inch- (1.3-mm-) thick stainless steel. Weld and flange seams and joints.

D. Acid-Resistant Ducts: PVC-coated galvanized steel.

E. Static-Pressure Classifications: Unless otherwise indicated, construct ducts to the following:
   1. Supply Ducts: 3-inch wg (750 Pa).
   2. Return Ducts: 2-inch wg (500 Pa), negative pressure.
   3. Exhaust Ducts: 2-inch wg (500 Pa), negative pressure.

F. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches (480 mm) and larger and 0.0359-inch (0.9-mm) thick or less, with more than 10 square feet (0.93 sq. m) of unbraced panel area, unless ducts are lined.

2.6 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS

A. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness are prohibited.

B. Apply adhesive to liner facing in direction of airflow not receiving metal nosing.

C. Butt transverse joints without gaps and coat joint with adhesive.

D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

E. Do not apply liners in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.

F. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s).

G. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely around perimeter; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.

H. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or “Z” profile or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   1. Fan discharge.
   2. Intervals of lined duct preceding unlined duct.
   3. Upstream edges of transverse joints in ducts.

I. Secure insulation liner with perforated sheet metal liner of same metal thickness as specified for duct, secured to ducts with mechanical fasteners that maintain metal liner distance from duct without compressing insulation.
   1. Sheet Metal Liner Perforations: 3/32-inch (2.4-mm) diameter with an overall open area of 23 percent.

J. Terminate liner with duct buildouts installed in ducts to attach dampers, turning vane assemblies, and other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct wall with bolts, screws, rivets, or welds. Terminate liner at fire dampers at connection to fire-damper sleeve.

2.7 ROUND AND FLAT-OVAL DUCT FABRICATION

A. General: Diameter as applied to flat-oval ducts in this Article is the diameter of the size of round duct that has a circumference equal to perimeter of a given size of flat-oval duct.

B. Round Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

C. Flat-Oval Ducts: Fabricate supply ducts with standard spiral lock seams or with butt-welded longitudinal seams according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

D. Double-Wall (Insulated) Ducts: Fabricate double-wall (insulated) ducts with an outer shell and an inner liner. Dimensions indicated on internally insulated ducts are inside dimensions.

1. Thermal Conductivity (k-Value): 0.26 at 75 DegF (0.037 at 24 DegC) mean temperature.
2. Outer Shell: Base outer-shell metal thickness on actual outer-shell dimensions. Fabricate outer-shell lengths 2 inches (50 mm) longer than inner shell and insulation, and in metal thickness specified for single-wall duct.
3. Insulation: 1-inch- (25-mm-) thick fibrous-glass insulation unless otherwise indicated. Terminate insulation where internally insulated duct connects to single-wall duct or uninsulated components. Terminate insulation and reduce outer duct diameter to inner liner diameter.
4. Solid Inner Liner: Fabricate round and flat-oval inner liners with solid sheet metal of thickness listed below:
5. Perforated Inner Liner: Fabricate round and flat-oval inner liners with sheet metal having 3/32-inch (2.4-mm) diameter perforations, with an overall open area of 23 percent. Use the following sheet metal thicknesses and seam construction:
   a. Ducts 3 to 8 Inches (75 to 200 mm) in Diameter: 0.019 inch (0.5 mm) with standard spiral seam construction.
   b. Ducts 9 to 42 Inches (225 to 1070 mm) in Diameter: 0.019 inch (0.5 mm) with single-rib spiral seam construction.
   c. Ducts 44 to 60 Inches (1120 to 1525 mm) in Diameter: 0.022 inch (0.55 mm) with single-rib spiral seam construction.
   d. Ducts 62 to 88 Inches (1575 to 2235 mm) in Diameter: 0.034 inch (0.85 mm) with standard spiral seam construction.
6. Maintain concentricity of liner to outer shell by mechanical means. Retain insulation from dislocation by mechanical means.

2.8 ROUND AND FLAT-OVAL SUPPLY AND EXHAUST FITTING FABRICATION

A. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal seam straight duct.

B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.

C. Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate bend radius of die-formed, gored, and pleated elbows one and one-half times elbow diameter. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg (minus 500 to plus 500 Pa):
   a. Ducts 3 to 26 Inches (75 to 660 mm) in Diameter: 0.028 inch (0.7 mm).
   b. Ducts 27 to 36 Inches (685 to 915 mm) in Diameter: 0.034 inch (0.85 mm).

c. Ducts 37 to 50 Inches (940 to 1270 mm) in Diameter: 0.040 inch (1.0 mm).
d. Ducts 52 to 60 Inches (1320 to 1525 mm) in Diameter: 0.052 inch (1.3 mm).
e. Ducts 62 to 84 Inches (1575 to 2130 mm) in Diameter: 0.064 inch (1.6 mm).

3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg (500 to 2490 Pa):
   a. Ducts 3 to 14 Inches (75 to 355 mm) in Diameter: 0.028 inch (0.7 mm).
   b. Ducts 15 to 26 Inches (380 to 660 mm) in Diameter: 0.034 inch (0.85 mm).
   c. Ducts 27 to 50 Inches (685 to 1270 mm) in Diameter: 0.040 inch (1.0 mm).
   d. Ducts 52 to 60 Inches (1320 to 1525 mm) in Diameter: 0.052 inch (1.3 mm).
   e. Ducts 62 to 84 Inches (1575 to 2130 mm) in Diameter: 0.064 inch (1.6 mm).
4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal seam flat-oval duct.
5. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material-handling classes A and B; and only where space restrictions do not permit using 1.5 bend radius elbows. Fabricate with single-thickness turning vanes.
6. Round Elbows, 8 Inches (200 mm) and Smaller: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configuration or nonstandard diameter elbows with gored construction.
7. Round Elbows, 9 through 14 Inches (225 through 355 mm): Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees, unless space restrictions require a mitered elbow. Fabricate nonstandard bend-angle configuration or nonstandard diameter elbows with gored construction.
8. Round Elbows, Larger than 14 Inches (355 mm), and All Flat-Oval Elbows: Fabricate gored elbows, unless space restrictions require a mitered elbow.
9. Die-Formed Elbows for Sizes through 8 Inches (200 mm) and All Pressures: 0.040 inch (1.0 mm) thick with two-piece welded construction.
10. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
11. Flat-Oval Elbow Metal Thickness: Same as longitudinal seam flat-oval duct specified above.
12. Pleated Elbows for Sizes through 14 Inches (355 mm) and Pressures through 10-Inch wg (2490 Pa): 0.022 inch (0.55 mm).

D. Double-Wall (Insulated) Fittings: Fabricate double-wall (insulated) fittings with an outer shell and an inner liner. Dimensions indicated on internally insulated ducts are inside dimensions.
1. Thermal Conductivity (k-Value): 0.26 at 75 DegF (0.037 at 24 DegC) mean temperature.
2. Outer Shell: Base outer-shell metal thickness on actual outer-shell dimensions. Fabricate outer-shell lengths 2 inches (50 mm) longer than inner shell and insulation. Use the same metal thicknesses for outer duct as for uninsulated fittings.
3. Insulation: 1-inch- (25-mm-) thick fibrous-glass insulation, unless otherwise indicated. Terminate insulation where internally insulated duct connects to single-wall duct or uninsulated components. Terminate insulation and reduce outer duct diameter to nominal single-wall size.
4. Solid Inner Liner: Fabricate round and flat-oval inner liners with solid sheet metal of thickness listed below:
5. Perforated Inner Liner: Fabricate round and flat-oval inner liners with sheet metal having 3/32-inch- (2.4-mm-) diameter perforations with an overall open area of 23 percent. Use the following sheet metal thicknesses:
   a. Ducts 3 to 34 Inches (75 to 865 mm) in Diameter: 0.028 inch (0.7 mm).
   b. Ducts 35 to 58 Inches (890 to 1475 mm) in Diameter: 0.034 inch (0.85 mm).
   c. Ducts 60 to 88 Inches (1525 to 2235 mm) in Diameter: 0.040 inch (1.0 mm).
6. Maintain concentricity of liner to outer shell by mechanical means. Retain insulation from dislocation by mechanical means.

E. PVC-Coated Elbows and Fittings: Fabricate elbows and fittings as follows:

1. Round Elbows 4 to 8 Inches (100 to 200 mm) in Diameter: Two piece, die stamped, with longitudinal seams spot welded, bonded, and painted with a PVC aerosol spray.
2. Round Elbows 9 to 26 Inches (230 to 660 mm) in Diameter: Standing seam construction.
3. Round Elbows 28 to 60 Inches (710 to 1525 mm) in Diameter: Standard gore construction, riveted and bonded.
4. Other Fittings: Riveted and bonded joints.
5. Couplings: Slip-joint construction with a minimum 2-inch (50-mm) insertion length.

PART 3 – EXECUTION

3.1 DUCT INSTALLATION, GENERAL

A. Drawings indicate general arrangement of ducts, fittings, and accessories. Provide all required fittings, accessories, and ancillaries as required for a complete system as determined by the Engineer.

B. Construct and install each duct system for the specific duct pressure classification indicated.

C. Install round and flat-oval ducts in lengths not less than 12 feet (3.7 m) unless interrupted by fittings.

D. Install ducts with fewest possible joints.

E. Install fabricated fittings for changes in directions, changes in size and shape, and connections.

F. Install couplings tight to duct wall surface with a minimum of projections into duct.

G. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.

H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

I. Install ducts with a clearance of 1 inch (25 mm) plus allowance for insulation thickness.

J. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.

K. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

L. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches (38 mm).

N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire damper, sleeve, and firestopping sealant. Refer to other sections for fire and smoke damper specifications as well as fire stopping specifications.

3.2 PVC-COATED DUCT INSTALLATION

A. Install PVC-coated duct and fittings according to manufacturer's written instructions.

B. Seal all joints and seams. Apply sealer to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

C. Secure couplings with sheet metal screws. Install screws at an interval of 12 inches (300 mm) with a minimum of 3 screws in each coupling.

D. Repair damage to PVC coating with manufacturer's recommended materials.

3.3 UNDERSLAB DUCT INSTALLATIONS

A. Verify undamaged conditions of duct before enclosure with fill or encasement.

B. Install underslab ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and as indicated.

C. Protect ducts from damage by equipment used in placing concrete on or around ducts.

D. Protect duct openings.

3.4 RANGE HOOD EXHAUST DUCT INSTALLATIONS

A. Install ducts to allow for thermal expansion of ductwork through 2000 DegF (1100 DegC) temperature range.

B. Install ducts without dips or traps that may collect residues, unless traps have continuous or automatic residue removal.

C. Install access openings at each change in direction and at 50-foot (15-m) intervals; locate on sides of duct a minimum of 1-1/2 inches (38 mm) from bottom; and fit with grease-tight covers of same material as duct.

D. Do not penetrate fire-rated assemblies.

3.5 DISHWASHER EXHAUST DUCT INSTALLATIONS

A. Install dishwasher exhaust ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

3.6 SEAM AND JOINT SEALING

A. General: Seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Pressure Classification Less than 2-Inch wg (500 Pa): Transverse joints.

C. Seal externally insulated ducts before insulation installation.

3.7 HANGING AND SUPPORTING

A. Install rigid round, rectangular, and flat-oval metal duct with support systems indicated in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Support horizontal ducts within 24 inches (600 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

C. Support vertical ducts at a maximum interval of 16 feet (5 m) and at each floor.

D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

E. Install concrete inserts before placing concrete.

F. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

3.8 CONNECTIONS

A. Connect equipment with flexible connectors according to other Sections.

B. For branch, outlet and inlet, and terminal unit connections, comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

3.9 FIELD QUALITY CONTROL

A. Disassemble, reassemble, and seal segments of systems as required to accommodate leakage testing and as required for compliance with test requirements.

B. Conduct tests, in presence of Architect, at static pressures equal to maximum design pressure of system or section being tested. If pressure classifications 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. Determine leakage from entire system or section of system by relating leakage to surface area of test section.

D. Maximum Allowable Leakage: Comply with requirements for Leakage Classification 3 for round and flat-oval ducts, Leakage Classification 12 for rectangular ducts in pressure classifications less than and equal to 2-inch wg (500 Pa) (both positive and negative pressures), and Leakage Classification 6 for pressure classifications from 2- to 10-inch wg (500 to 2490 Pa).

E. Remake leaking joints and retest until leakage is less than maximum allowable.

F. Leakage Test: Perform tests according to SMACNA's "HVAC Air Duct Leakage Test Manual."

3.10 ADJUSTING

A. Adjust volume-control dampers in ducts, outlets, and inlets to achieve design airflow.

B. Detailed procedures for Testing, Adjusting, and Balancing are specified in other Sections.

3.11 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect the system. Vacuum ducts before final acceptance to remove dust and debris.

END OF SECTION

SECTION 233300 – DUCT ACCESSORIES

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:
1. Backdraft dampers.
2. Manual-volume dampers.
3. Fire and smoke dampers.
4. Duct silencers.
5. Turning vanes.
6. Duct-mounted access doors and panels.
7. Flexible ducts.
8. Flexible connectors.
9. Duct accessory hardware.

1.2 SUBMITTALS

A. Product Data: For the following:
1. Backdraft dampers.
2. Manual-volume dampers.
3. Fire and smoke dampers.
4. Duct silencers.
5. Duct-mounted access doors and panels.
6. Flexible ducts.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:
1. Special fittings and manual- and automatic-volume-damper installations.
2. Fire- and smoke-damper installations, including sleeves and duct-mounted access doors and panels.

C. Product Certificates: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.

1.3 QUALITY ASSURANCE

A. NFPA Compliance: Comply with the following NFPA standards:
1. NFPA 90A, “Installation of Air Conditioning and Ventilating Systems.”
2. NFPA 90B, “Installation of Warm Air Heating and Air Conditioning Systems.”

1.4 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are 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. Galvanized, Sheet Steel: Lock-forming quality; ASTM A653/A653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.

B. Carbon-Steel Sheets: ASTM A366/A366M, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.

C. Aluminum Sheets: ASTM B209 (ASTM B209M), Alloy 3003, Temper H14, sheet form; with standard, one-side bright finish for ducts exposed to view and mill finish for concealed ducts.

D. Extruded Aluminum: ASTM B221 (ASTM B221M), Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for 36-inch (900-mm) length or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 BACKDRAFT DAMPERS

A. Description: Suitable for horizontal or vertical installations.

B. Frame: 0.052-inch (1.3-mm) thick, galvanized, sheet steel with welded corners and mounting flange.

C. Frame: 0.052-inch (1.3-mm) thick, galvanized, sheet steel with welded corners.

D. Frame: 0.063-inch (1.6-mm) thick extruded aluminum with mounting flange.

E. Frame: 0.063-inch (1.6-mm) thick extruded aluminum.

F. Blades: 0.025-inch (0.6-mm) thick, roll-formed aluminum.

G. Blades: 0.050-inch (1.2-mm) thick aluminum sheet.

H. Blade Seals: Felt.

I. Blade Seals: Vinyl.

J. Blade Seals: Neoprene.

K. Blade Axles: Nonferrous.

L. Blade Axles: Galvanized steel.

M. Tie Bars and Brackets: Aluminum.

N. Tie Bars and Brackets: Galvanized steel.

O. Return Spring: Adjustable tension.

2.3 MANUAL-VOLUME DAMPERS

A. General: 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 Classifications of 3-inch wg (750 Pa) 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: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 0.064 inch (1.62 mm) 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. Aluminum Frames: Hat-shaped, 0.10-inch (2.5-mm) thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
3. Roll-Formed Steel Blades: 0.064-inch (1.62-mm) thick, galvanized, sheet steel.
4. Roll-Formed Aluminum Blades: 0.10-inch (2.5-mm) thick aluminum sheet.
5. Extruded-Aluminum Blades: 0.050-inch (1.2-mm) thick extruded aluminum.
6. Blade Axles: Nonferrous.
7. Blade Axles: Galvanized steel.
8. Tie Bars and Brackets: Aluminum.
9. Tie Bars and Brackets: Galvanized steel.

D. Low-Leakage Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

E. Low-Leakage Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 0.064 inch (1.62 mm) 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. Aluminum Frames: Hat-shaped, 0.063-inch (1.6-mm) thick, extruded-aluminum channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
3. Roll-Formed Steel Blades: 0.064-inch (1.62-mm) thick, galvanized, sheet steel.
4. Roll-Formed Aluminum Blades: 0.10-inch (2.5-mm) thick aluminum sheet.
5. Extruded-Aluminum Blades: 0.050-inch (1.2-mm) thick extruded aluminum.
6. Blade Seals: Felt.
7. Blade Seals: Vinyl.
8. Blade Seals: Neoprene.
9. Blade Axles: Nonferrous.
10. Blade Axles: Galvanized steel.
11. Tie Bars and Brackets: Aluminum.
12. Tie Bars and Brackets: Galvanized steel.

F. High-Performance Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized steel channels, minimum of 0.064-inch (1.62-mm) 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. Aluminum Frames: Hat-shaped, 0.125-inch (3-mm) thick, extruded-aluminum channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
3. Steel Blades: 0.052-inch (1.3-mm) thick, galvanized, sheet steel; airfoil shaped.
4. Extruded-Aluminum Blades: Minimum of 0.081-inch (2-mm) thick, 6063T extruded aluminum.
5. Blade Seals: Dual-durometer vinyl on blade edges; metallic compression on jambs.
6. Blade Axles: Nonferrous.
7. Blade Axles: Galvanized steel.
8. Tie Bars and Brackets: Aluminum.
9. Tie Bars and Brackets: Galvanized steel.

G. Jackshaft: 1-inch (25-mm) diameter, galvanized steel pipe rotating within a pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper of a multiple-damper assembly.

H. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch (2.4-mm) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.4 FIRE DAMPERS

A. General: Labeled to UL 555.

B. Fire Rating: 1-1/2 hours.

C. Fire Rating: 1-1/2 and 3 hours.

D. Frame: SMACNA Type A with blades in airstream; fabricated with roll-formed, 0.034-inch (0.85-mm) thick galvanized steel; with mitered and interlocking corners.

E. Frame: SMACNA Type B with blades out of airstream; fabricated with roll-formed, 0.034-inch (0.85-mm) thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed galvanized, sheet steel.

1. Minimum Thickness: 0.05- inch (1.3-mm) or 0.138-inch (3.5-mm) thick as indicated and length to suit application.
2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch (0.85-mm) thick, galvanized, sheet steel. In place of interlocking blades, use full-length, 0.034-inch (0.85-mm) thick, galvanized steel blade connectors.

I. Horizontal Dampers: Include a blade lock and stainless-steel negator closure spring.

J. Fusible Link: Replaceable, 165 or 212 DegF (74 or 100 DegC) rated as indicated.

2.5 CEILING FIRE DAMPERS

A. General: Labeled to UL 555C; comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."

B. Frame: 0.040-inch (1.0-mm) thick, galvanized, sheet steel; round or rectangular; style to suit ceiling construction.

C. Blades: 0.034-inch (0.85-mm) thick, galvanized, sheet steel with nonasbestos refractory insulation.

D. Volume Adjustment: UL-labeled, fusible volume-control adjustment.

E. Fusible Link: Replaceable, 165 DegF (74 DegC) rated.

F. Fusible Link: Replaceable, 212 DegF (100 DegC) rated.

G. Fusible Link: Replaceable, 285 DegF (141 DegC) rated.

2.6 SMOKE DAMPERS

A. General: Labeled to UL 555S. Combination fire and smoke dampers shall be labeled for one-and-one-half-hour rating to UL 555.

B. Fusible Link: Replaceable, 165 or 212 DegF (74 or 100 DegC) rated as indicated.

C. Frame and Blades: 0.064-inch (1.62-mm) thick, galvanized, sheet steel.

D. Mounting Sleeve: Factory-installed, 0.052-inch (1.3-mm) thick, galvanized, sheet steel; length to suit wall or floor application.

E. Damper Motors: Provide for modulating or two-position action.
   1. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
   2. 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 (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
   3. 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 DegF (minus 40 DegC).
   4. Nonspring-Return Motors: For dampers larger than 25 square feet (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
   5. Two-Position Motor: 115 V, single phase, 60 Hz.
   6. Two-Position Motor: 230 V, single phase, 60 Hz.
   7. Two-Position Motor: 230 V, 3 phase, 60 Hz.
   8. Two-Position Motor: 460 V, 3 phase, 60 Hz.
   9. Modulating, Spring-Return Motor: 115 V, single phase, 60 Hz.
   10. Modulating, Spring-Return Motor: 230 V, single phase, 60 Hz.

11. Modulating, Spring-Return Motor: 230 V, 3 phase, 60 Hz.
12. Modulating, Spring-Return Motor: 460 V, 3 phase, 60 Hz.

2.7 DUCT SILENCERS

A. General: Factory-fabricated and -tested, round or rectangular silencer with performance characteristics and physical requirements as indicated.

B. Fire Performance: Adhesives, sealers, packing materials, and accessory materials shall have fire ratings not exceeding 25 for flame spread and 50 for smoke developed when tested according to ASTM E 84.

C. Rectangular Units: Fabricate casings with a minimum of 0.034-inch (0.85-mm) thick, solid sheet metal for outer casing and 0.022-inch (0.55-mm) thick, perforated sheet metal for inner casing.

D. Round Units: Casings with sheet metal thicknesses for diameters listed below:
1. Up to 24 Inches (600 mm): 0.034 inch (0.85 mm).
2. 26 through 40 Inches (660 through 1000 mm): 0.040 inch (1.0 mm).
3. 42 through 52 Inches (1060 through 1300 mm): 0.052 inch (1.3 mm).
4. 54 through 60 Inches (1370 through 1500 mm): 0.064 inch (1.62 mm).
5. Casings fabricated of spiral lock-seam duct may be one size thinner than that indicated.
6. Interior Partitions and Baffles: At least 0.034 inch (0.85 mm) and designed for minimum aerodynamic losses.

E. Sheet Metal Perforations: 1/8-inch (3-mm) diameter for inner casing and baffle sheet metal.

F. Fibrous Acoustic-Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression.

G. Nonfibrous Acoustic-Fill Material: Moisture-proof nonfibrous material.

H. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations.
1. Do not use nuts, bolts, and sheet metal screws for unit assemblies.
2. Lock form and seal or continuously weld joints.
3. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
4. Reinforcement: Cross or trapeze angles for rigid suspension.

I. Source Quality Control: Perform the following factory tests:
1. Acoustic Performance: Test according to ASTM E477 with airflow in both directions through silencer.
2. Record acoustic ratings, including dynamic insertion loss and self-noise power levels for both forward flow (air and noise in same direction) and reverse flow (air and noise in opposite directions) with an airflow of at least 2000-fpm (10-m/s) face velocity.
3. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg (1500-Pa) static pressure, whichever is greater.

2.8 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Manufactured Turning Vanes: Fabricate of 1-1/2-inch (38-mm) wide, curved blades set 3/4 inch (19 mm) o.c.; support with bars perpendicular to blades set 2 inches (50 mm) o.c.; and set into side strips suitable for mounting in ducts.

C. Acoustic Turning Vanes: Fabricate of airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.9 DUCT-MOUNTED ACCESS DOORS AND PANELS

A. General: Fabricate doors and panels airtight and suitable for duct pressure class.

B. Frame: Galvanized, sheet steel, with bend-over tabs and foam gaskets.

C. Door: Double-wall, galvanized, sheet metal construction with insulation fill and thickness, and number of hinges and locks as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.

D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

E. Insulation: 1-inch (25-mm) thick, fibrous-glass or polystyrene-foam board.

2.10 FLEXIBLE CONNECTORS

A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

1. Standard Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches (89 mm) wide attached to two strips of 2-3/4-inch (70-mm) wide, 0.028-inch (0.7-mm) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.

B. Extra-Wide Metal-Edged Connectors: Factory fabricated with a strip of fabric 5-3/4 inches (146 mm) wide attached to two strips of 2-3/4-inch (70-mm) wide, 0.028-inch (0.7-mm) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.

C. Transverse Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches (89 mm) wide attached to two strips of 4-3/8-inch (111-mm) wide, 0.028-inch (0.7-mm) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.

D. Conventional, Indoor System Flexible Connector Fabric: Glass fabric double coated with polychloroprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp, and 360 lbf/inch (63 N/mm) in the filling.

E. Conventional, Outdoor System Flexible Connector Fabric: Glass fabric double coated with a synthetic-rubber, weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp, and 440 lbf/inch (77 N/mm) in the filling.

F. High-Temperature System Flexible Connectors: Glass fabric coated with silicone rubber and having a minimum weight of 16 oz./sq. yd. (542 g/sq. m) and tensile strength of 285 lbf/inch (50 N/mm) in the warp, and 185 lbf/inch (32 N/mm) in the filling.

G. High-Corrosive-Environment System Flexible Connectors: Glass fabric coated with a chemical-resistant coating.
   1. Minimum Weight: 14 oz./sq. yd. (474 g/sq. m).
   2. Tensile Strength: 450 lbf/inch (79 N/mm) in the warp, and 340 lbf/inch (60 N/mm) in the filling.

2.11 FLEXIBLE DUCTS

A. General: Comply with UL 181, Class 1.

B. Flexible Ducts, Uninsulated: Spiral-wound steel spring with flameproof vinyl sheathing.

C. Flexible Ducts, Uninsulated: Corrugated aluminum.

D. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch (38-mm) thick, glass-fiber insulation around a continuous inner liner.
   1. Reinforcement: Steel-wire helix encapsulated in inner liner.
   2. Outer Jacket: Glass-reinforced, silver Mylar with a continuous hanging tab, integral fibrous-glass tape, and nylon hanging cord.
   3. Outer Jacket: Polyethylene film.
   4. Inner Liner: Polyethylene film.

E. Pressure Rating: 6-inch wg (1500 Pa) positive, 1/2-inch wg (125 Pa) negative.

2.12 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 length to suit duct insulation thickness.

B. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch (6-mm), zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.

C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches (75 to 450 mm) to suit duct size.

D. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and NAIMA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.

B. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.

C. Provide test holes at fan inlet and outlet and elsewhere as indicated.

D. Install fire and smoke dampers according to manufacturer's UL-approved written instructions.
   1. Install fusible links in fire dampers.

E. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, and equipment.
   1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.
   2. Install access panels on side of duct where adequate clearance is available.

F. Label access doors according to other Sections.

G. Flexible ducts shall be a maximum length of 4 feet. Provide a rigid elbow at connection to ceiling mounted registers, diffusers, and grilles. Flexible ducts shall only be used on supply air ductwork systems. Flexible ducts shall not be used on return and exhaust air systems.

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 other Sections.

END OF SECTION

SECTION 233400 – FANS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following types fans:
   1. Centrifugal fans for indoor installations.
   2. Utility set fans.
   3. Tubular centrifugal fans.
   4. Inline centrifugal fans.
   5. Power ventilators: roof- and wall-mounted exhausters.
   6. Ceiling-mounted ventilators.
   7. Propeller fans.
   8. Vaneaxial fans.

1.2 SUBMITTALS

A. Product data for selected models, including specialties, accessories, and 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 fan accessories.
   4. Materials gages and finishes including color charts.
   5. Dampers, including housings, linkages, and operators.

B. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

C. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field-installed wiring.

D. Maintenance data:

1.3 QUALITY ASSURANCE

A. UL Compliance: Fans and components shall be UL listed and labeled.

B. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

C. Electrical Component Standard: Components and installation shall comply with NFPA 70 “National Electrical Code.”

1.4 EXTRA MATERIALS

A. Furnish one additional complete set of belts for each belt-driven fan.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

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

1. Centrifugal Fans:
   a. Bayley Fan Group.
   b. Cook (Loren) Co.
   c. Greenheck Fan Corp.
   d. Twin City Fan and Blower Co.
2. Utility Sets:
   a. Bayley Fan Group.
   b. Cook (Loren) Co.
   c. Greenheck Fan Corp.
   d. Twin City Fan and Blower Co.
3. Tubular Centrifugal Fans:
   a. Bayley Fan Group.
   b. Cook (Loren) Co.
   c. Greenheck Fan Corp.
   d. Twin City Fan and Blower Co.
4. Inline Centrifugal Fans:
   a. Cook (Loren) Co.
   b. Greenheck Fan Corp.
   c. Jenn Industries Inc.
5. Centrifugal Roof Ventilators:
   a. Carnes Company, Inc.
   b. Cook (Loren) Co.
   c. Greenheck Fan Corp.
6. Axial Roof Ventilators:
   a. Carnes Company, Inc.
   b. Cook (Loren) Co.
   c. Greenheck Fan Corp.
7. Upblast Propeller Roof Exhaust Fans:
   a. Carnes Company, Inc.
   b. Cook (Loren) Co.
   c. Greenheck Fan Corp.
8. Centrifugal Wall Ventilators:
   a. Carnes Company, Inc.
   b. Cook (Loren) Co.
   c. Greenheck Fan Corp.
9. Ceiling-Mounted Ventilators:
   a. Carnes Company, Inc.
   b. Cook (Loren) Co.
   c. Greenheck Fan Corp.
10. Propeller Fans:
    a. Bayley Fan Group.
    b. Cook (Loren) Co.

c. Greenheck Fan Corp.

11. Vaneaxial Fans:

a. Joy

b. Strobic-Air

c. Twin City Fan and Blower Co.

2.2 SOURCE QUALITY CONTROL

A. Testing Requirements: The following factory tests are required:

1. Sound Power Level Ratings: Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating." Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.

2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51, "Laboratory Methods of Testing Fans for Rating."

2.3 FANS, GENERAL

A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished, with indicated capacities and characteristics.

B. Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.

1. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fan's class.

C. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

1. Service Factor: 1.4.

D. Belts: Oil-resistant, nonsparking, and nonstatic.

E. Motor and Fan Wheel Pulleys: Adjustable pitch for use with motors. Select pulley so that pitch adjustment is at the middle of the adjustment range at fan design conditions.

1. Belt Guards: Provide steel belt guards for motors mounted on the outside of the fan cabinet.

F. Shaft Bearings: Provide type indicated, having a median life "Rating Life" (AFBMA (L50)) of 200,000, calculated in accordance with AFBMA Standard 9 for ball bearings and AFBMA Standard 11 for roller bearings.

G. Factory Finish: The following finishes are required:

1. Sheet Metal Parts: Prime coating prior to final assembly.

2. Exterior Surfaces: Baked-enamel finish coat after assembly.

H. Motors:

1. Refer to other Sections for motor equipment.

2.4 CENTRIFUGAL FANS

A. General Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.

B. Housings: Fabricated from formed and reinforced galvanized steel panels to form curved scroll housings with continuously welded or deep-locked seams and access doors or panels to allow access to internal parts and components.
   1. Inlet Cones: Spun metal.
   2. Duct Connections: Flanged.
   3. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.

C. Fan Wheels: Single-width, single-inlet, welded to cast-iron or cast-steel hub and spun steel inlet cone, with hub keyed to the shaft.

D. Fan Wheels: Double-width, double-inlet, welded to cast-iron or cast-steel hub and spun steel inlet cone, with hub keyed to the shaft.
   1. Blade Materials: Steel.
   2. Blade Type: Backward-curved, flat-plate type.
   3. Blade Type: Backward-curved, airfoil type.
   4. Blade Type: Forward-curved, airfoil type.

E. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow- block type ball bearings.

F. Shaft Bearings: Grease-lubricated, self-aligning, pillow-block type; tapered roller bearings with double-locking collars and two- piece, cast-iron housing.

G. Shaft Bearings: Grease-lubricated, self-aligning, pillow-block type, with double spherical roller bearings with adapter mount and two-piece cast-iron housing.

H. Accessories: The following accessories are required where indicated:
   1. Scroll Bypass Dampers: Aluminum, opposed, airfoil blades with extruded vinyl seals on blades, low-friction bearings, and positive control linkage for manual or automatic operation.
   2. Scroll Housing Access Doors: Latch-type handles; flush-mounted for uninsulated housings and raised-mounted for insulated housings.
   3. Inlet Vanes: Radial vanes with linkage for manual or automatic operation.
      a. Double-Width Fans Inlet Vanes: Connected for single operator.
   4. Inlet Screens: Heavy wire mesh screens, mounted inside of shaft bearings.
   5. Discharge Dampers: Heavy-gage steel, opposed blade design, with linkage for manual or automatic operation.
   6. Drain Connections: Threaded, 3/4-inch NPS, capped nipple installed at lowest point of housing.
   7. Shaft Cooler: Metal disc between bearings and fan wheel, designed to dissipate heat from shaft.
   8. Spark-Resistant Construction: AMCA construction option A, B, or C as indicated.
   9. Shaft Seals: Air-tight seals installed around shaft on drive side of single-width fans.

2.5 UTILITY SET FANS

A. General Description: Belt-driven, centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.

B. Housings: Fabricated from heavy-gage steel with side sheets fastened to scroll sheets by means of welding or deep lock seam.
   1. Inlet: Round duct collar.

2. Discharge: Slip-joint duct connection.
3. Housings Discharge Arrangement: Adjustable to 8 standard positions.

C. Fan Wheels: Single-width, single-inlet, welded to cast-iron or cast-steel hub and spun steel inlet cone, with hub keyed to the shaft.
1. Blade Materials: Steel.
2. Blade Type: Backward-curved, die-formed.
3. Blade Type: Forward-curved, die-formed.

D. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow-block-type ball bearings.

E. Accessories: The following accessories are required where indicated:
1. Backdraft Dampers: Gravity-actuated with counterweight and interlocking aluminum blades and felt edges in steel frame installed on fan discharge.
2. Access Doors: Gasketed doors with latch-type handles.
3. Scroll Dampers: Single-blade damper installed at fan scroll top with adjustable linkage.
4. Spark-Resistant Construction: AMCA construction option A, B, or C as indicated.
5. Inlet Screens: Removable, heavy wire mesh.
6. Drain Connections: 3/4-inch, threaded coupling drain connection installed at lowest point of housing.
7. Weather Hoods: Weather-resistant with stamped vents over motor and drive compartment.

2.6 TUBULAR CENTRIFUGAL FANS

A. General Description: Tubular, inline, belt-driven, centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, drive assembly, motor and disconnect switch, mounting brackets, and accessories.

B. Housings: Fabricated from formed and reinforced galvanized steel panels with welded seams.
1. Duct Connections: Spun inlet cones with flange removable for access to internal parts, and an outlet flange.
2. Mounting Brackets: Suitable for horizontal or vertical mounting.
3. Motor Mount: Adjustable for belt tensioning.
4. Fan Wheels: Single-width, single-inlet, welded to cast-iron or cast-steel hub and spun steel inlet cone, with hub keyed to the shaft.
a. Blade Materials: Steel.
b. Blade Type: Backward-curved, flat-plate type.
c. Blade Type: Backward-curved, airfoil type.

C. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow- block-type ball bearings.

D. Shaft Bearings: Grease-lubricated, self-aligning, pillow-block type; tapered roller bearings with double-locking collars and two- piece, cast-iron housing.

E. Shaft Bearings: Grease-lubricated, self-aligning, pillow-block type, with double spherical roller bearings with adapter mount and two-piece cast-iron housing.

F. Accessories: The following accessories are required where indicated:
1. Companion Flanges: For inlet and outlet connections.
2. Weather Cover: Heavy-gage, galvanized, sheet steel with ventilation slots, bolted to housing.

3. Belt Guard: Manufacturer's standard to meet OSHA requirements.
4. Ceiling Brackets: Structural angles welded and drilled for hanger rod attachment.
5. Inlet Vanes: Radial vanes with linkage suitable for manual or automatic operation.
6. Access Doors: Located over wheel in an accessible position, hinged and having latch-type handles; flush mounted for uninsulated housings, raised-mounted for insulated housings.
7. Spark-Resistant Construction: AMCA construction option A, B, or C as indicated.
8. Inlet and Outlet Screens: Removable, heavy wire mesh.

2.7 INLINE CENTRIFUGAL FANS

A. General Description: Inline, belt-driven, centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, drive assembly, motor and disconnect switch, mounting brackets, and accessories.

B. Housing: Split, spun-aluminum housing, with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Drive Units: Motor encased in housing out of air stream, factory-wired to disconnect located on outside of fan housing.

D. Belt-Drive Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Wheel: Aluminum, airfoil blades welded to aluminum hub.

F. Accessories: The following accessories are required as indicated:
1. Volume Control Damper: Manual operated with quadrant lock, located in fan outlet.
2. Companion Flanges: For inlet and outlet duct connections.
3. Fan Guards: Expanded metal in removable frame.
4. Speed Control: Variable speed switch with on-off control and speed control for 100 to 50 percent of fan air delivery.

2.8 CENTRIFUGAL ROOF VENTILATORS

A. General Description: Belt-driven or direct-drive as indicated, centrifugal consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

B. Housing: Heavy-gage, removable, spun-aluminum, dome top, and outlet baffle; square, one-piece, hinged, aluminum base with venturi inlet cone.
1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.

C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.

D. Belt-Driven Drive Assembly: Resiliently mounted to the housing, with the following features:
1. Pulleys: Cast-iron, adjustable-pitch.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
4. Fan and motor isolated from exhaust air stream.

E. Motor shall be open drip proof type.

F. Accessories: The following items are required as indicated:
   1. Disconnect Switch: Nonfusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.
   2. Bird Screens: Removable 1/2-inch mesh, 16-gage, aluminum or brass wire.
   3. Dampers: Motor-operated, parallel-blade, volume control dampers mounted in curb base.
      a. Blades: Die-formed sheet aluminum.
      b. Frame: Extruded aluminum, with waterproof, felt blade seals.
      c. Linkage: Nonferrous metals, connecting blades to counter weight or operator.
      d. Operators: Manufacturer's standard electric motor.
      e. Operators: Manufacturer's standard pneumatic motor.
   4. Roof Curbs: Prefabricated, heavy-gage, galvanized steel; mitered and welded corners; 2-inch-thick, rigid, fiberglass insulation adhered to inside walls; built-in cant and mounting flange for flat roof decks; and 2-inch wood nailer. Size as required to suit roof opening and fan base.
      a. Overall Height: 12 inches.

2.9 AXIAL ROOF VENTILATORS

A. General Description: Belt-driven or direct-drive as indicated, axial fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

B. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; and square, one-piece, hinged, aluminum base.

C. Fan Wheel: Aluminum hub and blades.

D. Fan Wheel: Steel hub and blades.

E. Belt-Driven Drive Assembly: Resiliently mounted to the housing, with the following features:
   1. Pulleys: Cast-iron, adjustable-pitch.
   2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
   3. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.

F. Accessories: The following items are required as indicated:
   1. Disconnect Switch: Nonfusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.
   2. Bird Screens: Removable, 1/2-inch mesh, 16-gage aluminum or brass wire.
   3. Dampers: Motor-operated, parallel-blade, volume control dampers mounted in curb base.
      a. Blades: Die-formed sheet aluminum.
      b. Frame: Extruded aluminum with waterproof, felt blade bumpers.
      c. Linkage: Nonferrous metals.
      d. Operators: Manufacturer's standard electric motor.
      e. Operators: Manufacturer's standard pneumatic motor.
   4. Roof Curbs: Prefabricated, heavy-gage, galvanized steel; mitered and welded corners; 2-inch-thick, rigid fiberglass insulation adhered to inside walls; built-in cant and mounting flange for flat roof deck; and 2-inch wood nailer. Size as required to suit roof opening and fan base.
      a. Overall Height: 12 inches.

2.10 UPBLAST PROPELLER ROOF EXHAUST FANS

A. General Description: Belt-driven or direct-drive as indicated, propeller fans consisting of housing, wheel, butterfly-type discharge damper, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

B. Wind Band, Fan Housing, and Base: Reinforced and braced galvanized steel, containing galvanized steel butterfly dampers and rain trough, motor and drive assembly, and fan wheel.

C. Wind Band, Fan Housing, and Base: Reinforced and braced aluminum, containing aluminum butterfly dampers and rain trough, motor and drive assembly, and fan wheel.
   1. Dampers Rods: Steel with bronze bearings.
   2. Dampers Rods: Steel with nylon bearings.

D. Fan Wheel: Dynamically and statically balanced, replaceable, cast- aluminum blades fastened to cast-aluminum hub. Factory-set pitch angle of blades.

E. Fan Wheel: Replaceable, extruded-aluminum, airfoil blades fastened to cast-aluminum hub. Factory set pitch angle of blades.

F. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow- block-type ball bearings.

G. Motors and Fan Wheel Pulleys: Adjustable pitch. Select pulley so that pitch adjustment is at the middle of the adjustment range at design conditions.

H. Motors Mounts: Outside of the fan cabinet with adjustable base for belt tensioning, drive assembly and belts enclosure, and weatherproof housing of same material as fan housing.

I. Roof Curbs: Prefabricated, heavy-gage, galvanized steel; mitered and welded corners; 2-inch-thick, rigid fiberglass insulation adhered to inside walls; built-in cant and mounting flange for flat roof deck; and 2-inch wood nailer. Size as required to suit roof opening and fan base.
   1. Overall Height: 12 inches.

2.11 CENTRIFUGAL WALL VENTILATORS

A. General Description: Belt-driven or direct-drive as indicated, centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.

B. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venturi design fan inlet cone.

C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.

D. Belt-Driven Drive Assembly: Resiliently mounted to the housing, with the following features:
   1. Pulleys: Cast-iron, adjustable-pitch.
   2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
   3. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
   4. Fan and motor isolated from exhaust air stream.

E. Accessories: The following items are required as indicated:
   1. Disconnect Switch: Nonfusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.

2. Bird Screens: Removable, 1/2-inch mesh, 16-gage aluminum or brass wire.
3. Dampers: Motor-operated, parallel-blade dampers mounted in curb base.
   a. Blades: Die-formed sheet aluminum.
   b. Frame: Extruded aluminum, with waterproof, felt blade bumpers.
   c. Linkage: Nonferrous metals.
   d. Operators: Manufacturer's standard electric motor.
   e. Operators: Manufacturer's standard pneumatic motor.

2.12 CEILING-MOUNTED VENTILATORS

A. General Description: Centrifugal fan designed for installation in ceiling, wall, or concealed inline applications.

B. Housing: Galvanized 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: Stainless steel, 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. Remote Fan Speed Control: Solid state, capable of controlling fan speed from full speed to approximately half speed.

G. Accessories: Manufacturer's standard roof jack, wall cap, and transition fittings as indicated.

2.13 PROPELLER FANS

A. General Description: Belt-driven or direct-drive propeller fans as indicated consisting of fan blades, hub, housing, orifice ring, motor, drive, and accessories.

B. Housings: Galvanized, sheet steel with flanged edges, and integral orifice ring.

C. Wheels: Formed-steel blades riveted to a heavy-gage steel spider bolted to cast-iron hub.

D. Fan Wheel: Replaceable, cast-aluminum blades fastened to cast- aluminum hub. Factory set pitch angle of blades.

E. Fan Wheel: Replaceable, extruded-aluminum, airfoil blades fastened to cast-aluminum hub. Factory set pitch angle of blades.

F. Drive Assembly: Direct-drive or belt-driven as indicated.

G. Belt-Driven Drive Assembly: Resiliently mounted to the housing, with the following features:
   1. Pulleys: Cast-iron, adjustable-pitch.
   2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
   3. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
   4. Motor and Drive Assembly: Resiliently mounted to the housing.

H. Accessories: The following accessories are required as indicated:
   1. Belt Guards: Expanded metal with reinforced edges.
   2. Motor operated shutters with aluminum blades in steel frames, motor mounted on discharge side of fan.

2.14 VANEAXIAL FANS

A. General Description: Belt-driven or direct-drive as indicated, variable pitch or adjustable pitch as indicated, vaneaxial fans consisting of fan wheel and housing, straightening vane section, factory-mounted motor, an inlet cone section, and accessories.
   1. Variable pitch fans include internally mounted, pneumatic actuator, externally mounted positive positioner, and mechanical-blade-pitch indicator for variable volume operation.

B. Housings: Steel housing, 14-gage minimum, with inlet bell and diffuser sections.
   1. Inlet and Outlet Connections: Outer mounting frame and companion flanges; inlet cone shall be welded to the fan raceway.
   2. Guide Vane Section: Integral guide vanes downstream of the fan wheel designed to straighten the airflow.

C. Wheels: Cast-aluminum, axial-flow type, with airfoil-shaped blades mounted on cast-iron wheel plate keyed to shaft with solid steel key.
   1. Variable-Pitch Fans: Provide a factory-mounted actuator and blade pitch operating mechanism.

D. Fan Hub and Blade Bearing Assemblies: Cast aluminum, machined and fitted with threaded bearing wells to receive blade bearing assemblies.
   1. Blades: Replaceable, cast aluminum; factory-mounted and balanced to the hub assembly.
   2. Fan Shaft: Turned, ground, and polished steel.
   3. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow-block-type ball bearings.
   4. Shaft Bearings: Grease-lubricated, self-aligning, pillow-block type; tapered roller bearings with double-locking collars and two-piece, cast-iron housing.

E. Direct-Drive Units: Motor encased in housing out of air stream, factory-wired to disconnect located on outside of fan housing.

F. Belt-Drive Units: Provide enclosure around belts and sheaves.
   1. Motor Mounting: Adjustable base.
   2. Sheaves: Adjustable.
   3. Belts: Oil-resistant, nonsparking, and nonstatic.

G. Accessories: The following accessories are required as indicated:
   1. Companion Flanges: Rolled-steel flanges.
   2. Inlet and Outlet Screens: Heavy wire mesh inlet screens on fans not connected to ductwork.
   3. Backdraft Dampers: Butterfly-style, for mounting with flexible connection to the discharge of the fan, or direct-mounted to the discharge diffuser section.
   4. Stall Alarm Probe: A sensing probe capable of detecting fan operation in stall and sending a signal to control devices. Control devices and sequence of operation are specified in other Sections.
   5. Flow Measurement Port: Pressure measurement taps installed in the inlet of the fan to detect and signal air flow readings to temperature control systems. Control devices and sequence of operation are specified in other Sections.

6. Inlet Vanes: Adjustable; having peripheral control linkage operated from outside of the air stream, bronze sleeve bearings on each end of vane support, and provision for manual or automatic operation as indicated.

2.15 MOTORS

A. Torque Characteristics: Sufficient to accelerate the driven loads satisfactorily.

B. Motor Sizes: Minimum sizes and electrical characteristics as indicated. If not indicated, large enough so that the driven load will not require the motor to operate in the service factor range.

C. Temperature Rating: 50 DegC maximum temperature rise at 40 DegC ambient for continuous duty at full load (Class A Insulation).

D. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.

E. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design B. Provide permanent-split capacitor classification motors for shaft-mounted fans and capacitor start classification for belted fans.
   1. Bases: Adjustable.
   2. Bearings: The following features are required:
      a. Ball or roller bearings with inner and outer shaft seals.
      b. Grease lubricated.
      c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
   3. Enclosure Type: The following features are required:
      a. Open dripproof motors where satisfactorily housed or remotely located during operation.
      b. Guarded dripproof motors where exposed to contact by employees or building occupants.
   4. Overload protection: Built-in, automatic reset, thermal overload protection.
   5. Noise rating: Quiet.
   6. Efficiency: Energy-efficient motors shall have a minimum efficiency as scheduled in accordance with IEEE Standard 112, Test Method B. If efficiency not specified, motors shall have a higher efficiency than “average standard industry motors” in accordance with IEEE Standard 112, Test Method B.
   7. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, and special features.

F. Starters, Electrical Devices, and Wiring: Electrical devices and connections are specified in other Sections.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, housekeeping pads, and other conditions affecting performance of fans.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install fans level and plumb, in accordance with manufacturer's written instructions. Support units as described below, using the vibration control devices indicated. Vibration control devices are specified in Division 23 Section "Mechanical Vibration Controls and Seismic Restraints".

1. Support floor-mounted units on concrete equipment bases using neoprene pads. Secure units to anchor bolts installed in concrete equipment base.
2. Support floor-mounted units on concrete equipment bases using housed spring isolators. Secure units to anchor bolts installed in concrete equipment base.
3. Secure roof-mounted fans to roof curbs with cadmium-plated hardware.
   a. Installation of roof curbs is specified in other Sections.
4. Suspended Units: Suspend units from structural steel support frame using threaded steel rods and vibration isolation springs.

B. Arrange installation of units to provide access space around air- handling units for service and maintenance.

3.3 EQUIPMENT BASES

A. Construct concrete equipment pads as follows:

1. Coordinate size of equipment bases with actual unit sizes provided. Construct base 4 inches larger in both directions than the overall dimensions of the supported unit.
2. Form concrete pads with steel channels conforming to ASTM A36, size and location as indicated. Miter and weld corner and provide cross bracing. Anchor or key to floor slab.
3. Form concrete pads with framing lumber with form release compounds. Chamfer top edge and corners of pad.
4. Install reinforcing bars, tied to frame, and place anchor bolts and sleeves to facilitate securing units.
5. Place concrete and allow to cure before installation of units. Use Portland cement conforming to ASTM C150, 4,000 psi compressive strength, and normal weight aggregate.
6. Clean exposed steel form in accordance with SSPC Surface Preparation Specifications SP 2 or SP 3 and apply 2 coats of rust-preventive metal primer.

3.4 CONNECTIONS

A. Duct installations and connections are specified in other Sections. Make final duct connections with flexible connections.

B. Electrical Connections: The following requirements apply:

1. Electrical power wiring is specified in other Divisions.
2. Temperature control wiring and interlock wiring are specified in Division 23.
3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Inspection: Arrange and pay for a factory- authorized service representative to perform the following:

1. Inspect the field assembly of components and installation of fans including ductwork and electrical connections.
2. Prepare a written report on findings and recommended corrective actions.

3.6 ADJUSTING, CLEANING, AND PROTECTING

A. Adjust damper linkages for proper damper operation.

B. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

3.7 COMMISSIONING

A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
   1. Remove shipping blocking and bracing.
   2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
   3. Perform cleaning and adjusting specified in this Section.
   4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
   5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
   6. Verify manual and automatic volume control and that fire and smoke dampers in connected ductwork systems are in the full-open position.
   7. Disable automatic temperature control operators.

B. Starting procedures for fans:
   1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
      a. Replace fan and motor pulleys as required to achieve design conditions.
   2. Measure and record motor electrical values for voltage and amperage.

C. Shut unit down and reconnect automatic temperature control operators.

D. Refer to Division 23 Section “Testing, Adjusting, and Balancing” for procedures for air-handling-system testing, adjusting, and balancing.

3.8 DEMONSTRATION

A. Demonstration Services: Arrange and pay for a factory-authorized service representative to train Owner’s maintenance personnel on the following:
   1. Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
   2. Familiarization with contents of Operating and Maintenance Manuals.

B. Schedule training with at least seven (7) days’ advance notice.

END OF SECTION

238200-CONVECTION HEATING AND COOLING UNITS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Electric baseboard radiation.

1.2 SUBMITTALS

A. Product Data: Submit schedules for equipment and radiation enclosures indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output of equipment. Submit coil and frame configurations, and rough-in dimensions.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit operating instructions, maintenance and repair data, and parts lists.

1.4 WARRANTY

A. Furnish manufacturer's warranty for unit heater motors for five years after Substantial Completion.

PART 2 PRODUCTS

2.1 ELECTRIC BASEBOARD RADIATION

A. Assembly: UL listed and labeled with terminal box and cover, and built-in controls.

B. Heating Elements: Enclosed copper tube, aluminum finned element of coiled nickel-chrome resistance wire centered in tubes and embedded in refractory material.

C. Enclosure: Minimum 0.030 inch thick steel with 7 inch high back and top of one piece; front panel, end panel, and end caps.

D. Control: Built-in bi-metal heating thermostat, factory wired.

2.2 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Disconnect Switch: Factory mount in control panel.

238200-CONVECTION HEATING AND COOLING UNITS

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify wall construction and ductwork are ready for installation.

B. Verify concealed blocking and supports are in place and connections are correctly located.

3.2 INSTALLATION

A. Install unit heaters from building structure. Support independently from piping.

B. Install electric heating equipment including devices furnished by manufacturer but not factory-mounted.

END OF SECTION

SECTION 260001 – ELECTRICAL

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. Provide all labor, material, tools, equipment, transportation and services necessary for and incidental to completion of all electrical work as indicated on the Drawings and/or as specified herein.

1.2 DRAWING USE AND INTERPRETATION

A. The Drawings are diagrammatic and indicate the general arrangement of systems and equipment unless indicated otherwise by dimensions or details. Exact equipment locations and raceway routing, etc. shall be governed by actual field conditions and/or instructions of the Engineer and/or Owner's Representative.

1.3 COMPLETE SYSTEMS

A. General: Furnish and install all materials as required for complete systems, including all parts obviously or reasonably incidental to a complete installation, whether specifically indicated or not. All systems shall be completely assembled, tested, adjusted and demonstrated to be ready for operation prior to Owner's acceptance.

B. Wiring: The wiring specified and/or shown on the Drawings is for complete and workable systems. Any deviations from the wiring shown due to a particular manufacturer's or subcontractor's requirements shall be made at no cost to either the Contract or the Owner.

1.4 CODES AND REGULATIONS

A. General: Comply with the latest recognized edition of the National Electrical Code (NEC) and all governing federal, state, and local laws, ordinances, codes, rules, and regulations. Where the Contract Documents exceed these requirements, the Contract Documents shall govern. In no case shall work be installed contrary to or below minimum legal standards.

B. Utilities: Comply with all applicable rules, restrictions, and requirements of the utility companies serving the project site/facilities.

C. Non-Compliance: Should any work be performed which is found not to comply with any of the above codes and regulations, provide all work and pay all costs necessary to correct the deficiencies.

1.5 REFERENCE STANDARDS

A. All latest published standards of the following associations/organizations shall be followed and applied where applicable as minimum requirements:
   1. (ADA), Americans with Disabilities Act.
   2. (ANSI), American National Standards Institute.
   3. (ASTM), American Society for Testing and Materials.
   4. (CBM), Certified Ballast Manufacturer.
   5. (EPACT), National Energy Policy Act.
   6. (ETL), Electrical Testing Laboratory.
   7. (ICEA), Insulated Cable Engineers Association.

8. (IEEE), Institute of Electrical and Electronic Engineers.
9. (IESNA), Illuminating Engineering Society of North America.
10. (NBFU), National Board of Fire Underwriters.
11. (NEMA), National Electrical Manufacturers Association.
12. (NESC), National Electrical Safety Code.
13. (NFPA), National Fire Protection Association.
14. (UL), Underwriter's Laboratories.

1.6 PERMITS

A. General: Obtain and pay for any and all permits required by all applicable agencies, prior to commencing work.

1.7 SUBMITTALS

A. General: Prepare and submit for approval, per the procedures set forth in Division 1, all submittals required by Division 1, this section, and by all other Contract Documents.

B. Types: Required submittals may include: Schedule of Values; List of Subcontractors; Product Data; Shop Drawings; Samples; Test Reports; Certifications; Warranties; Maintenance Manuals; Record Drawings; and various administrative submittals.

C. Number of Copies: As indicated in Division 1, Division 26 or elsewhere in the Contract Documents. For quantities indicated in the Contract Documents or specification sections other than Division 26 sections, increase number of copies by one to allow for the Engineer's record copy. Minimum number of copies per submittal: three.

D. Product Data: Submit for all basic electrical equipment, devices, and materials to be used on the project. Product data to consist of manufacturer's standard catalog cuts, descriptive literature and/or diagrams, in 8-1/2" x 11" format, and in sufficient detail so as to clearly indicate compliance with all specified requirements and standards. Mark each copy to clearly indicate proposed product, options, finishes, etc.

E. Shop Drawings: Submit for all custom equipment and systems (e.g., panelboards) to be used on the project. Shop Drawings to be newly prepared, specifically for this project, and shall include all information listed in the Shop Drawings submittal requirements in the respective specification section. Include all pertinent information such as equipment/system identification, manufacturer, dimensions, nameplate data, sizes, capacities, types, materials, performance data, features, accessories, wiring diagrams, etc., in sufficient detail so as to clearly indicate compliance with all specified requirements and standards. For control systems, provide computer generated control ladder diagrams specifically developed for this project (standard diagrams not acceptable).

F. Maintenance Manuals: Include operating and maintenance data in accordance with Division 1. Include all Product Data/Shop Drawing submittals as well as descriptions of function, normal operating characteristics and limitations, and manufacturer's printed operating maintenance, trouble shooting, repair, adjustment, and emergency instructions, and complete replacement parts listing.

G. Record Documents: Prepare and submit in accordance with Division 1. In addition to Division 1 requirements, indicate actual installed locations for all equipment and devices, routing of major interior raceways, locations of all concealed and underground equipment and raceways, and all approved modifications to the Contract Documents, and deviations necessitated by field conditions and change orders.

1.8 QUALITY ASSURANCE

A. Manufacturers' Qualifications: Not less than three years experience in the actual production of the specified products.

B. Installers' Qualifications: Firm with not less than five years experience in the installation of electrical systems and equipment similar in scope and complexity to those required for this Project, and having successfully completed at least ten comparable scale projects.

C. Incidental Work: Excavation, backfill, painting, patching, welding, carpentry, mechanical work, concrete pads and the like related to or required for Division 26 work shall be performed by craftsman skilled in the appropriate trade, but shall be provided for under Division 26.

1.9 INSPECTIONS

A. General: During and upon completion of the work, arrange and pay all associated costs for inspections of all electrical work installed under this contract, in accordance with the Conditions of the Contract.

B. Inspections Required: As per the laws and regulations of the local and/or state agencies having jurisdiction at the project site.

C. Inspection Agency: Approved by the local and/or state agencies having jurisdiction at the project site.

D. Certificates: Submit all required inspection certificates.

E. Coordination: Coordinate inspections with the local utility.

1.10 DELIVERY STORAGE AND HANDLING

A. Comply with Division 1 requirements.

B. Packing and Shipping: Deliver products in original, unopened packaging, properly identified with manufacturer's identification, and compliance labels.

C. Storage and Protection: Comply with all manufacturer's written recommendations. Store all products in a manner which shall protect them from damage, weather, and entry of debris.

D. Damaged Products: Do not install damaged products. Arrange for prompt replacement.

PART 2 – PRODUCTS

2.1 GENERAL

A. Where Specified: Materials and equipment shall be as specified herein and/or as indicated on the Drawings.

B. General Requirements: All materials and equipment shall be in accordance with the Contract Documents, and to the extent possible, standard products of the various manufacturers, except where special construction or performance features are called for. All materials and equipment to be new, clean, undamaged, and free of defects and corrosion.

C. Acceptable Products: The product of a specified or approved manufacturer will be acceptable only when that product complies with or is modified as necessary to comply with all requirements of the Contract Documents.

D. Common Items: Where more than one of any specific item is required, all shall be of the same type and manufacturer.

E. UL Listing: All electrical materials and equipment shall be Underwriters' Laboratories (UL) listed and labeled, where UL standards and listings exist for such materials or equipment.

2.2 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to the Conditions of the Contract, and Division 1.

2.3 FIRESTOPPING MATERIALS

A. General: Firestop systems composed of firestop compounds and appropriate damming materials installed together with the penetrant (e.g., conduit) to form a complete firestop system, providing a fire resistant rating at least equal to the hourly fire resistance rating of the floor, wall or partition into which the firestop system is to be installed.

B. Test Standards: Fires topping materials shall be tested together as a system to the time/temperature requirements of ASTM E119 and shall be tested to UL 1479 (ASTM E814) and be UL classified for up to 3 hours.

C. Firestop Sealants: Non-hardening, conformable, intumescent putties, sealants or other compounds, containing no toxic solvents or asbestos, and exhibiting aggressive adhesion to all common building materials and penetrants, while allowing reasonable movement of the penetrants, without being displaced. Compounds shall be waterproof, non-toxic and smoke and gas tight.

D. Firestop Mortars: Light-weight, water-based, cementitious, fast drying, low density mortar, non-shrinking and non-cracking during its cure, and which forms a surface capable of being sanded, bored and painted.

E. Damming Materials: Mineral wool or ceramic fiber.

F. Multi-Cable Transits: Assemblies consisting of a frame, a compression mechanism, and grooved insert sealing modules sized for multiple penetrating elements of various sizes.

G. Acceptable Manufacturers: Hilti; Heavy Duty/Nelson; International Protective Coatings; Specified Technologies, Inc.

2.4 SOIL MATERIALS

A. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, or natural or crushed sand.

B. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1-1/2 inch sieve, and not more than 5 percent passing a No. 4 sieve.

C. Backfill and Fill Materials: Materials complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP, free of clay, rock, or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetable, and other deleterious matter.

2.5 CONCRETE WORK

A. Concrete:
   1. Minimum Strength: 3000 psi @ 28 days.
   2. Aggregate: 3/4" aggregate.
   3. Cement: 588 #/cu. yd. minimum, type I or II.
   4. Slump: 4 inches maximum.
   5. Air: 5 to 7 percent.

B. Reinforcing: Grade 60 bars, sized as indicated, and 6" x 6" - W1.4 x W1.4 mesh, and other reinforcing as indicated.

C. Forms: Wood, metal or other approved materials, constructed so as to withstand the forces of the newly placed concrete.

D. Equipment Pads: Minimum 4" thick indoor, 12" thick outdoor (with 9" below grade), with 1" x 45º chamfer on all top edges. For on grade installations provide 12" layer of crushed stone beneath pad. For pads to be placed on concrete floors, provide anchors into concrete floor.
   1. Comply with equipment manufacturer's specifications and/or utility company requirements.

2.6 RACEWAY SYSTEMS

A. Raceway Sizing: As required by the NEC (minimum) with oversized raceways as indicated and where required for ease of pulling cable. Minimum conduit size: 3/4-inch, unless indicated otherwise.

B. Raceway Types: Rigid galvanized steel conduit, liquid-tight flexible steel conduit and Schedule 40 heavywall and Schedule 80 extra-heavywall rigid non-metallic (PVC) conduit, conforming to applicable ANSI, NEMA and UL standards.

C. Fittings: All raceway fittings (except for rigid non-metallic conduit) to be steel or malleable iron, and UL-listed for the intended application. Outlet Boxes (Concealed in Walls): Non-gangable, galvanized steel, with square cornered tile (or masonry) type extension rings or cover. Minimum size: two-gang masonry box or 4" square box with single-gang adapter (plaster) ring. Depth of adapter ring to suit application. Minimum depth: 1-1/2". Minimum capacity: 21 cubic inches.

D. Outlet Boxes (Surface Mounted): Cadmium plated cast or malleable iron.

E. Pull and Junction Boxes, and Wireways: Use as indicated and required. Junction and pull boxes for general indoor use (dry locations) to be of galvanized code gauge steel construction, minimum 4" square by 1-1/2" deep, with screw-on covers. Wireways to be UL listed, sheet steel construction with screw-on covers. For exterior and damp or wet indoor locations, use boxes and wireways approved for such use.

F. Handholes: Light-weight and high-strength, constructed of fiberglass reinforced polymer concrete, gray color, suitable for use at temperatures down to -50ºF, and resistant to sunlight, weathering, chemicals and freeze-thaw cycles, with bolt-on cover (with standard logo indicating type of service), and designed for in-grade use in areas with light vehicular traffic (5,000 lb. load over 10"x10" area). Acceptable Manufacturers: Quazite "Composolite," Styles "PC" or "PG", Carson Oldcastle.

G. Pipe Sleeves: Rigid steel conduit or iron pipe.

H. Conduit Seals: For Cast-in-Place Concrete Applications: Acceptable Manufacturers: O-Z/Gedney Type "FSK"; Thunderline Corp. "Link Seal" with "Link Seal Wall Sleeve." For Core Drilled and Pre-Cast

Opening Applications: Acceptable Manufacturers: O-Z/Gedney Type "CSML"; Thunderline corp. "Link Seal."

I. Pull Wires: No. 14 AWG zinc-coated steel monofilament plastic line with 200 lb. tensile strength.

2.7 600 VOLT CLASS WIRE

A. General: All wire and cable shall be constructed in accordance with all applicable ICEA, NEMA and IEEE published standards, and shall be UL-listed and labeled. Single-conductor, 98% conductivity, annealed, uncoated copper conductors with 600-volt rated type "THHN/THWN" insulation.

B. Wire shall be annealed bare copper per ANSI/ASTM B3, UL 83, and Federal Specification JC-30A with 600 volt insulation, be stranded (except for #10 AWG and smaller may be solid), and be minimum size #12 AWG (Except for control wiring and signal circuits).

C. Insulation: Provide THHN/THWN insulation for all conductors, except XHHW insulation may be used for conductors #4 and larger.

D. Ampacity of conductors shall be rated for 75 degrees C regardless of temperature of conductor insulation when combining circuits in one conduit. Derate conductors and increase size per NEC when installing multiple circuits in a raceway, utilizing 75˚C ampacity table.

E. Connectors: Nylon shell insulated metallic screw-on connectors for #14-10 AWG, and bolted pressure or compression type lugs and connectors with insulating covers for #8 AWG and larger.

2.8 WIRING DEVICES

A. Switches: 20 amp, 120-277 volt, A.C. only, toggle type, single-pole, double-pole, three-way or four-way as indicated or required. Acceptable Manufacturers: Leviton; Arrow-Hart; Hubbell; Pass and Seymour.

B. Receptacles (General Use): 125 volt, 20 amp, NEMA 5-20R, duplex type. Acceptable Manufacturers: Leviton; Arrow-Hart; Hubbell; Pass and Seymour.

C. GFI Receptacles: Ground fault circuit interrupter, feed-through, duplex type, 125 volt, 20 amp, NEMA 5-20R, with solid-state ground-fault sensing and 5 mA trip level. Acceptable Manufacturers: Leviton; Arrow-Hart; Hubbell; Pass and Seymour.

D. Special Receptacles: As indicated by ratings and/or NEMA configuration. Acceptable Manufacturers: Leviton; Arrow-Hart; Hubbell; Pass and Seymour.

E. Coverplates (Exterior Locations): Weatherproof cast aluminum or polycarbonate. Receptacles installed in damp or wet locations shall have an enclosure and cover that are weatherproof with the attachment plug inserted or removed per NEC 406.9.

2.9 EQUIPMENT CONNECTIONS

A. Materials as specified in this section, and as required.

2.10 HANGERS AND SUPPORTS

A. General: All hangers, supports, fasteners and hardware shall be zinc-coated or of equivalent corrosion resistance by treatment or inherent property, and shall be manufactured products designed for the application. Products for outdoor use shall be hot dip galvanized.

B. Types: Hangers, straps, riser supports, clamps, U-channel, threaded rods, etc. as indicated and/or required.

C. Seismic restraints and supports as indicated and/or required.

2.11 ELECTRICAL IDENTIFICATION

A. Nameplates: Three-layer laminated plastic with minimum 3/16" high white engraved characters on black background, and punched for mechanical fastening. Fasteners: self-tapping stainless-steel screws or number 10-32 stainless steel machine screws with nuts and flat and lock washers. Each nameplate on all panelboards and switchgear shall indicate the following:

1. Panel Name
2. Voltage, Phase, Number of Wires
3. Source

B. Underground Warning Tape: Six-inch wide polyethylene tape, permanently bright colored with continuous-printed legend indicating general type of underground line below and "CAUTION." Colors as follows:

1. Red - Electric
2. Orange - Communications

C. Marking Pens: Permanent, waterproof, quick drying black ink. Acceptable Manufacturers: Sanford Fine Point "Sharpie," or equal.

D. Wire Tags: Vinyl or vinyl-cloth self-adhesive wraparound type indicating appropriate circuit number, etc.

E. Arc Flash Panelboard Stickers: Provide per NEC 110.16.

2.12 ELECTRIC SERVICE

A. Materials as specified elsewhere in this section, and as required by the serving electric utility company.

2.13 GROUNDING

A. General: Ground rods, conductors, clamps and connectors, etc. as required.

B. Ground Rods: Minimum 5/8" diameter by 10' long copper clad steel.

C. Welded Connectors: Exothermic process.

2.14 DRY TYPE TRANSFORMERS

A. General: Transformers shall be UL listed and labeled, and meet all applicable NEMA, ANSI, and IEEE standards. Transformers shall be factory assembled, general purpose, ventilated type of size and electrical characteristics indicated.

B. Enclosure: Ventilated, drip-proof code gauge steel housing with bolted removable access panels, phosphatized and finished with corrosion inhibiting undercoat and ANSI-61 gray baked enamel. Transformers shall be suitable for mounting on floor or other substantial structure, except for 15 KVA size and smaller which shall be suitable for wall mounting.

C. Core and Coil: Constructed of continuous copper windings and high grade non-aging, grain oriented silicon steel core laminations having high magnetic permeability and low hysteresis and eddy current losses. Core and coil of units rated 15 KVA or more shall be completely isolated from the enclosure using vibration absorbing mounts and shall have flexible grounding strap connected to the enclosure. Connections to primary and secondary bushing shall be made using fully rated flexible straps.

D. Insulation System: 220ºC temperature class for all transformers.

E. Temperature Rise: Winding temperature rise by resistance limited to 115ºC for all transformer sizes, referenced to 40ºC ambient temperature. Hot spot temperature shall not exceed 30ºC above winding temperature rise rating. Case temperature shall not exceed 35ºC above 40ºC ambient temperature.

F. Taps: Two 5% FCBN taps for transformer sizes below 30 KVA; and two 2-1/2% FCAN and four 2-1/2% FCBN taps for transformer sizes 30 KVA and larger; referenced to nameplate voltage.

G. Noise Levels: Less than ANSI standards and shall meet the following requirements:
1. 15 to 50 kVa 45 dB
2. 51 to 150 kVa 50 dB
3. 151 to 300 kVa 55 dB
4. 301 to 500 kVa 60 dB
5. 501 to 700 kVa 62 dB
6. 701 to 1000 kVa 64 dB

H. Efficiencies shall be as indicated in the following table:

NEMA CLASS 1 EFFICIENCY LEVELS FOR DRY-TYPE TRANSFORMERS LOW VOLTAGE, 75˚C AT 35% OF NAMEPLATE LOAD			
SINGLE-PHASE EFFICIENCY		**THREE-PHASE EFFICIENCY**	
15 kVA	97.7	15 kVA	97.0
25 kVA	98.0	30 kVA	97.5
37.5 kVA	98.2	45 kVA	97.7
50 kVA	98.3	75 kVA	98.0
75 kVA	98.5	112.5 kVA	98.2
100 kVA	98.6	150 kVA	98.3
167kVA	98.7	225 kVA	98.5
250 kVA	98.8	300 kVA	98.6
333 kVA	98.9	500 kVA	98.7
		750 kVA	98.8
		1000 kVA	98.9

I. Ratings: KVA rating, voltages, phases and configuration as indicated. Minimum impedance: 4.5%.

J. Nameplates: The nameplate shall be permanently mounted to the exterior front, with permanently etched numbers and letters, and shall include the following:
1. KVA size
2. Primary and Secondary Voltage Ratings.
3. Serial Number
4. Weight

5. Composition of Windings (Primary, Secondary)
6. Wiring Diagram
7. Percent impedance
8. Taps
9. Basic Impulse Level

K. Acceptable Manufacturers: General Electric; Square D; Cutler-Hammer, Siemens; ACME.

2.15 PANELBOARDS

A. Types: Two-row, bolt-on circuit breaker branch circuit panelboards, and circuit breaker or fusible switch type distribution panelboards, as indicated or required.

B. General: Ratings, mains, mounting and complement of branch overcurrent protective devices as indicated below or on the Drawings.

C. Short Circuit Ratings: Minimum 10,000 amps for 208/120 volt panelboards and 14,000 amps for 480/277 volt panelboards. Provide panelboards with higher ratings as indicated or as required.

D. Enclosures: NEMA 3R for wet locations (unless indicated otherwise). Provide galvanized steel rough-in box and cover with gray enamel finish Panel fronts are to have a door (circuit breakers) in door (circuit breakers & wiring gutters) in trim with concealed hinges and flush type tumbler lock. All panels shall be keyed alike. Doors in excess of 48" high shall be equipped with a three-point catch and vault handle with integral tumbler lock. Panel shall be dead front, safety type and be multi-section as noted or as necessary to comply with NEC.

E. Bussing: Full capacity Copper, include solid copper ground bus, bonded to enclosure and solid copper neutral bus with lug for each branch circuit

F. Acceptable Manufacturers: General Electric “A Series” and “Spectra Series”; Square D “NQOD,” “NEHB,” “I-Line” and “QMB”; Cutler-Hammer “Pow-R-Line C.”

G. Panelboard Schedules: Refer to the schedules on the Contract Drawings.

2.16 CIRCUIT BREAKERS

A. For Panelboard Mounting: Bolt-on type.

B. INDIVIDUAL MOTOR CONTROLLERS Manual Motor Starters: Fractional horsepower, single-phase, snap action toggle type which clearly indicates “On,” “Off” and “Trip” positions, with properly sized thermal overload protection, NEMA-1 enclosure (unless indicated otherwise) with handle locking guard, and pilot light.

C. Manual Motor Starter with Relay: Similar to "Manual Motor Starter" above, except two gang with relay sized for load indicated and hand-off-auto switch. Connect relay for 120V operation on load side of starter in "automatic" mode. Coordinate connection of Form C maintained contact for control with mechanical contractor.

D. Magnetic Starters: As scheduled or indicated on the Drawings, and unless indicated otherwise, NEMA rated (IEC rated not acceptable), full voltage, non-reversing type with properly sized overload protection in all phases, low voltage protection or release and external manual reset. Equip each starter with holding coil rated for 120 volts unless otherwise indicated or required; control circuit transformer sized for the number of devices controlled, with dual fused primary and single fused secondary (omit for 120

volt starters); and interlock contacts rated for the coil, unit, or motor controlled. If standard interlock contacts are of insufficient quantity and/or ratings, provide auxiliary contacts or relays.

E. Combination Magnetic Starters: Magnetic starters as specified above, with fusible or non-fused switch as indicated, sized as indicated, with defeatable cover interlock, quick-make, quick-break switching mechanism and padlockable indicating handle.

F. Enclosures: NEMA-1 for indoor application, and NEMA-3R for outdoor application unless indicated otherwise, sized as required to house all components, including any optional accessories.

G. Acceptable Manufacturers: Allen Bradley; General Electric; Square D; Cutler-Hammer; Siemens.

2.17 LIGHTING FIXTURES

A. General:

1. Fixture types as described below or indicated on the Drawings. Lighting fixture manufacturers' series or catalog numbers listed indicate general quality, type, and style, but may not cover all required design features and details. Provide lighting fixtures having all features, details and accessories as noted in the fixture descriptions. Provide all fittings, hangers, clamps, brackets, yokes, flanges and miscellaneous devices required for a complete installation.
2. Whenever possible, (based upon design requirements) provide lighting fixtures with ballasts provided integral to fixture and prewired.

B. LED Lamps: Minimum 40,000 hours lamp life before 20% loss of output, 3500k interior, 4500K site and parking lot lighting, unless indicate otherwise. Acceptable Manufacturers: Philips, Cree, Luxeon, OSRAM.

C. Site Lighting Fixtures: Include foundations, poles (match campus wide poles), luminaries (match campus wide luminaires – Kim Lighting Curvilinear LED), lamps, drivers and all miscellaneous accessories as indicated or required for a complete assembly. Unless indicated otherwise, foundations to be cast-in-place concrete with constructed forms for square foundations and spirally wrapped treated paper forms for round foundations. Provide concrete as specified in this section or in Division 3, anchor bolts, and reinforcing steel as indicated or required. Provide a 1"x45º chamfer at top of each foundation. Poles to be able to withstand winds of not less than 100 mph without damage to the poles or attached luminaries. Provide pole bases with handholes, handhole covers finished to match the pole finish, and ground lug.

2.18 LIGHTING CONTROL EQUIPMENT

A. Occupancy Sensor Wall Switches: Two-wire (retrofit applications only) or three-wire (new installations), dual technology, employing a temperature compensated dual element sensor and multi-faceted fresnel lens, designed for taking the place of a standard toggle switch, and compatible with solid-state lighting ballasts, rated 120/277VAC 0-800 watts ballast or tungsten, 277VAC 0-1200 watts. Adjustments to include auto-off time delay adjustable 5, 15, or 30 minutes with walk through test mode, and adjustable sensitivity. Sensitivity adjustments shall be as follows: PIR-High/Low, Ultrasonic fully adjustable. Controls to include manual-on, manual-off, and automatic-off. Indicators to include red LED to indicate when unit is triggered; Acceptable Manufacturers: Watt Stopper DW-100, or approved equal.

A. Lighting Control Contactors: 277 volt AC (all loads), 30 amp, number of poles lighting contactors as indicated on Drawings. Normally open, mechanically held, 277 volt coil, with "Hand-Off Auto" selector switch, NEMA-3 enclosure with engraved nameplate "LIGHTING CONTROL", interior mounting panel and hinged, lockable cover. Acceptable Manufacturers: Square D, or equal by GE or Westinghouse.

B. Lighting Control Relays: 277 volt AC (all loads), 20 amp, 6-pole (N.O.), magnetically held, 120 volt coil, with "Hand-Off Auto" selector switch, green push-to-test/transformer type interlocked pilot light and NEMA-3R enclosure with engraved nameplate "LIGHTING CONTROL RELAY." Acceptable Manufacturers: Square D Class 8903, Type "L"; or equal by GE, Cutler-Hammer, Siemens.

C. Photoswitches: Raintight, 120 volt or 277 volt as indicated or required, with SPST contacts rated for 2000 watts, with field adjustable light level sensitivity (1-15FC), and time delay. Acceptable Manufacturers: Tork #2100 Series, or approved equal.

D. Time Switches: Two-channel, programmable, astronomic, seven-day digital time switch with 365-day, holiday capability (16 single dates and 5 holiday blocks), and capable of 48 events per channel, per week. Unit to include automatic adjustment for daylight savings switchovers and leap years corrections, manual on-off override control for each channel, 72-hour battery backup, and NEMA-1 metal enclosure. Astronomic feature to be field adjustable for 10º - 60º Northern or Southern latitudes, and selectable to one or both channels, with adjustable 1-99 minute offset from sunrise or sunset. Time switches to be suitable for operation from a 120 or 277 volt power source, as indicated or required. Contacts to be rated 10 amp resistive, 7.5 amp inductive and 1/3 horsepower, at 120 volts AC, and 10 amp resistive at 277 volts AC. Acceptable Manufacturers: Tork #DZS200A Series; or equal by Paragon or Intermatic.

PART 3 – EXECUTION

3.1 GENERAL

A. The installation of all electrical work shall be in accordance with the intent of the Contract Documents, as determined by the Engineer.

B. Installation Requirements: All materials and equipment shall be installed as recommended by the respective manufacturers, by mechanics experienced and skilled in their particular trade, in a neat and workmanlike manner, in accordance with the standards of the trade, and so as not to void any warranty or UL listing.

C. Administration and Supervision: All electrical work shall be performed under the Contractor's direct supervision, using sufficient and qualified personnel as necessary to complete the work in accordance with the progress schedule. The Contractor shall assign one or more competent supervisors who shall have authority to accept and execute orders and instructions, and who shall cooperate with the other Contractors and subcontractors, the Engineer and Owner in all matters to resolve conflicts and avoid delays.

3.2 EXAMINATION

A. Conditions Verification: Examine the areas and conditions under which the work is to be performed, and identify any conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

3.3 COORDINATION

A. General: Sequence, coordinate and integrate the installation of all electrical materials and equipment for efficient flow of work, in conjunction with the other trades. Review the Drawings for work of the other trades, and report and resolve any discovered discrepancies, prior to commencing work.

B. Cooperation: Cooperate with the other Contractors and individual disciplines for placement, anchorage and accomplishment of the work. Resolve interferences between work of other disciplines or Contractors, prior to commencing installation.

C. Supports and Sleeves: 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.

D. Obstacles and Interferences: When installing equipment and raceways, provide offsets, fittings, accessories and changes in elevation or location as necessary to avoid obstacles and interferences, per actual field conditions.

E. Space Requirements: Electrical equipment sizes indicated on drawings are generally based on specified manufacturer. Verify that the proposed equipment will fit in the space indicated on the drawings. Maintain clearances required by NEC.

3.4 DIMENSIONS

A. Building Dimensions: For exact locations of building elements, refer to dimensioned drawings. However, field measurements take precedence over dimensioned drawings.

B. Site Dimensions: Field measurements take precedence over scaled electrical site plans.

C. Limiting Dimensions: Equipment outlines shown on detail drawings of 1/4" = 1'-0" scale or larger and dimensions indicated on the Drawings are limiting dimensions. Do not install equipment exceeding dimensions indicated by outlines on Drawings, or equipment or arrangements that reduce indicated clearances.

D. Establish the exact location of electrical equipment based on the actual field verified dimensions of equipment furnished.

3.5 EQUIPMENT PROTECTION

A. Protect all electrical equipment, and materials and work from the weather elements, paint, mortar, construction debris and damage, until project is substantially complete. Repair, replace, clean all electrical work so affected.

3.6 ELECTRICAL INSTALLATION - GENERAL

A. Dimensions and Clearances: Field measure all dimensions and clearances affecting the installation of electrical work, in relation to established datum, building openings and clearances, and work of other trades, as construction progresses.

B. Rough-In Locations: Verify final locations for rough-ins with field measurements and requirements of actual equipment being installed.

C. Door Swings: Verify the swings of all doors before switch outlets or other electrical devices are installed. If necessary, relocate devices so they are not obstructed by doors when doors are open.

D. Ceiling Mounted Devices: The locations indicated on the architectural reflected ceiling plans take precedence over the electrical documents, in the event of conflict.

E. Install equipment according to manufacturer's written instructions.

F. Install equipment, conduit, cable tray, hangers, and supports to withstand seismic forces for the seismic zone of the installation.

3.7 LAYOUT

A. General: Install electrical systems, materials and equipment level and plumb, and parallel and perpendicular to other building systems and components, where installed exposed.

B. Serviceability: Install electrical equipment and raceways, etc. to readily facilitate servicing, maintenance and repair or replacement of components, and so as to minimize interference with other equipment and installations.

C. Clearances: Prior to commencing work, verify that all electrical equipment will adequately fit and conform to the indicated and code required clearances, in the spaces indicated on the Drawings. If rearrangement is required, submit plan and elevation drawings or sketches indicating proposed rearrangement, for the Engineer's approval. Do not rearrange without express written permission of the Engineer.

3.8 Right-Of-Way: When laying out electrical work, give priority in available space to steam and condensate lines, sanitary lines, drain lines, fire protection piping and sheet metal duct work. Provide offsets as required to avoid conflicts. Resolve all conflicts before commencing installation.MOUNTING HEIGHTS

A. General: Indicated heights are measured from the center of the device outlet box to finished floor or grade, unless indicated otherwise. Request instructions for mounting heights not indicated.

3.9 HOLES, SLEEVES, AND OPENINGS

A. General: Provide all holes, sleeves, and openings required for the completion of Division 26 work and restore all surfaces damaged, to match surrounding surfaces. Maintain integrity of all fire and smoke rated barriers using approved fire stopping systems. When cutting holes or openings, or installing sleeves, do not cut, damage or disturb structural elements or reinforcing steel, unless approved, in writing, by the Project Structural Engineer.

B. Conduit Penetrations: Size core drilled holes so that an annular space of not less than 1/4" and not more than 1" is left around the conduit. When openings are cut in lieu of core drilled, provide sleeve in rough opening. Size sleeves to provide and annular space of not less than 1/4" and not more than 1" around the conduit. Patch around sleeve to match surrounding surfaces.

3.10 FIRESTOPPING SYSTEMS

A. General: Install fire stopping at all electrical raceway and cable penetrations through floor structures and interior walls or partitions which are time-rated fire and/or smoke barriers.

B. Preparation: Prior to installation, verify that all penetrating elements and supporting devices are permanently installed and that surfaces which will be in contact with penetration seal materials are clean and free of dust, dirt, grease, oil, loose materials, rust or other substances.

C. Installation: Install firestop systems in accordance with UL approved design details and the manufacturer's instructions. Install sleeves, conduits and cables with required clearance spaces, allowing installation of sealing materials. Do not exceed the outside diameter of the sleeve, conduit or cable by more than one inch or by less than 1/4" when making openings for penetrations. Install firestop systems so as to completely seal openings to prevent passage of smoke and water.

3.11 CUTTING AND PATCHING

A. General: Provide all cutting, drilling, chasing, fitting and patching necessary for accomplishing the work of Division 26. This includes any and all work necessary to: uncover work to provide for the installation of ill-timed work; remove and replace defective work and work not conforming to the requirements of the Contract Documents; install equipment and materials in existing structures; in addition to that required during the normal course of construction.

B. Comply with the cutting and patching requirements of Division 1.

C. Building Structure: Do not endanger the integrity of the building structure by cutting, drilling or otherwise modifying any structural member, without specific approval. Do not proceed with any structural modifications without written permission of the Project Structural Engineer.

D. Repairs: Repair any and all damage to work of other trades caused by cutting and patching operations, using skilled mechanics of the trades involved.

3.12 WELDING

A. General: Where welding is required, such welding shall be performed in a skilled manner by certified welders. Verify that welds are free from cracks, craters, undercuts, and strikes, weld spatter, and any other surface defects. Clean and re-weld any welds deemed unacceptable in size or configuration. Do not weld to structural steel without prior written permission from the Project Structural Engineer.

3.13 UNDERGROUND ELECTRICAL WORK

A. General: Perform all excavating, trenching and backfilling, etc. as indicated or required for the installation of all underground electrical work. Coordinate work with other trades and verify existing underground services and conditions.

B. Conduit Burial Depth: 30" below finished grade or 6” below bottom of frost line, whichever is deeper, unless indicated otherwise. All excavation and burial depths indicated are below finished grade.

C. Excavating: Do not excavate below required depth, except as necessary for removal of unstable soil or when rock is encountered. When rock is encountered, excavate six inches below the required depth and backfill with a minimum 6" layer of crushed stone or gravel between rock bearing surface and the electrical installation. Stockpile satisfactory excavated materials where directed, until required for backfilling. Remove and legally dispose of excess excavated materials and materials not suitable for backfill use. Shore and brace as required for stability of excavation. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting off at an elevation of 30" below finished grade.

D. Protection: Protect structures, utilities, sidewalks, pavements and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by excavations.

E. Existing Utilities: Remove existing electrical and other utility lines so indicated. Where existing utilities which are to remain exist within areas of excavation, locate such utilities and support and protect during excavation operations.

F. Trenching: Cut all trenches neatly and uniformly and so as to provide ample working room and at least six inches clearance on both sides of raceways, etc., unless otherwise noted. Take necessary precautions when working near existing underground utilities, and coordinate with the installation of concurrent utilities by other trades. Unless indicated otherwise, pitch all electrical conduit runs downward away

from buildings, manholes, and pad mounted equipment. Excavate trenches to depth indicated or required. Limit length of open trench to that in which installations can be made and trenches backfilled within the same day.

G. Sand Envelope: Install a minimum envelope of three inches (top, bottom, and sides: three inches each) of fine grain sand around all electrical cables and conduits installed below grade unless indicated otherwise.

H. Preparation for Backfilling: Backfill excavations as promptly as work permits, but not until completion of inspection, testing, approvals, and recording of underground utility locations. Prior to backfilling, remove all concrete form work, shoring, bracing, trash and debris.

I. Backfilling: Use only approved materials free from boulders, sharp objects and other unsuitable materials. Match the final elevations and materials of areas affected by electrical excavating, trenching and backfilling. Replace conduit and cables damaged by improper backfilling. Replace surface materials to match existing surface materials if no other utility or site work is being done in area. Place specified soil materials in 4" - 8" layers to required subgrade elevations, for area classifications as follows:

1. Under Sidewalks: Use combination of subbase materials and excavated or borrowed materials.
2. Under Building Slabs: Use drainage fill materials.
3. Under Piping and Equipment: Use subbase materials where required over rock bearing surfaces and for correction of unauthorized excavation.
4. For Raceways Less Than 30" Below Surface of Paved Areas or Roadways: Provide 4" thick concrete base slab support. After raceway installation, provide 4" thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase. Refer to Contract Documents for Conduit Encased in Concrete Details.

J. Backfill Placement: Place backfill and fill materials in layers of not more than 8" in loose depth for material compacted by heavy equipment, and not more than 4" in loose depth for material compacted by hand-operated tampers. 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 specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of raceways and equipment by carrying material uniformly around them to approximately same elevation in each lift.

K. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.

L. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D1557 and not less than the following percentages of relative density, determined in accordance with ASTM D2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).

1. Areas under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive materials and 95 percent relative density for cohesionless materials.
2. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive materials, and 95 percent relative density for cohesionless materials.

3. Other Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive materials, and 90 percent relative density for cohesionless materials.

M. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations.

N. Subsidence: Where subsidence occurs at electrical installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

3.14 CONCRETE WORK

A. General: All concrete shall be prepared from approved materials and poured on clean, stable surfaces.

B. Exterior Base Surfaces: Twelve-inch layer of crushed stone over well consolidated, stable, undisturbed soil. Where the underlying soil contains excess organic material, trash or voids, or fails to provide solid bearing for any other reason, excavate to the depth required for solid bearing and re-establish the required elevation with approved granular materials.

C. Finishing: Trowel all exposed surfaces smooth. Round-off or chamfer all exposed edges.

D. Curing: Beginning immediately after placement, protect concrete from premature drying, excessive hot or cold temperatures and mechanical injury. Maintain minimal moisture loss at relatively constant temperature throughout period necessary for hydration of cement and hardening of concrete.

3.15 RACEWAY SYSTEMS

A. Raceway Types: Unless indicated otherwise, use raceway types as follows:
   1. Indoors, Concealed in Walls or Above Ceilings: EMT.
   2. Indoors, Exposed: Use rigid galvanized steel conduit below ten feet above finished floor.
   2. Outdoors, Below Grade: (Minimum 1-inch size). Schedule 40 rigid non-metallic conduit. Stub up using rigid galvanized steel elbows.
   3. Outdoors, Exposed: Rigid galvanized steel conduit.
   4. Liquid-Tight Flexible Steel Conduit: Use where flexible steel conduit connections are required in damp, wet or oily locations, and for final connections to all motors and similar equipment.

B. Raceway Installation: Cut conduit ends square using saw or pipecutter and ream each cut end smooth. Carefully make all conduit bends and offsets so that the inside diameter of pipe is not reduced. Make bends so that legs are in the same plane. Make offsets so that legs are in the same plane and parallel. Protect stub-ups from damage, and carefully re-bend when necessary.

C. Fittings: Make up all raceway fittings tight so that final installation of raceway, fittings and enclosures constitutes a firm mechanical assembly and a continuous electrical conductor. Where required, provide bonding jumpers to assure electrical continuity.

D. Protection: Protect all raceways, enclosures and equipment during construction to prevent entry of concrete, debris and other foreign matter. Free clogged conduits of all obstructions, or replace, prior to pulling wire. Do not pull wire within buildings until buildings are completely enclosed.

E. Boxes: Install all outlet, pull and junction boxes rigidly, plumb and level. Support and secure boxes independently from conduits terminating at box. Install all boxes so as to be accessible and so that covers may be easily removed.

F. Handholes: Provide as indicated, installed plumb and level. Where not indicated, install every 200' at a minimum.

G. Conduit Seals: Install conduit seal for each conduit penetrating an exterior building wall below grade (unless penetration is below lowest building floor slab), and elsewhere as indicated, and so as to achieve a sealed watertight installation.

H. Pull Strings: Provide pull strings in all spare conduits.

3.16 CONDUCTORS - 600 VOLT AND BELOW

A. Minimum Conductor Size: All branch circuit wiring shall be minimum #12 AWG. All control circuit wiring shall be minimum #14 AWG, unless indicated otherwise. Provide larger sizes as indicated or required.

B. Branch Circuit Conductor Sizes: Provide branch circuit conductor sizes as indicated on the panelboard schedules, plans, or elsewhere. Neutral conductor size to match phase conductors unless indicated otherwise. Provide branch circuit switch legs and travelers as required for the switching indicated.

C. Equipment Grounding Conductor Required: For each branch circuit and feeder run, provide an equipment grounding conductor for continuous length of run, sized per NEC 250-122 (minimum), larger if so indicated.

D. Feeders: Provide feeder conductor sizes and quantities as indicated.

E. In Raceway: Install all wiring in conduit or other specified raceway, unless indicated otherwise.

F. Terminations: Furnish and install terminations, including lugs if necessary, to make all electrical connections indicated or required. Make connections and terminations for all stranded AWG conductors using crimp, clamp, or box type connectors and terminators. Enclose all strands of stranded conductors in connectors, and lugs.

G. Color: Conductors #10 and smaller shall be factory color-coded by integral pigmentation with a separate color for each phase and neutral. #8 and larger shall have stripes, bands, hash marks or color pressure-sensitive plastic tape. Color code all branch circuit and feeder conductors as follows:

1. 208/120 Volts:

PHASE	**COLOR**
A	Black
B	Red
C	Blue
Neutral	White

2. 480/277 Volts:

PHASE	**COLOR**
A	Brown
B	Orange

PHASE	COLOR
C	Yellow
Neutral	Gray

3. Equipment Grounding Conductors: Green

H. Phase Arrangement: Arrange phases in all electrical equipment as follows:
1. A, B, C: Front to Rear.
2. A, B, C: Top to Bottom.
3. A, B, C: Left to Right When Facing Established Front of Equipment.

I. Provide conductors with not less than 90□C rated insulation when branch circuit wiring is attached to high temperature light fixtures (e.g. fluorescent & HID), boilers, incinerators, ovens, ranges, kitchen exhaust fans, other heat-producing equipment, and "100% Rated" overcurrent protective devices. Use special higher temperature wire as required for connection to specialty equipment as required by equipment manufacturer.

3.17 EQUIPMENT CONNECTIONS

A. Connect complete, all equipment requiring electrical connections, furnished as part of this Contract or by others, unless indicated otherwise.

B. Equipment Variations: Note that equipment sizes and capacities as shown on the Contract Documents are for bidding purposes and as such may not be the exact unit actually furnished. Contractor shall anticipate minor variations in equipment and shall include in his Bid all costs required to properly connect the equipment actually furnished.

C. Verification: Obtain and review shop drawings, product data and manufacturer's instructions for equipment furnished by others. Examine actual equipment to verify proper connection locations and requirements.

D. Coordination: Sequence electrical rough-in and final connections to coordinate with installation and start-up schedule and work by other trades.

E. Rough-In: Provide all required conduit, boxes, fittings, wire, connectors and miscellaneous accessories, etc., as necessary to rough in and make final connections to all equipment requiring electrical connections. In general, motors and equipment shall be wired in conduit to a junction box (or safety switch) near the unit, and from there to the unit in flexible metal or liquid-tight flexible steel conduit.

F. Connections: Provide properly sized overload and short circuit protection for all equipment connected, whether furnished under this Contract or by others. Verify proper connections with manufacturer's published diagrams and comply with same. Verify that equipment is ready for electrical connections, wiring and energization, prior to performing same.

G. Control Wiring: Provide all control wiring to remote devices or equipment as indicated or required. Modify equipment control wiring, install or disconnect jumpers, etc., as required.

3.18 HANGERS AND SUPPORTS

A. General: Rigidly support and secure all electrical materials, raceway and equipment to building structure using hangers, supports and fasteners, suitable for the use, materials and loads encountered. Provide all necessary hardware.

B. Overhead Mounting: Attach overhead mounted equipment to structural framework or supporting metal framework. Do not make attachments to steel roofing, steel flooring or ceiling mineral tile.

C. Wall Mounting: Support wall mounted equipment by masonry, concrete block, metal framing or sub-framing.

D. Exterior Walls: Mount all electrical equipment located on the interior of exterior building walls, at least one inch away from wall surface, using suitable spacers.

E. Structural Members: Do not cut, drill or weld any structural member.

F. Independent Support: Do not support electrical materials or equipment from other equipment, piping, ductwork or supports for same.

G. Temporary Conditions: Do not attach to or support electrical work from removable or knockout panels or temporary walls or partitions.

H. Raceway Supports: Rigidly support all raceway with maximum spacings per NEC, and so as to prevent distortion of alignment during pulling operation. Use approved hangers, clamps and straps for individual runs. Do not use perforated straps or tie wires. Where multiple parallel raceways are run together, use trapeze type hanger arrangement made from U-channel and accessories, suspended by threaded rods, and allow at least 25% spare capacity for future installation of additional raceways. Rigidly anchor vertical conduits serving floor-mounted or "island" type equipment mounted away from walls with metal bracket or rigid steel conduit extension secured to floor.

I. Miscellaneous Supports: Provide any additional structural support steel brackets, angles, fasteners and hardware as required to adequately support all electrical materials and equipment.

J. Seismic restraints and supports: Provide as indicated and/or as required per seismic zone indicated.

3.19 ELECTRICAL IDENTIFICATION

A. General: Locate nameplate, marking, or other identification means on outside of equipment or box front covers when above ceilings and when in mechanical or electrical equipment rooms or other unfinished areas, and on inside of front cover when in finished rooms/areas. Use Contract Document designations for identification unless indicated otherwise.

B. Nameplates: Provide nameplate engraved with equipment designation for each safety switch, panelboard, transformer, motor starter, and all other electrical cabinets, etc.

C. Underground Warning Tape: During trench backfilling for each underground electrical, telephone, signal and communications line, provide a continuous underground warning tape located directly above line, at six to eight inches below finished grade.

D. Marking Pen Labeling: Mark each junction and pull box indicating source designation and circuit number(s) for the enclosed conductors.

E. Wire Tags: For power circuits, apply wire tag indicating appropriate circuit or feeder number to each conductor present in distribution panel and panelboard gutters, and to each conductor in pull and junction boxes where more than one feeder or multi-wire branch circuit is present. Where only a single feeder or multi-wire branch circuit is present, box cover labeling and conductor color coding is sufficient. For control, communications and signal circuits, apply wire tag indicating circuit or termination number at all terminations and at all intermediate locations and boxes where more than one circuit is present.

F. Panelboard Circuit Directories: At completion of project, accurately complete each panelboard circuit directory card, identifying load served or "spare" or "space" for each circuit pole. When modifying, adding or deleting circuits at an existing panelboard, update the existing (or provide new) circuit directory card to accurately reflect final conditions.

G. ~~Abandoned Equipment: Label all abandon equipment as "Abandon as of _____." For conduits and conductors include opposite end location~~.

3.20 ELECTRIC SERVICE

A. General: Arrange with the local electric utility company, and pay all associated costs for providing temporary electric service (if required) and permanent electric service for the project as indicated and required. Comply with and coordinate all requirements of the utility company.

B. Grounding: Provide grounding electrode system for the service, per the NEC and utility company requirements.

3.21 GROUNDING

A. General: Provide all system and equipment grounding as indicated and as required by the NEC.

B. Equipment Grounding: Provide a green equipment grounding conductor, sized per NEC 250-122 (larger if so indicated) with each feeder and branch circuit run.

C. Provide exothermic welded connections where indicated.

3.22 DRY TYPE TRANSFORMERS

A. Mounting: Install outdoor pad mounted transformers onconcrete pad as required. .

B. Conduit Connections: Make all conduit connections to transformer cases using sealtight conduit.

C. Ventilation Openings: Do not obstruct transformer ventilation openings.

D. Taps: Set transformer taps for proper secondary voltage.

3.23 PANELBOARDS

A. Secure rough-in boxes to support channel steel framing, independent of conduits. Install with top of cabinet at 7'-0" above floor, but with minimum 8" clearance above floor unless so doing would exceed maximum 6'-6" disconnect height allowed by NEC.

B. Cover all unused overcurrent protective device spaces.

3.24 INDIVIDUAL MOTOR CONTROLLERS

A. General: Make all connections to motors and control equipment complete and verify that equipment is in proper operating order. Connect power to motors for correct direction of rotation. Verify nameplate ratings of all motors. Report any deviations or discrepancies.

B. Overcurrent and Overload Protection: Provide fuses where indicated or required, and overload elements sized in accordance with the ambient temperature, the actual motor nameplate full load amperes, and service factor.

C. Power Wiring: Unless indicated otherwise, provide all required power wiring from indicated power source to each motor controller and from each motor controller to respective motor.

D. Control Wiring: Provide as indicated. Unless indicated otherwise, use No. 14 AWG wire for all control circuits. For circuits longer than 200 feet and for 120 volt motors, use No. 12 AWG wire.

3.25 LIGHTING FIXTURES

A. Lamps and Ballasts: Replace all burned out, defective and inoperative lamps, and all noisy, defective and inoperative ballasts, starters, etc. prior to Owner's acceptance.

3.26 LIGHTING CONTROL EQUIPMENT

A. Occupancy Sensor Wall Switches and Occupancy Sensors: Install sensors in general locations indicated. Adjust exact locations if required to comply with manufacturers recommendations for optimum placement. Make all required line and control wiring connections. Adjust field of views, sensitivities and time delays, and set system configuration selector switches, etc. as indicated, directed or required for optimum control.

B. Lighting Control Contactors: Connect "Auto" position of contactor H-O-A selector switch through photoswitch or other indicated control contacts, and the "HAND" position to override the automatic control.

C. Photoswitches: Adjust sensitivity for proper operation.

3.27 CHECKOUT, TESTING, AND ADJUSTING

A. General: Provide testing equipment, materials, instruments, and personnel to perform all test procedures and adjustments required by the Contract Documents and/or deemed necessary by the Engineer to establish proper performance and installation of electrical systems and equipment. All test instruments to be accurately calibrated and in good working order.

B. Scheduling: Schedule tests at least three days in advance, and so as to allow Engineer and Owner representative(s) to witness the test, unless directed otherwise. Do not schedule tests until the system installation is complete and fully operational, unless indicated or directed otherwise.

C. Manufacturer's Authorized Representatives: For all new and modified systems and equipment, arrange and pay for the services of the manufacturer's authorized representative(s) to be present at time of equipment or system start-up, to supervise the start-up, and to conduct and/or certify all required testing and adjusting.

D. Test Reports: Submit test reports neatly typewritten on 8-1/2" x 11" sheets indicating system or equipment being tested, methodology of testing, date, and time of test, witnesses of test, and test results. Submit test reports in (3) copies to the Engineer for review, within (5) days after test is performed, and include a copy with the appropriate operation and maintenance data.

E. Correction/Replacement: After testing, correct any deficiencies, and replace materials and equipment shown to be defective or unable to perform at design or rated capacity. Retest without additional cost to the Owner or Contract. Submit finalization report indicating corrective measures taken, and satisfactory results of retest.

3.28 SYSTEMS DEMONSTRATION

A. Instruct the Owner's representative(s) in the start-up, operation and maintenance of all electrical systems and equipment in accordance with Division 1, and as requested by the Owner's Representative.

3.29 CLEANING AND TOUCH-UP PAINTING

A. Perform cleaning required by Division 1.

B. General: Periodically remove from the project site, all waste, rubbish and construction debris accumulated from construction operations, and maintain order. The premises shall be left clean and free of any debris and unused construction materials, prior to final acceptance.

C. Electrical Equipment: Remove all dust, dirt, debris, mortar, wire scraps, rust, and other foreign materials from the interior and exterior of all electrical equipment and enclosures, and wipe down. Clean accessible current carrying elements and insulators prior to energizing.

D. Light Fixtures: Thoroughly clean all new or relocated light fixtures and lamps, just prior to final inspection. Fixture enclosures, reflectors, lenses, etc. shall be cleaned free of dust, dirt, fingerprints, etc. by an approved method.

E. Touch-Up Painting: Restore and refinish to original condition, all surfaces of electrical equipment scratched, marred and/or dented during shipping, handling, or installation. Remove all rust, and prime and paint as recommended by the manufacturer.

END OF SECTION

SECTION 260002 – BUILDING ELECTRICAL

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. Provide all labor, material, tools, equipment, transportation and services necessary for and incidental to completion of all electrical work as indicated on the Drawings and/or as specified herein.

1.2 DRAWING USE AND INTERPRETATION

A. The Drawings are diagrammatic and indicate the general arrangement of systems and equipment unless indicated otherwise by dimensions or details. Exact equipment locations and raceway routing, etc. shall be governed by actual field conditions and/or instructions of the Engineer and/or Owner's Representative.

1.3 COMPLETE SYSTEMS

A. General: Furnish and install all materials as required for complete systems, including all parts obviously or reasonably incidental to a complete installation, whether specifically indicated or not. All systems shall be completely assembled, tested, adjusted and demonstrated to be ready for operation prior to Owner's acceptance.

B. Wiring: The wiring specified and/or shown on the Drawings is for complete and workable systems. Any deviations from the wiring shown due to a particular manufacturer's or subcontractor's requirements shall be made at no cost to either the Contract or the Owner.

1.4 CODES AND REGULATIONS

A. General: Comply with the latest recognized edition of the National Electrical Code (NEC) and all governing federal, state, and local laws, ordinances, codes, rules, and regulations. Where the Contract Documents exceed these requirements, the Contract Documents shall govern. In no case shall work be installed contrary to or below minimum legal standards.

B. Utilities: Comply with all applicable rules, restrictions, and requirements of the utility companies serving the project site/facilities.

C. Non-Compliance: Should any work be performed which is found not to comply with any of the above codes and regulations, provide all work and pay all costs necessary to correct the deficiencies.

1.5 REFERENCE STANDARDS

A. All latest published standards of the following associations/organizations shall be followed and applied where applicable as minimum requirements:
   1. (ADA), Americans with Disabilities Act.
   2. (ANSI), American National Standards Institute.
   3. (ASTM), American Society for Testing and Materials.
   4. (BCNYS), Building Code of New York State.
   5. (CBM), Certified Ballast Manufacturer.
   6. (EPACT), National Energy Policy Act.
   7. (ETL), Electrical Testing Laboratory.

8. (FCNYS), Fire Code of New York State.
9. (ICEA), Insulated Cable Engineers Association.
10. (IEEE), Institute of Electrical and Electronic Engineers.
11. (IESNA), Illuminating Engineering Society of North America.
12. (NBFU), National Board of Fire Underwriters.
13. (NEMA), National Electrical Manufacturers Association.
14. (NESC), National Electrical Safety Code.
15. (NFPA), National Fire Protection Association.
16. (UL), Underwriter's Laboratories.

1.6 PERMITS

A. General: Obtain and pay for any and all permits required by all applicable agencies, prior to commencing work.

1.7 SUBMITTALS

A. General: Prepare and submit for approval, per the procedures set forth in Division 1, all submittals required by Division 1, this section, and by all other Contract Documents.

B. Types: Required submittals may include: Schedule of Values; List of Subcontractors; Product Data; Shop Drawings; Samples; Test Reports; Certifications; Warranties; Maintenance Manuals; Record Drawings; and various administrative submittals.

C. Number of Copies: As indicated in Division 1, Division 26 or elsewhere in the Contract Documents. For quantities indicated in the Contract Documents or specification sections other than Division 26 sections, increase number of copies by one to allow for the Engineer's record copy. Minimum number of copies per submittal: three.

D. Product Data: Submit for all basic electrical equipment, devices, and materials to be used on the project. Product data to consist of manufacturer's standard catalog cuts, descriptive literature and/or diagrams, in 8-1/2" x 11" format, and in sufficient detail so as to clearly indicate compliance with all specified requirements and standards. Mark each copy to clearly indicate proposed product, options, finishes, etc.

E. Shop Drawings: Submit for all custom equipment and systems (e.g., panelboards) to be used on the project. Shop Drawings to be newly prepared, specifically for this project, and shall include all information listed in the Shop Drawings submittal requirements in the respective specification section. Include all pertinent information such as equipment/system identification, manufacturer, dimensions, nameplate data, sizes, capacities, types, materials, performance data, features, accessories, wiring diagrams, etc., in sufficient detail so as to clearly indicate compliance with all specified requirements and standards. For control systems, provide computer generated control ladder diagrams specifically developed for this project (standard diagrams not acceptable).

F. Maintenance Manuals: Include operating and maintenance data in accordance with Division 1. Include all Product Data/Shop Drawing submittals as well as descriptions of function, normal operating characteristics and limitations, and manufacturer's printed operating maintenance, trouble shooting, repair, adjustment, and emergency instructions, and complete replacement parts listing.

G. Record Documents: Prepare and submit in accordance with Division 1. In addition to Division 1 requirements, indicate actual installed locations for all equipment and devices, routing of major interior raceways, locations of all concealed and underground equipment and raceways, and all

approved modifications to the Contract Documents, and deviations necessitated by field conditions and change orders.

1.8 QUALITY ASSURANCE

A. Manufacturers' Qualifications: Not less than three years experience in the actual production of the specified products.

B. Installers' Qualifications: Firm with not less than five years experience in the installation of electrical systems and equipment similar in scope and complexity to those required for this Project, and having successfully completed at least ten comparable scale projects.

C. Incidental Work: Excavation, backfill, painting, patching, welding, carpentry, mechanical work, concrete pads and the like related to or required for Division 26 work shall be performed by craftsman skilled in the appropriate trade, but shall be provided for under Division 26.

1.9 INSPECTIONS

A. General: During and upon completion of the work, arrange and pay all associated costs for inspections of all electrical work installed under this contract, in accordance with the Conditions of the Contract.

B. Inspections Required: As per the laws and regulations of the local and/or state agencies having jurisdiction at the project site.

C. Inspection Agency: Approved by the local and/or state agencies having jurisdiction at the project site.

D. Certificates: Submit all required inspection certificates.

E. Coordination: Coordinate inspections with the local utility.

1.10 DELIVERY STORAGE AND HANDLING

A. Comply with Division 1 requirements.

B. Packing and Shipping: Deliver products in original, unopened packaging, properly identified with manufacturer's identification, and compliance labels.

C. Storage and Protection: Comply with all manufacturer's written recommendations. Store all products in a manner which shall protect them from damage, weather, and entry of debris.

D. Damaged Products: Do not install damaged products. Arrange for prompt replacement.

PART 2 – PRODUCTS

2.1 GENERAL

A. Where Specified: Materials and equipment shall be as specified herein and/or as indicated on the Drawings.

B. General Requirements: All materials and equipment shall be in accordance with the Contract Documents, and to the extent possible, standard products of the various manufacturers, except where special construction or performance features are called for. All materials and equipment to be new, clean, undamaged, and free of defects and corrosion.

C. Acceptable Products: The product of a specified or approved manufacturer will be acceptable only when that product complies with or is modified as necessary to comply with all requirements of the Contract Documents.

D. Common Items: Where more than one of any specific item is required, all shall be of the same type and manufacturer.

E. UL Listing: All electrical materials and equipment shall be Underwriters' Laboratories (UL) listed and labeled, where UL standards and listings exist for such materials or equipment.

2.2 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to the Conditions of the Contract, and Division 1.

2.3 FIRESTOPPING MATERIALS

A. General: Firestop systems composed of firestop compounds and appropriate damming materials installed together with the penetrant (e.g., conduit) to form a complete firestop system, providing a fire resistant rating at least equal to the hourly fire resistance rating of the floor, wall or partition into which the firestop system is to be installed.

B. Test Standards: Firestopping materials shall be tested together as a system to the time/temperature requirements of ASTM E119 and shall be tested to UL 1479 (ASTM E814) and be UL classified for up to 3 hours.

C. Firestop Sealants: Non-hardening, conformable, intumescent putties, sealants or other compounds, containing no toxic solvents or asbestos, and exhibiting aggressive adhesion to all common building materials and penetrants, while allowing reasonable movement of the penetrants, without being displaced. Compounds shall be waterproof, non-toxic and smoke and gas tight.

D. Firestop Mortars: Light-weight, water-based, cementations, fast drying, low density mortar, non-shrinking and non-cracking during its cure, and which forms a surface capable of being sanded, bored and painted.

E. Damming Materials: Mineral wool or ceramic fiber.

F. Multi-Cable Transits: Assemblies consisting of a frame, a compression mechanism, and grooved insert sealing modules sized for multiple penetrating elements of various sizes.

G. Acceptable Manufacturers: Hilti; Heavy Duty/Nelson; International Protective Coatings; Specified Technologies, Inc.

2.4 RACEWAY SYSTEMS

A. Raceway Sizing: As required by the NEC (minimum) with oversized raceways as indicated and where required for ease of pulling cable. Minimum conduit size: 3/4-inch, unless indicated otherwise.

B. Raceway Types: Rigid galvanized steel conduit, electrical metallic tubing (EMT), flexible steel conduit, liquid-tight flexible steel conduit and Schedule 40 heavywall and Schedule 80 extra-heavywall rigid non-metallic (PVC) conduit, conforming to applicable ANSI, NEMA and UL standards.

C. Fittings: All raceway fittings (except for rigid non-metallic conduit) to be steel or malleable iron, and UL-listed for the intended application. EMT fittings to be compression type.

D. Outlet Boxes (Concealed in Walls): Non-gangable, galvanized steel, with square cornered tile (or masonry) type extension rings or cover. Minimum size: two-gang masonry box or 4" square box with single-gang adapter (plaster) ring. Depth of adapter ring to suit application. Minimum depth: 1-1/2". Minimum capacity: 21 cubic inches.

E. Outlet Boxes (Surface Mounted): Cadmium plated cast or malleable iron.

F. Pull and Junction Boxes, and Wireways: Use as indicated and required. Junction and pull boxes for general indoor use (dry locations) to be of galvanized code gauge steel construction, minimum 4" square by 1-1/2" deep, with screw-on covers. Wireways to be UL listed, sheet steel construction with screw-on covers. For exterior and damp or wet indoor locations, use boxes and wireways approved for such use.

G. Handholes: Light-weight and high-strength, constructed of fiberglass reinforced polymer concrete, gray color, suitable for use at temperatures down to -50ºF, and resistant to sunlight, weathering, chemicals and freeze-thaw cycles, with bolt-on cover (with standard logo indicating type of service), and designed for in-grade use in areas with light vehicular traffic (5,000 lb. load over 10"x10" area). Acceptable Manufacturers: Quazite “Composolite,” Styles “PC” or “PG.”

H. Pipe Sleeves: Rigid steel conduit or iron pipe.

I. Conduit Seals: For Cast-in-Place Concrete Applications: Acceptable Manufacturers: O-Z/Gedney Type “FSK”; Thunderline Corp. “Link Seal” with “Link Seal Wall Sleeve.” For Core Drilled and Pre-Cast Opening Applications: Acceptable Manufacturers: O-Z/Gedney Type “CSML”; Thunderline corp. “Link Seal.”

J. Pull Wires: No. 14 AWG zinc-coated steel monofilament plastic line with 200 lb. tensile strength.

2.5 600 VOLT CLASS WIRE

A. General: All wire and cable shall be constructed in accordance with all applicable ICEA, NEMA and IEEE published standards, and shall be UL-listed and labeled. Single-conductor, 98% conductivity, annealed, uncoated copper conductors with 600-volt rated type “THHN/THWN” insulation.

B. Wire shall be annealed bare copper per ANSI/ASTM B3, UL 83, and Federal Specification JC-30A with 600 volt insulation, be stranded (except for #10 AWG and smaller may be solid), and be minimum size #12 AWG (Except for control wiring and signal circuits).

C. Insulation: Provide THHN/THWN insulation for all conductors, except XHHW insulation may be used for conductors #4 and larger.

D. Fire Pump Wiring: Provide UL 2196 classified two hour fire rating cable. Cable shall be UL listed type RHH/RHW-2 similar to Drake USA Lifeline RHW-2.

E. Ampacity of conductors shall be rated for 75 degrees C regardless of temperature of conductor insulation when combining circuits in one conduit. Derate conductors and increase size per NEC when installing multiple circuits in a raceway, utilizing 75˚C ampacity table.

F. Connectors: Nylon shell insulated metallic screw-on connectors for #14-10 AWG, and bolted pressure or compression type lugs and connectors with insulating covers for #8 AWG and larger.

2.6 WIRING DEVICES

A. Switches: 20 amp, 120-277 volt, A.C. only, toggle type, single-pole, double-pole, three-way or four-way as indicated or required. Acceptable Manufacturers: Leviton; Arrow-Hart; Hubbell; Pass and Seymour.

B. Receptacles (General Use): 125 volt, 20 amp, NEMA 5-20R, duplex type. Acceptable Manufacturers: Leviton; Arrow-Hart; Hubbell; Pass and Seymour.

C. GFI Receptacles: Ground fault circuit interrupter, feed-through, duplex type, 125 volt, 20 amp, NEMA 5-20R, with solid-state ground-fault sensing and 5 mA trip level. Acceptable Manufacturers: Leviton; Arrow-Hart; Hubbell; Pass and Seymour.

D. Special Receptacles: As indicated by ratings and/or NEMA configuration. Acceptable Manufacturers: Leviton; Arrow-Hart; Hubbell; Pass and Seymour.

E. Device Color: Brown, unless directed otherwise. Coordinate color with architect.

F. Coverplates (Interior Devices): For finished spaces, nylon coverplates to match wiring device. For unfinished spaces (e.g. mechanical room, electrical room, etc.), minimum .032" thick, Type 430 stainless steel with U.S. #32D satin finish.

G. Coverplates (Exterior Locations): Weatherproof cast aluminum or polycarbonate. Receptacles installed in damp or wet locations shall have an enclosure and cover that are weatherproof with the attachment plug inserted or removed per NEC 406.9.

2.7 EQUIPMENT CONNECTIONS

A. Materials as specified in this section, and as required.

2.8 HANGERS AND SUPPORTS

A. General: All hangers, supports, fasteners and hardware shall be zinc-coated or of equivalent corrosion resistance by treatment or inherent property, and shall be manufactured products designed for the application. Products for outdoor use shall be hot dip galvanized.

B. Types: Hangers, straps, riser supports, clamps, U-channel, threaded rods, etc. as indicated and/or required.

C. Seismic restraints and supports as indicated and/or required.

2.9 ELECTRICAL IDENTIFICATION

A. Nameplates: Three-layer laminated plastic with minimum 3/16" high white engraved characters on black background, and punched for mechanical fastening. Fasteners: self-tapping stainless-steel

screws or number 10-32 stainless steel machine screws with nuts and flat and lock washers. Each nameplate on all panelboards and switchgear shall indicate the following:

1. Panel Name
2. Voltage, Phase, Number of Wires
3. Source

B. Marking Pens: Permanent, waterproof, quick drying black ink. Acceptable Manufacturers: Sanford Fine Point "Sharpie," or equal.

C. Wire Tags: Vinyl or vinyl-cloth self-adhesive wraparound type indicating appropriate circuit number, etc.

D. Arc Flash Panelboard Stickers: Provide per NEC 110.16.

2.10 ELECTRIC SERVICE

A. Materials as specified elsewhere in this section, and as required by the serving electric utility company.

2.11 TELEPHONE SERVICE

A. Materials as specified elsewhere in this section, and as required by the serving utility company.

2.12 SAFETY SWITCHES

A. General: Heavy duty, horsepower rated, fully enclosed, fusible (with rejection fuse clips) or non-fused as indicated, quick-make, quick break switching mechanism interlocked with cover, and NEMA-1 enclosure for dry locations, and NEMA-3R enclosure for wet locations, unless indicated otherwise. Switches to be labeled as "Suitable for Use as Service Entrance Equipment," where so indicated or required.

B. Ratings: Provide switches with ratings as indicated. If ratings are not indicated, provide switch with ratings to suit the electrical system and load served.

C. Acceptable Manufacturers: General Electric; Square D; Cutler-Hammer, Siemens.

2.13 GROUNDING

A. General: Ground rods, conductors, clamps and connectors, etc. as required.

B. Ground Rods: Minimum 5/8" diameter by 10' long copper clad steel.

C. Welded Connectors: Exothermic process.

D. Grounding System Resistance: 25 ohms.

~~2.14 DRY TYPE TRANSFORMERS~~

~~A. General: Transformers shall be UL listed and labeled, and meet all applicable NEMA, ANSI, and IEEE standards. Transformers shall be factory assembled, general purpose, ventilated type of size and electrical characteristics indicated.~~

~~B. Enclosure: Ventilated, drip-proof code gauge steel housing with bolted removable access panels, phosphatized and finished with corrosion inhibiting undercoat and ANSI 61 gray baked enamel. Transformers shall be suitable for mounting on floor or other substantial structure, except for 15 KVA size and smaller which shall be suitable for wall mounting.~~

~~C. Core and Coil: Constructed of continuous copper windings and high grade non-aging, grain oriented silicon steel core laminations having high magnetic permeabilities and low hysteresis and eddy current losses. Core and coil of units rated 15 KVA or more shall be completely isolated from the enclosure using vibration absorbing mounts and shall have flexible grounding strap connected to the enclosure. Connections to primary and secondary bushing shall be made using fully rated flexible straps.~~

~~D. Insulation System: 220ºC temperature class for all transformers.~~

~~E. Temperature Rise: Winding temperature rise by resistance limited to 115ºC for all transformer sizes, referenced to 40ºC ambient temperature. Hot spot temperature shall not exceed 30ºC above winding temperature rise rating. Case temperature shall not exceed 35ºC above 40ºC ambient temperature.~~

~~F. Taps: Two 5% FCBN taps for transformer sizes below 30 KVA; and two 2-1/2% FCAN and four 2-1/2% FCBN taps for transformer sizes 30 KVA and larger; referenced to nameplate voltage.~~

~~G. Noise Levels: Less than ANSI standards and shall meet the following requirements:~~

~~1. 15 to 50 kVa – 45 dB~~
~~2. 51 to 150 kVa - 50 dB~~
~~3. 151 to 300 kVa – 55 dB~~
~~4. 301 to 500 kVa – 60 dB~~
~~5. 501 to 700 kVa – 62 dB~~
~~6. 701 to 1000 kVa – 64 dB~~

~~H. Efficiencies shall be as indicated in the following table:~~

~~NEMA CLASS 1 EFFICIENCY LEVELS FOR DRY-TYPE TRANSFORMERS LOW VOLTAGE, 75˚C AT 35% OF NAMEPLATE LOAD~~			
~~SINGLE-PHASE EFFICIENCY~~		~~THREE-PHASE EFFICIENCY~~	
~~15 kVA~~	~~97.7~~	~~15 kVA~~	~~97.0~~
~~25 kVA~~	~~98.0~~	~~30 kVA~~	~~97.5~~
~~37.5 kVA~~	~~98.2~~	~~45 kVA~~	~~97.7~~
~~50 kVA~~	~~98.3~~	~~75 kVA~~	~~98.0~~
~~75 kVA~~	~~98.5~~	~~112.5 kVA~~	~~98.2~~
~~100 kVA~~	~~98.6~~	~~150 kVA~~	~~98.3~~
~~167kVA~~	~~98.7~~	~~225 kVA~~	~~98.5~~
~~250 kVA~~	~~98.8~~	~~300 kVA~~	~~98.6~~
~~333 kVA~~	~~98.9~~	~~500 kVA~~	~~98.7~~
		~~750 kVA~~	~~98.8~~
		~~1000 kVA~~	~~98.9~~

~~I. Ratings: KVA rating, voltages, phases and configuration as indicated. Minimum impedance: 4.5%.~~

~~J. Nameplates: The nameplate shall be permanently mounted to the exterior front, with permanently etched numbers and letters, and shall include the following:~~

~~1. KVA size~~

~~2. Primary and Secondary Voltage Ratings.~~

~~3. Serial Number~~

~~4. Weight~~

~~5. Composition of Windings (Primary, Secondary)~~

~~6. Wiring Diagram~~

~~7. Percent impedance~~

~~8. Taps~~

~~9. Basic Impulse Level~~

~~K. Acceptable Manufacturers: General Electric; Square D; Cutler-Hammer, Siemens; ACME.~~

2.15 PANELBOARDS

A. Types: Two-row, bolt-on circuit breaker branch circuit panelboards, and circuit breaker or fusible switch type distribution panelboards, as indicated or required.

B. General: Ratings, mains, mounting and complement of branch overcurrent protective devices as indicated below or on the Drawings.

C. Short Circuit Ratings: Minimum 10,000 amps for 208/120 volt panelboards and 14,000 amps for 480/277 volt panelboards. Provide panelboards with higher ratings as indicated or as required.

D. Enclosures: NEMA-1 for dry locations and NEMA 3R for wet locations (unless indicated otherwise). Provide galvanized steel rough-in box and cover with gray enamel finish Panel fronts are to have a door (circuit breakers) in door (circuit breakers & wiring gutters) in trim with concealed hinges and flush type tumbler lock. All panels shall be keyed alike. Doors in excess of 48" high shall be equipped with a three-point catch and vault handle with integral tumbler lock. Panel shall be dead front, safety type and be multi-section as noted or as necessary to comply with NEC.

E. Bussing: Full capacity Copper, include solid copper ground bus, bonded to enclosure and solid copper neutral bus with lug for each branch circuit

F. Fusible Switches: Quick-make, quick-break, horsepower rated, with rejection fuse clips, padlockable handle, and hinged door with defeatable interlock.

G. Acceptable Manufacturers: General Electric “A Series” and “Spectra Series”; Square D “NQOD,” “NEHB,” “I-Line” and “QMB”; Cutler-Hammer “Pow-R-Line C.”

H. Panelboard Schedules: Refer to the schedules on the Contract Drawings.

2.16 CIRCUIT BREAKERS

A. General: Molded case with thermal and magnetic trips unless indicated otherwise. Minimum 10,000 amps interrupting capacity for 208V and 240V, 14,000 amps interrupting capacity for 480V and higher ratings as indicated or required.

B. For Panelboard Mounting: Bolt-on type.

C. Individually Mounted: NEMA-1 enclosures for indoor application, NEMA-3R for outdoor application, unless indicated otherwise.

D. Breakers to be added to Existing Panelboards: Same manufacturer, type and interrupting rating as for the existing breakers in same panelboard.

2.17 FUSES

A. UL Class RK-5 and RK-1, 250 volt or 600 volt as required for system voltage, dual element, time delay, current limiting, 200,000 AIC, ampere ratings as indicated.

B. Acceptable Manufacturers: Bussmann "Fusetron"; or equal by Gould Shawmut.

2.18 LIGHTING FIXTURES

A. General:

1. Fixture types as described below or indicated on the Drawings. Lighting fixture manufacturers' series or catalog numbers listed indicate general quality, type, and style, but may not cover all required design features and details. Provide lighting fixtures having all features, details and accessories as noted in the fixture descriptions. Provide all fittings, hangers, clamps, brackets, yokes, flanges and miscellaneous devices required for a complete installation.
2. Whenever possible, (based upon design requirements) provide lighting fixtures with ballasts provided integral to fixture and prewired.

B. LED Lamps: Minimum 40,000 hours lamp life before 20% loss of output, 3500k interior, 4500K site and parking lot lighting, unless indicate otherwise. Acceptable Manufacturers: Philips, Cree, Luxeon, OSRAM.

~~C. High Intensity Discharge Ballasts: High power factor, constant wattage autotransformer (CWA) where available, or types as indicated or recommended by the lamp manufacturer.~~

~~D. Site Lighting Fixtures: Include foundations, poles, luminaries, lamps, ballasts and all miscellaneous accessories as indicated or required for a complete assembly. Unless indicated otherwise, foundations to be cast-in-place concrete with constructed forms for square foundations and spirally wrapped treated paper forms for round foundations. Provide concrete as specified in this section or in Division 3, anchor bolts, and reinforcing steel as indicated or required. Provide a 1"x45º chamfer at top of each foundation. Poles to be able to withstand winds of not less than 100 mph without damage to the poles or attached luminaries. Provide pole bases with handholes, handhole covers finished to match the pole finish, and ground lug.~~

2.19 LIGHTING CONTROL EQUIPMENT

A. Occupancy Sensor Wall Switches: Two-wire (retrofit applications only) or three-wire (new installations), dual technology, employing a temperature compensated dual element sensor and multi-faceted fresnel lens, designed for taking the place of a standard toggle switch, and compatible with solid-state lighting ballasts, rated 120/277VAC 0-800 watts ballast or tungsten, 277VAC 0-1200 watts. Adjustments to include auto-off time delay adjustable 5, 15, or 30 minutes with walk through test mode, and adjustable sensitivity. Sensitivity adjustments shall be as follows: PIR-High/Low, Ultrasonic fully adjustable. Controls to include manual-on, manual-off, and automatic-off. Indicators to include red LED to indicate when unit is triggered; Acceptable Manufacturers: Watt Stopper DW-100, or approved equal.

B. Ceiling Occupancy Sensors: Provide dual technology, passive infrared/ultrasonic technology controller,. Unit to operate in conjunction with a separately mounted power pack (see below). Coverage for ceiling mount to be up to1000 square feet. Adjustments to include manual-off time delay adjustable 5, 10, 15, 20, or 30 minutes, and adjustable sensitivity. Sensor shall have built in light level sensor allowing adjustment of lighting control between 10 to 300 footcandles. Controls to include automatic-on or manual-on, automatic-off, Indicators to include red LED to indicate when unit is triggered. Multiple Sensors may be used to control a single power pack. Power Packs to be separately mounted U.L. listed power supply consisting of transformer, contact closure relay, and system configuration electronics and selector switches. Power output of transformer to be sufficient for powering up to twelve sensors. Units to be rated for 10 to 20 amps (as required) universal load at 120 volts or 277 as required. Provide low voltage control wiring as required by the manufacturer. Acceptable Manufacturers: Wattstopper DT-300, or approved equal.

C. Lighting Control Relays: 277 volt AC (all loads), 20 amp, 6-pole (N.O.), magnetically held, 120 volt coil, with "Hand-Off Auto" selector switch, green push-to-test/transformer type interlocked pilot light and NEMA-1 enclosure with engraved nameplate "LIGHTING CONTROL RELAY." Acceptable Manufacturers: Square D Class 8903, Type "L"; or equal by GE, Cutler-Hammer, Siemens.

D. Photoswitches: Raintight, 120 volt or 277 volt as indicated or required, with SPST contacts rated for 2000 watts, with field adjustable light level sensitivity (1-15FC), and time delay. Acceptable Manufacturers: Tork #2100 Series, or approved equal.

E. Time Switches: Two-channel, programmable, astronomic, seven-day digital time switch with 365-day, holiday capability (16 single dates and 5 holiday blocks), and capable of 48 events per channel, per week. Unit to include automatic adjustment for daylight savings switchovers and leap years corrections, manual on-off override control for each channel, 72-hour battery backup, and NEMA-1 metal enclosure. Astronomic feature to be field adjustable for 10º - 60º Northern or Southern latitudes, and selectable to one or both channels, with adjustable 1-99 minute offset from sunrise or sunset. Time switches to be suitable for operation from a 120 or 277 volt power source, as indicated or required. Contacts to be rated 10 amp resistive, 7.5 amp inductive and 1/3 horsepower, at 120 volts AC, and 10 amp resistive at 277 volts AC. Acceptable Manufacturers: Tork #DZS200A Series; or equal by Paragon or Intermatic.

2.20 ADDRESSABLE FIRE ALARM AND DETECTION SYSTEMS

A. General: Noncoded, addressable, microprocessor based type system with manual and automatic alarm initiation, analog addressable smoke detectors.

B. Functional Description: Provide a complete addressable fire alarm and detection system with the following functions and operating features:

1. Priority of Signals: Automatic response functions shall be accomplished by the first address initiated. Alarm functions resulting from initiation by the first address shall not be altered by subsequent alarms. An alarm signal shall be the highest priority. Supervisory or trouble signals shall have second- and third-level priority. Signals of a higher level priority shall take precedence over signals of lower priority even though the lower priority condition occurred first. Annunciate all alarm signals regardless of priority or order received.
2. Noninterfering: Provide addressable, powered, wired, and supervised system so a signal on one address does not prevent the receipt of signals from any other address. All devices shall be manually resettable from the FACP after the initiating device or devices have been restored to normal. Systems that require the use of batteries or battery backup for the programming function are not acceptable.

3. Signal Initiation: The manual or automatic operation of an alarm initiating or supervisory operating device shall cause the FACP to transmit an appropriate signal including:
   a. General alarm.
   b. Smoke detector alarm.
   c. Door release.
   d. Elevator recall.
   e. System trouble.
   f. Fan shutdown.
   g. Smoke control initiation.
4. Silencing at FACP: Switches shall provide capability for acknowledgment of alarm; supervisory, trouble, and other specified signals at the FACP; and capability to silence the local audible signal and light an LED (light emitting diode). Subsequent alarms shall cause the audible signal to sound again until silenced in turn by switch operation. Restoration to normal of alarm, supervisory, and trouble conditions shall extinguish the associated LED and cause the audible signal to sound again until the restoration is acknowledged by switch operation.
5. Power Loss Indication: Sound trouble signal at the FACP upon loss of primary power at the FACP and the annunciator. Illuminate the emergency power light at both locations when the system is operating on an alternate power supply.
6. Annunciation: Annunciate manual or automatic operation of any alarm or supervisory initiating device both on the FACP and on the remote annunciator indicating the location and type device.
7. General Alarm: A system general alarm includes:
   a. Indicating the general alarm condition at the FACP and the system annunciator.
   b. Identifying the device that is the source of the alarm (or its zone) at the FACP and the system annunciator.
   c. Initiating audible and visible alarm signals throughout the building, including all smoke detector audible bases.
   d. Initiating automatic recall operation of elevators.
   e. Closing fire and smoke doors normally held open by magnetic door holders.
   f. Stopping supply and return fans.
   g. Closing smoke dampers on system.
   h. Initiating smoke control sequence through a signal to the building automatic temperature control system.
   i. Initiating transmission of alarm signal to remote central station.
8. Manual station alarm operation initiates a general alarm.
9. Smoke detection initiates a general alarm.
10. Smoke detection in an apartment is to initiate a trouble signal at the FACP and initiate the audible alarm in its' sounder base; all other smoke detection is to initiate a general alarm.
11. Heat detection initiates a general alarm.
12. Permissible Signal Time Elapse: The maximum permissible elapsed time between the actuation of any fire alarm or fire detection system alarm initiating device and its indication at the FACP is ten seconds.
13. Circuit Supervision: Indicate circuit faults with both a zone and a trouble signal at the FACP. Provide a distinctive indicating audible tone and (LED) indicating light. The maximum elapsed time between the occurrence of the trouble condition and its indication at the FACP is 200 seconds.

PART 3 – EXECUTION

3.1 GENERAL

A. The installation of all electrical work shall be in accordance with the intent of the Contract Documents, as determined by the Engineer.

B. Installation Requirements: All materials and equipment shall be installed as recommended by the respective manufacturers, by mechanics experienced and skilled in their particular trade, in a neat and workmanlike manner, in accordance with the standards of the trade, and so as not to void any warranty or UL listing.

C. Administration and Supervision: All electrical work shall be performed under the Contractor's direct supervision, using sufficient and qualified personnel as necessary to complete the work in accordance with the progress schedule. The Contractor shall assign one or more competent supervisors who shall have authority to accept and execute orders and instructions, and who shall cooperate with the other Contractors and subcontractors, the Engineer and Owner in all matters to resolve conflicts and avoid delays.

3.2 EXAMINATION

A. Conditions Verification: Examine the areas and conditions under which the work is to be performed, and identify any conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

3.3 COORDINATION

A. General: Sequence, coordinate and integrate the installation of all electrical materials and equipment for efficient flow of work, in conjunction with the other trades. Review the Drawings for work of the other trades, and report and resolve any discovered discrepancies, prior to commencing work.

B. Cooperation: Cooperate with the other Contractors and individual disciplines for placement, anchorage and accomplishment of the work. Resolve interferences between work of other disciplines or Contractors, prior to commencing installation.

C. Chases, Slots, and Openings: Arrange for chases, slots, and openings during the progress of construction, as required to allow for installation of the electrical work.

D. Supports and Sleeves: 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.

E. Obstacles and Interferences: When installing equipment and raceways, provide offsets, fittings, accessories and changes in elevation or location as necessary to avoid obstacles and interferences, per actual field conditions.

F. Space Requirements: Electrical equipment sizes indicated on drawings are generally based on specified manufacturer. Verify that the proposed equipment will fit in the space indicated on the drawings. Maintain clearances required by NEC.

3.4 DIMENSIONS

A. Building Dimensions: For exact locations of building elements, refer to dimensioned drawings. However, field measurements take precedence over dimensioned drawings.

B. Site Dimensions: Field measurements take precedence over scaled electrical site plans.

C. Limiting Dimensions: Equipment outlines shown on detail drawings of 1/4" = 1'-0" scale or larger and dimensions indicated on the Drawings are limiting dimensions. Do not install equipment exceeding dimensions indicated by outlines on Drawings, or equipment or arrangements that reduce indicated clearances.

D. Establish the exact location of electrical equipment based on the actual field verified dimensions of equipment furnished.

3.5 EQUIPMENT PROTECTION

A. Protect all electrical equipment, and materials and work from the weather elements, paint, mortar, construction debris and damage, until project is substantially complete. Repair, replace, clean all electrical work so affected.

3.6 ELECTRICAL INSTALLATION - GENERAL

A. Unfinished and Finished Areas: For the purposes of these electrical specifications, “unfinished” areas shall include mechanical, electrical and telephone equipment rooms. All other areas shall be considered “finished” spaces, unless indicated or approved otherwise.

B. In Unfinished Areas: Raceways, equipment and devices may be installed concealed or exposed, unless indicated otherwise.

C. In Finished Areas: Conceal all raceway and flush mount all electrical boxes, equipment, and devices unless indicated or approved otherwise. The space above suspended ceilings or behind furred spaces is considered outside finished areas and electrical materials installed within these areas are considered concealed.

D. Minimum Mounting Height: Install exposed raceway and all other electrical equipment (e.g., lighting fixtures) with not less than 7'-6" clear to finished floor, unless indicated or approved otherwise, and excluding raceway and equipment mounted on walls.

E. Dimensions and Clearances: Field measure all dimensions and clearances affecting the installation of electrical work, in relation to established datum, building openings and clearances, and work of other trades, as construction progresses.

F. Rough-In Locations: Verify final locations for rough-ins with field measurements and requirements of actual equipment being installed.

G. Door Swings: Verify the swings of all doors before switch outlets or other electrical devices are installed. If necessary, relocate devices so they are not obstructed by doors when doors are open.

H. Ceiling Mounted Devices: The locations indicated on the architectural reflected ceiling plans take precedence over the electrical documents, in the event of conflict.

I. Install equipment according to manufacturer’s written instructions.

J. Install equipment, conduit, cable tray, hangers, and supports to withstand seismic forces for the seismic zone of the installation.

3.7 LAYOUT

A. General: Install electrical systems, materials and equipment level and plumb, and parallel and perpendicular to other building systems and components, where installed exposed.

B. Serviceability: Install electrical equipment and raceways, etc. to readily facilitate servicing, maintenance and repair or replacement of components, and so as to minimize interference with other equipment and installations.

C. Clearances: Prior to commencing work, verify that all electrical equipment will adequately fit and conform to the indicated and code required clearances, in the spaces indicated on the Drawings. If rearrangement is required, submit plan and elevation drawings or sketches indicating proposed rearrangement, for the Engineer's approval. Do not rearrange without express written permission of the Engineer.

D. Right-Of-Way: When laying out electrical work, give priority in available space to steam and condensate lines, sanitary lines, drain lines, fire protection piping and sheet metal duct work. Provide offsets as required to avoid conflicts. Resolve all conflicts before commencing installation.

3.8 MOUNTING HEIGHTS

A. General: Indicated heights are measured from the center of the device outlet box to finished floor or grade, unless indicated otherwise. Request instructions for mounting heights not indicated.

3.9 HOLES, SLEEVES, AND OPENINGS

A. General: Provide all holes, sleeves, and openings required for the completion of Division 26 work and restore all surfaces damaged, to match surrounding surfaces. Maintain integrity of all fire and smoke rated barriers using approved firestopping systems. When cutting holes or openings, or installing sleeves, do not cut, damage or disturb structural elements or reinforcing steel, unless approved, in writing, by the Project Structural Engineer.

B. Conduit Penetrations: Size core drilled holes so that an annular space of not less than 1/4" and not more than 1" is left around the conduit. When openings are cut in lieu of core drilled, provide sleeve in rough opening. Size sleeves to provide and annular space of not less than 1/4" and not more than 1" around the conduit. Patch around sleeve to match surrounding surfaces.

3.10 FIRESTOPPING SYSTEMS

A. General: Install firestopping at all electrical raceway and cable penetrations through floor structures and interior walls or partitions which are time-rated fire and/or smoke barriers.

B. Preparation: Prior to installation, verify that all penetrating elements and supporting devices are permanently installed and that surfaces which will be in contact with penetration seal materials are clean and free of dust, dirt, grease, oil, loose materials, rust or other substances.

C. Installation: Install firestop systems in accordance with UL approved design details and the manufacturer's instructions. Install sleeves, conduits and cables with required clearance spaces, allowing installation of sealing materials. Do not exceed the outside diameter of the sleeve, conduit or cable by more than one inch or by less than 1/4" when making openings for penetrations. Install firestop systems so as to completely seal openings to prevent passage of smoke and water.

3.11 CUTTING AND PATCHING

A. General: Provide all cutting, drilling, chasing, fitting and patching necessary for accomplishing the work of Division 26. This includes any and all work necessary to: uncover work to provide for the installation of ill-timed work; remove and replace defective work and work not conforming to the requirements of the Contract Documents; install equipment and materials in existing structures; in addition to that required during the normal course of construction.

B. Comply with the cutting and patching requirements of Division 1.

C. Building Structure: Do not endanger the integrity of the building structure by cutting, drilling or otherwise modifying any structural member, without specific approval. Do not proceed with any structural modifications without written permission of the Project Structural Engineer.

D. Repairs: Repair any and all damage to work of other trades caused by cutting and patching operations, using skilled mechanics of the trades involved.

3.12 WELDING

A. General: Where welding is required, such welding shall be performed in a skilled manner by certified welders. Verify that welds are free from cracks, craters, undercuts, and strikes, weld spatter, and any other surface defects. Clean and re-weld any welds deemed unacceptable in size or configuration. Do not weld to structural steel without prior written permission from the Project Structural Engineer.

3.13 RACEWAY SYSTEMS

A. Raceway Types: Unless indicated otherwise, use raceway types as follows:
   1. Indoors, Concealed in Walls or Above Ceilings: EMT.
   2. Indoors, Exposed: Use rigid galvanized steel conduit below ten feet above finished floor. EMT may be used above ten feet.
   3. Indoors, Below Floor Slab: (Minimum 3/4 inch size). Schedule 80 rigid non-metallic conduit. Stub up using rigid galvanized steel elbows.
   4. Outdoors, Below Grade: (Minimum 1-inch size). Schedule 40 rigid non-metallic conduit. Stub up using rigid galvanized steel elbows.
   5. Outdoors, Exposed: Rigid galvanized steel conduit.
   6. Flexible Steel Conduit: Use (in dry locations only) for connections to transformers, vibrating equipment, and equipment requiring minor adjustments in positions, for final connections to recessed lighting fixtures, and between outlet boxes in metal stud partitions.
   7. Liquid-Tight Flexible Steel Conduit: Use where flexible steel conduit connections are required in damp, wet or oily locations, and for final connections to all motors and similar equipment.

B. Raceway Routing: As required by job conditions unless specific routes or dimensioned positions are indicated on the drawings. Install tight to slabs, beams and joists wherever possible. Route exposed conduit, and conduit installed above ceilings, parallel or perpendicular to walls ceilings and structural members. Install to maintain minimum headroom and to present a neat appearance. Run parallel raceways together with bends made from same center line. Verify exact locations of all raceways, pull boxes, and junction boxes. Resolve any conflicts before installation.

C. Raceway Installation: Cut conduit ends square using saw or pipecutter and ream each cut end smooth. Carefully make all conduit bends and offsets so that the inside diameter of pipe is not reduced. Make bends so that legs are in the same plane. Make offsets so that legs are in the same plane and parallel. Protect stub-ups from damage, and carefully rebend when necessary.

D. Fittings: Make up all raceway fittings tight so that final installation of raceway, fittings and enclosures constitutes a firm mechanical assembly and a continuous electrical conductor. Where required, provide bonding jumpers to assure electrical continuity.

E. Protection: Protect all raceways, enclosures and equipment during construction to prevent entry of concrete, debris and other foreign matter. Free clogged conduits of all obstructions, or replace, prior to pulling wire. Do not pull wire within buildings until buildings are completely enclosed.

F. Boxes: Install all outlet, pull and junction boxes rigidly, plumb and level. Support and secure boxes independently from conduits terminating at box. Install all boxes so as to be accessible and so that covers may be easily removed.

G. Handholes: Provide as indicated, installed plumb and level. Where not indicated, install every 200' at a minimum.

H. Conduit Seals: Install conduit seal for each conduit penetrating an exterior building wall below grade (unless penetration is below lowest building floor slab), and elsewhere as indicated, and so as to achieve a sealed watertight installation.

I. Pull Strings: Provide pull strings in all spare conduits.

3.14 CONDUCTORS - 600 VOLT AND BELOW

A. Minimum Conductor Size: All branch circuit wiring shall be minimum #12 AWG. All control circuit wiring shall be minimum #14 AWG, unless indicated otherwise. Provide larger sizes as indicated or required.

B. Branch Circuit Conductor Sizes: Provide branch circuit conductor sizes as indicated on the panelboard schedules, plans, or elsewhere. Neutral conductor size to match phase conductors unless indicated otherwise. Provide branch circuit switch legs and travelers as required for the switching indicated.

C. Equipment Grounding Conductor Required: For each branch circuit and feeder run, provide an equipment grounding conductor for continuous length of run, sized per NEC 250-122 (minimum), larger if so indicated.

D. Feeders: Provide feeder conductor sizes and quantities as indicated.

E. In Raceway: Install all wiring in conduit or other specified raceway, unless indicated otherwise.

F. Terminations: Furnish and install terminations, including lugs if necessary, to make all electrical connections indicated or required. Make connections and terminations for all stranded AWG conductors using crimp, clamp, or box type connectors and terminators. Enclose all strands of stranded conductors in connectors, and lugs.

G. Color: Conductors #10 and smaller shall be factory color-coded by integral pigmentation with a separate color for each phase and neutral. #8 and larger shall have stripes, bands, hash marks or color pressure-sensitive plastic tape. Color code all branch circuit and feeder conductors as follows:

1. 208/120 Volts:

PHASE	COLOR
A	Black

PHASE	COLOR
B	Red
C	Blue
Neutral	White

2. 480/277 Volts:

PHASE	COLOR
A	Brown
B	Orange
C	Yellow
Neutral	Gray

3. Equipment Grounding Conductors: Green

H. Phase Arrangement: Arrange phases in all electrical equipment as follows:
   1. A, B, C: Front to Rear.
   2. A, B, C: Top to Bottom.
   3. A, B, C: Left to Right When Facing Established Front of Equipment.

I. Provide conductors with not less than 90 C rated ins
high temperature light fixtures (e.g. fluorescent & HID), boilers, incinerators, ovens, ranges, kitchen exhaust fans, other heat-producing equipment, and “100% Rated” overcurrent protective devices. Use special higher temperature wire as required for connection to specialty equipment as required by equipment manufacturer.

3.15 EQUIPMENT CONNECTIONS

A. Connect complete, all equipment requiring electrical connections, furnished as part of this Contract or by others, unless indicated otherwise.

B. Equipment Variations: Note that equipment sizes and capacities as shown on the Contract Documents are for bidding purposes and as such may not be the exact unit actually furnished. Contractor shall anticipate minor variations in equipment and shall include in his Bid all costs required to properly connect the equipment actually furnished.

C. Verification: Obtain and review shop drawings, product data and manufacturer’s instructions for equipment furnished by others. Examine actual equipment to verify proper connection locations and requirements.

D. Coordination: Sequence electrical rough-in and final connections to coordinate with installation and start-up schedule and work by other trades.

E. Rough-In: Provide all required conduit, boxes, fittings, wire, connectors and miscellaneous accessories, etc., as necessary to rough in and make final connections to all equipment requiring electrical connections. In general, motors and equipment shall be wired in conduit to a junction box (or safety switch) near the unit, and from there to the unit in flexible metal or liquid-tight flexible steel conduit.

F. Connections: Provide properly sized overload and short circuit protection for all equipment connected, whether furnished under this Contract or by others. Verify proper connections with

manufacturer's published diagrams and comply with same. Verify that equipment is ready for electrical connections, wiring and energization, prior to performing same.

G. Control Wiring: Provide all control wiring to remote devices or equipment as indicated or required. Modify equipment control wiring, install or disconnect jumpers, etc., as required.

3.16 HANGERS AND SUPPORTS

A. General: Rigidly support and secure all electrical materials, raceway and equipment to building structure using hangers, supports and fasteners, suitable for the use, materials and loads encountered. Provide all necessary hardware.

B. Overhead Mounting: Attach overhead mounted equipment to structural framework or supporting metal framework. Do not make attachments to steel roofing, steel flooring or ceiling mineral tile.

C. Wall Mounting: Support wall mounted equipment by masonry, concrete block, metal framing or sub-framing.

D. Exterior Walls: Mount all electrical equipment located on the interior of exterior building walls, at least one inch away from wall surface, using suitable spacers.

E. Structural Members: Do not cut, drill or weld any structural member.

F. Independent Support: Do not support electrical materials or equipment from other equipment, piping, ductwork or supports for same.

G. Temporary Conditions: Do not attach to or support electrical work from removable or knockout panels or temporary walls or partitions.

H. Raceway Supports: Rigidly support all raceway with maximum spacings per NEC, and so as to prevent distortion of alignment during pulling operation. Use approved hangers, clamps and straps for individual runs. Do not use perforated straps or tie wires. Where multiple parallel raceways are run together, use trapeze type hanger arrangement made from U-channel and accessories, suspended by threaded rods, and allow at least 25% spare capacity for future installation of additional raceways. Rigidly anchor vertical conduits serving floor-mounted or "island" type equipment mounted away from walls with metal bracket or rigid steel conduit extension secured to floor.

I. Miscellaneous Supports: Provide any additional structural support steel brackets, angles, fasteners and hardware as required to adequately support all electrical materials and equipment.

J. Seismic restraints and supports: Provide as indicated and/or as required per seismic zone indicated.

3.17 ELECTRICAL IDENTIFICATION

A. General: Locate nameplate, marking, or other identification means on outside of equipment or box front covers when above ceilings and when in mechanical or electrical equipment rooms or other unfinished areas, and on inside of front cover when in finished rooms/areas. Use Contract Document designations for identification unless indicated otherwise.

B. Nameplates: Provide nameplate engraved with equipment designation for each safety switch, panelboard, transformer, motor starter, and all other electrical cabinets, etc.

C. Marking Pen Labeling: Mark each junction and pull box indicating source designation and circuit number(s) for the enclosed conductors.

D. Wire Tags: For power circuits, apply wire tag indicating appropriate circuit or feeder number to each conductor present in distribution panel and panelboard gutters, and to each conductor in pull and junction boxes where more than one feeder or multi-wire branch circuit is present. Where only a single feeder or multi-wire branch circuit is present, box cover labeling and conductor color coding is sufficient. For control, communications and signal circuits, apply wire tag indicating circuit or termination number at all terminations and at all intermediate locations and boxes where more than one circuit is present.

E. Panelboard Circuit Directories: At completion of project, accurately complete each panelboard circuit directory card, identifying load served or "spare" or "space" for each circuit pole. When modifying, adding or deleting circuits at an existing panelboard, update the existing (or provide new) circuit directory card to accurately reflect final conditions.

F. Abandoned Equipment: Label all abandon equipment as "Abandon as of _____." For conduits and conductors include opposite end location.

3.18 ELECTRIC SERVICE

A. General: Arrange with the local electric utility company, and pay all associated costs for providing temporary electric service (if required) and permanent electric service for the project as indicated and required. Comply with and coordinate all requirements of the utility company.

B. Grounding: Provide grounding electrode system for the service, per the NEC and utility company requirements.

3.19 TELEPHONE SERVICE

A. Provide telephone service raceways as required by the serving utility company. Provide pull string.

3.20 GROUNDING

A. General: Provide all system and equipment grounding as indicated and as required by the NEC.

B. Equipment Grounding: Provide a green equipment grounding conductor, sized per NEC 250-122 (larger if so indicated) with each feeder and branch circuit run.

C. Provide exothermic welded connections where indicated.

3.21 DRY TYPE TRANSFORMERS

A. Mounting: Install transformers on floors or walls, or suspend from building structure as indicated, with mounting provisions, supporting means and methods as required for the weights and types of building construction encountered, and in compliance with all building and seismic codes. All floor mounted transformers to be set on 4" high concrete housekeeping pads.

B. Conduit Connections: Make all conduit connections to transformer cases using flexible metal conduit.

C. Ventilation Openings: Do not obstruct transformer ventilation openings.

D. Taps: Set transformer taps for proper secondary voltage.

3.22 PANELBOARDS

A. Secure rough-in boxes to building structure or steel framing, independent of conduits. Install with top of cabinet at 7'-0" above floor, but with minimum 8" clearance above floor unless so doing would exceed maximum 6'-6" disconnect height allowed by NEC.

B. Cover all unused overcurrent protective device spaces.

3.23 SAFETY SWITCHES

A. Mount securely at the location indicated on the drawings.

B. Provide fuses as required.

3.24 INDIVIDUAL MOTOR CONTROLLERS

A. General: Make all connections to motors and control equipment complete and verify that equipment is in proper operating order. Connect power to motors for correct direction of rotation. Verify nameplate ratings of all motors. Report any deviations or discrepancies.

B. Overcurrent and Overload Protection: Provide fuses where indicated or required, and overload elements sized in accordance with the ambient temperature, the actual motor nameplate full load amperes, and service factor.

C. Power Wiring: Unless indicated otherwise, provide all required power wiring from indicated power source to each motor controller and from each motor controller to respective motor.

D. Control Wiring: Provide as indicated. Unless indicated otherwise, use No. 14 AWG wire for all control circuits. For circuits longer than 200 feet and for 120 volt motors, use No. 12 AWG wire.

3.25 LIGHTING FIXTURES

A. Lamps and Ballasts: Replace all burned out, defective and inoperative lamps, and all noisy, defective and inoperative ballasts, starters, etc. prior to Owner’s acceptance.

3.26 LIGHTING CONTROL EQUIPMENT

A. Occupancy Sensor Wall Switches and Occupancy Sensors: Install sensors in general locations indicated. Adjust exact locations if required to comply with manufacturers recommendations for optimum placement. Make all required line and control wiring connections. Adjust field of views, sensitivities and time delays, and set system configuration selector switches, etc. as indicated, directed or required for optimum control.

B. Lighting Control Relays: Connect “Auto” position of relay H-O-A selector switch through photoswitch or other indicated control contacts, and the “HAND” position to override the automatic control.

C. Photoswitches: Adjust sensitivity for proper operation.

3.27 ADRESSABLE FIRE ALARM AND DETECTION SYSTEM

A. Existing System: Equipment, devices, appliances and wiring to be compatible with existing system.

B. Install addressable fire alarm and detection systems as indicated, in accordance with equipment manufacturer's written instruction, and complying with applicable portions of NEC, and NECA's "Standard of Installation".

C. The contractor shall provide full testing of the new or existing system in accordance with the procedures outlined in NFPA 72, including section 7-1.6, System Reacceptance Testing, for existing software functions and devices. Testing of smoke detectors shall be with smoke or listed aerosol approved by the detector manufacturer. The system shall be retested until all deficiencies have been rectified. The contractor shall submit a written test report signed by the manufacturer's representative indicating that the fire alarm system has been 100% tested and approved.

D. The contractor must retain the services of the fire alarm system manufacturer for provision of two (2) - 4 hour training sessions (separate days) dedicated to training the owner in the complete operation and maintenance of all system components and control panel, providing testing reports indicating each device was tested and is consistent with NFPA 72, and for the acceptance testing with the authority having jurisdiction.

3.28 CHECKOUT, TESTING, AND ADJUSTING

A. General: Provide testing equipment, materials, instruments, and personnel to perform all test procedures and adjustments required by the Contract Documents and/or deemed necessary by the Engineer to establish proper performance and installation of electrical systems and equipment. All test instruments to be accurately calibrated and in good working order.

B. Scheduling: Schedule tests at least three days in advance, and so as to allow Engineer and Owner representative(s) to witness the test, unless directed otherwise. Do not schedule tests until the system installation is complete and fully operational, unless indicated or directed otherwise.

C. Manufacturer's Authorized Representatives: For all new and modified systems and equipment, arrange and pay for the services of the manufacturer's authorized representative(s) to be present at time of equipment or system start-up, to supervise the start-up, and to conduct and/or certify all required testing and adjusting.

D. Test Reports: Submit test reports neatly typewritten on 8-1/2" x 11" sheets indicating system or equipment being tested, methodology of testing, date, and time of test, witnesses of test, and test results. Submit test reports in (3) copies to the Engineer for review, within (5) days after test is performed, and include a copy with the appropriate operation and maintenance data.

E. Correction/Replacement: After testing, correct any deficiencies, and replace materials and equipment shown to be defective or unable to perform at design or rated capacity. Retest without additional cost to the Owner or Contract. Submit finalization report indicating corrective measures taken, and satisfactory results of retest.

3.29 SYSTEMS DEMONSTRATION

A. Instruct the Owner's representative(s) in the start-up, operation and maintenance of all electrical systems and equipment in accordance with Division 1, and as requested by the Owner's Representative.

3.30 CLEANING AND TOUCH-UP PAINTING

A. Perform cleaning required by Division 1.

B. General: Periodically remove from the project site, all waste, rubbish and construction debris accumulated from construction operations, and maintain order. The premises shall be left clean and free of any debris and unused construction materials, prior to final acceptance.

C. Electrical Equipment: Remove all dust, dirt, debris, mortar, wire scraps, rust, and other foreign materials from the interior and exterior of all electrical equipment and enclosures, and wipe down. Clean accessible current carrying elements and insulators prior to energizing.

D. Light Fixtures: Thoroughly clean all new or relocated light fixtures and lamps, just prior to final inspection. Fixture enclosures, reflectors, lenses, etc. shall be cleaned free of dust, dirt, fingerprints, etc. by an approved method.

E. Touch-Up Painting: Restore and refinish to original condition, all surfaces of electrical equipment scratched, marred and/or dented during shipping, handling, or installation. Remove all rust, and prime and paint as recommended by the manufacturer.

END OF SECTION

SECTION 310519.13 – GEOTEXTILES

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the installation of separation/stabilization fabric as shown on the Contract Drawings and as specified herein.

1.2 QUALITY ASSURANCE

A. The latest edition of the following standards, as referenced herein, shall be applicable.
   1. American Society for Testing and Materials (ASTM).

1.3 SUBMITTALS

A. Product Data:
   1. Submit Manufacturer's material specifications, product literature and installation instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
   1. Deliver sufficient materials to the site to prevent interruption of the work.
   2. All materials shall be inspected by Contractor upon delivery. Contractor shall notify Engineer of any damage. Products received at the site torn, with holes, deteriorated, or otherwise damaged will not be approved and shall be returned and replaced at no expense to the Owner.

B. Storage:
   1. All material shall be stored in strict accordance with the manufacturer's recommendations and as approved by the Engineer.
   2. Do not store products directly on ground. Ship and store geotextile with suitable wrapping for protection against moisture and ultraviolet exposure. Store geotextile in way that protects it from elements, if stored outdoors, elevate and protect geotextile with waterproof cover.

C. Handling:
   1. All material shall be handled in strict accordance with the manufacturer's recommendations and as approved by the Engineer.

PART 2 – PRODUCTS

2.1 WOVEN GEOTEXTILE

A. Stabilization Fabric: To be used beneath roadways and walks.

B. Composed of polymeric yarn interlaced to foam planar structure with uniform weave pattern.

C. Calendared or finished so yarns will retain their relative position with respect to each other.

D. Polymeric Yarn: Long-chain synthetic polymers (polyester or polypropylene) with stabilizer or inhibitors added to make filament resistant to deterioration due to heat and ultraviolet light exposure.

E. Sheet Edges: Selvaged or finished to prevent outer material from separating from sheet.

F. Unseamed Sheet Width: Minimum 12 feet.

G. Physical Properties: Conform to requirements noted below:

PROPERTY	DESIGN VALUE	TEST METHOD
Tensile Strength	315 lbs	ASTM D4632
Elongation	12%	ASTM D4632
Trapezoidal Tear	113 lbs	ASTM D4533
CBR Puncture Strength	900 lbs	ASTM D6241
A.O.S.	40 (US Sieve)	ASTM D4751
Permittivity	.05 sec^{-1}	ASTM D4491

2.2 NONWOVEN GEOTEXTILE

A. Separation/Filtration Fabric: To be used in drainage ditches, haybale installation, culvert outfall installations, rip-rap outfall installations, and cover material separation

B. Previous sheet of polyester, polypropylene, or polyethylene fabricated into stable network of fibers that retain their relative position with respect to each other. Nonwoven geotextile shall be composed of continuous or discontinuous (staple) fibers held together through needle-punching, spun-bonding, thermal-bonding, or resin-bonding.

C. Geotextile Edges; Selvaged or otherwise finished to prevent outer material from pulling away from geotextile.

D. Unseamed Sheet Width: Minimum 12 feet.

E. Physical Properties: Conform to the requirements noted below:

PROPERTY	DESIGN VALUE	TEST METHOD
Tensile Strength	160 lbs	ASTM D4632
Elongation	50%	ASTM D4632
Trapezoidal Tear	60 lbs	ASTM D4533
CBR Puncture Strength	400 lbs	ASTM D6241
A.O.S.	70 (US Sieve)	ASTM D4751
Permittivity	1.4 sec^{-1}	ASTM D4491

PART 3 – EXECUTION

3.1 GENERAL

A. The Contractor shall be responsible for the installation, and seaming of geotextile fabric in accordance with the specifications and the manufacturer's recommendations, as approved by the Engineer.

3.2 SUBGRADE PREPARATION

A. Surfaces to be covered with geotextile fabric shall be smooth and free of rocks, sticks, roots, sharp objects, and all debris that may damage the fabric. The surface to be covered shall be firm and unyielding, with no sudden changes or breaks in grade. There shall be no standing water or excessive moisture on the surface when the fabric is placed.

B. The compacted subgrade shall be maintained in a smooth, uniform and compacted condition during installation of the fabric.

3.3 GEOTEXTILE INSTALLATION

A. The fabric shall be cleaned of all debris or other materials that may negatively affect the fabric's performance.

B. Mechanical equipment shall not be permitted to operate directly on the fabric unless authorized to do so by the manufacturer and approved by the Engineer.

C. Geotextile Placement:

1. Fabric shall be placed as recommended by the manufacturer and approved by the Engineer on surfaces which have been prepared to conform with these Specifications and found acceptable for fabric installation.
2. The fabric shall be placed as smooth and wrinkle-free as possible.
3. When installing geotextile in trenches, swales, ditches, etc., overlap geotextile in the direction of flow.
4. All areas of fabric damaged during installation as determined by the Engineer shall be repaired or replaced by the Contractor as specified at no additional cost to the Owner. Should the fabric be damaged during any step of the installation, the damaged section shall be repaired by covering it with a piece of fabric which extends at least 24 inches in all directions beyond the damaged area. The fabric shall be secured by sewing or bonding as approved by the Engineer.
5. At time of installation, fabric will be rejected if it has defects, ribs, holes, flaws, deterioration, or damage incurred during manufacture, transportation, handling, or storage. Damaged materials shall be removed and replaced at no additional cost to the Owner.
6. Fabric shall be placed with long dimension down slope.
7. Fabric shall be protected at all times during construction from contamination by surface run-off and any fabric so contaminated shall be removed and replaced with uncontaminated fabric.

D. Seams and Overlaps of Geotextile:

1. All overlaps shall be a minimum of eighteen (18) inches (450 mm).

3.4 COVER MATERIALS OVER GEOTEXTILES

A. Granular materials shall be placed on geotextiles as shown on the Contract Drawings. During backdumping and spreading, a minimum depth of 6 inches of granular material shall be maintained at all times between the fabric and wheels of trucks or spreading equipment. All equipment used in spreading or traveling on the cover layer for any reason shall exert low ground pressures and shall be approved by the manufacturer and Engineer. Dozer blades, etc. shall not make direct contact with the fabric; however, if tears occur in the fabric during the spreading operation, the granular material shall be cleared from the fabric and the damaged area repaired as previously described.

B. The granular material shall be spread in the direction of fabric overlap. Large fabric wrinkles which may develop during the spreading operations shall be folded and flattened in the direction of the spreading. Occasionally, large folds may reduce the fabric overlap width. Special care shall be given to maintain proper overlap and fabric continuity.

C. All equipment spreading cover material or traveling on the cover layer shall avoid making sharp turns, quick stops or quick starts.

D. Fabric shall be covered as soon as possible after placement to minimize exposure to sunlight. Fabric shall not be exposed for more than 5 days.

3.5 DISPOSAL OF SCRAP MATERIALS

A. On completion of installation, the Contractor shall legally dispose of all trash and scrap material off-site or in a location approved by the Owner and Engineer, remove equipment used in connection with the work herein, and shall leave the premises in a neat acceptable manner.

END OF SECTION

SECTION 311000 – SITE CLEARING

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:
1. Protecting existing trees, shrubs, groundcovers, plants, and grass to remain.
2. Removing existing trees, shrubs, groundcovers, plants, and grass.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and abandoning site utilities in place or removing site utilities.

1.2 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches (50 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

C. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots.

1.3 MATERIAL OWNERSHIP

A. Except for excess stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.4 SUBMITTALS

A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

B. Record drawings, according to Section "Project Record Documents," identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

C. Certification: Submit written certification by qualified arborist that trees indicated to remain have been protected during the course of construction in accordance with recognized standards and that where damage did occur, trees were promptly and properly treated. Indicate which damaged trees (if any) are incapable of retaining full growth potential and are recommended to be replaced.

1.5 QUALITY ASSURANCE

A. Stake limits of clearing, grubbing, and stripping, prior to commencing of work.

B. Arborist Qualifications: Engage a qualified arborist who has successfully completed tree protection and trimming, to perform the following work:
   1. Remove branches from trees that are to remain, if required.
   2. Recommend procedures to compensate for loss of roots and perform initial pruning of branches and stimulation of root growth where removed to accommodate new construction.
   3. Recommend procedures for excavation and grading work juxtaposed to established plants.
   4. Perform tree repair work for damage incurred by new construction.

1.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction. Detour routes shall be identified by adequate signs in accordance with the MUTCD.

B. Protect areas outside limits of disturbance from encroachment by construction personnel or equipment, regardless of property Ownership. Access shall be by specific, written permission or easement only

C. Salvageable Improvements: Carefully remove items indicated to be salvaged and deliver to storage location defined on the plans or specified here in.

D. Utility Locator Service: Properly notify utility locator service for area where Project is located before site clearing in accordance with local protocol.

E. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

F. Contractor shall verify existing grades prior to performing work under this section. If existing grades are at variance with the drawings, notify the Owner and receive instructions prior to proceeding. No additional compensation will be considered resulting from grade variances once site clearing has commenced.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag, fence and protect trees and vegetation to remain or to be relocated.

C. Remove branches from trees that are to remain, if required to clear new construction and only if specifically approved by Engineer.
   1. Where directed by Engineer, extend pruning operation to restore natural shape of entire tree.
   2. Cut branches and roots, if required, with sharp pruning instruments; do not break or chop.

D. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TREE PROTECTION

A. Erect and maintain temporary fencing around tree drip line before starting site clearing. Remove fence when construction is complete.
   1. Do not store construction materials, debris, or excavated material within fenced area.
   2. Do not permit vehicles, equipment, or foot traffic within fenced area.
   3. Maintain fenced area free of weeds and trash.

B. Do not machine excavate within tree drip line.

C. Where excavation for new construction is required within tree drip line, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

D. Do not allow exposed roots to dry out before permanent backfill is placed; provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in moist condition and temporarily support and protect from damage until permanently relocated and covered with earth.
   1. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
   2. Coat cut faces of roots more than 1-1/2 inches (38 mm) in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
   3. Backfill with soil as soon as possible.
   4. Where trenching for utilities is required within drip line, tunnel under or around roots by hand digging. Do not cut main lateral roots or tap roots; cut only smaller roots that interfere with installation of new work. Cut roots with sharp pruning instruments; do not break or chop.

E. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Engineer and acceptable to the Owner.
   1. Employ an arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
   2. Replace trees that cannot be repaired and restored to full-growth status, as determined by Engineer and acceptable.

3.3 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
   1. Arrange with utility companies and Owner to shut off indicated utilities.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Engineer and owner not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Engineer and Owner's written permission.

C. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

A. Completely remove obstructions, trees, shrubs, stumps, roots, grass, and other vegetation to permit installation of new construction.
   1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
   2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
   3. Use only hand methods for grubbing within tree protection zone.
   4. Chip removed tree branches and dispose of off-site.

3.5 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Where trees are designated to remain, stop topsoil stripping and adequate distance from the trees to prevent damage to the main root system.

C. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
   1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

D. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Do not stockpile topsoil within tree protection zones.
   2. Dispose of excess topsoil as specified for waste material disposal.

3.6 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
   1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
   2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.7 DISPOSAL

A. Burning of debris onsite is not permitted.

B. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
   1. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the preparation of the site, protection, excavation, embankment, drainage, dewatering, for site grading, as shown on the Drawings, and as herein specified.

B. The Contractor shall accept the site in the condition in which it exists at the time of the award of the Contract.

C. The Engineer shall determine the suitability of materials that are to be used in the work and should any materials encountered be unsatisfactory for the purpose intended, they shall be removed from the site at the Contractor's expense.

1.2 QUALITY ASSURANCE

A. Reference Standards:
1. The latest edition of the following standards, as referenced herein, shall be applicable.
a. NJDOT "Standard Specifications for Road and Bridge Construction, Division 200 “Earthwork”.
b. "Standard Specifications for Highway Materials and Methods of Sampling and Testing, American Association of State Highway and Transportation Officials (AASHTO)."

B. The Contractor shall comply with the requirements for soil erosion and sedimentation control, and other requirements of governmental authorities having jurisdiction, including the State of New Jersey.

C. The Contractor shall provide and pay for all costs in connection with an approved independent testing facility to determine conformance of soils and aggregate with the specifications in accordance with Section “Quality Requirements.”

1.3 SUBMITTALS

A. Samples:
1. The Contractor shall furnish earth materials to the testing laboratory for analysis and report, as directed by the Engineer, or as outlined in the specifications.

B. Test Results:
1. The testing laboratory shall submit written reports of all tests, investigations, and recommendations to the Contractor, Owner, and the Engineer.

1.4 PROJECT REQUIREMENTS

A. Notify the Engineer of any unexpected subsurface condition.

B. Protection of Existing Utilities:
1. Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate support and protection during earthwork operations, comply with OSHA requirements.

2. Coordinate interruption and/or termination of utilities with the utility companies and the Owner.
3. Provide a minimum of 48 hours' notice to the Owner and receive written notice to proceed before interrupting any utility.
4. Demolish and completely remove from the site any existing underground utilities designated to be removed as shown on the Drawings or as specified in Section "Site Clearing."
5. Repair any damaged utilities as acceptable to the Engineer, at no additional cost to the Owner.

C. Protection of Persons and Property:
1. Barricade open excavations occurring as part of this work, and post with warning lights.
2. Operate warning lights as recommended by authorities having jurisdiction.
3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.
4. Perform excavation within drip-line of large trees to remain by hand, and protect the root system from damage or dryout to the greatest extent possible. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1" diameter and larger with emulsified asphalt tree paint.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Select Granular Material: Sound, durable, sand, gravel, stone or blends with these materials, free from organic, frozen, or other deleterious materials, conforming to the requirements of NJDOT Section 200 and meeting the following gradation requirements (NJDOT Soil Aggregate Type I-5:

SIEVE	PERCENT PASSING
2"	100
3/4"	70 - 100
No. 4	30 – 80
No. 50	10 – 35
No. 200	5 - 12

B. Selected Fill: Sound, durable, sand, gravel, stone, or blends of these materials, free from organic, frozen or other deleterious materials, and meeting the following gradation requirements (NJDOT Soil Aggregate Type I-12).

SIEVE	PERCENT PASSING
4"	100
3/4"	70 - 100
No. 50	0 – 75
No. 200	0 – 5

1. Fines passing No. 200 shall be non-plastic.

2. Particle size analysis shall show no gap grading.

PART 3 - EXECUTION

3.1 PRECONSTRUCTION MATERIAL QUALIFICATION TESTING

A. A 100-pound minimum representative sample shall be obtained from each potential borrow source. If different material gradations are known to exist in the pit, samples shall be obtained for each material. Each sample shall be mixed thoroughly and reduced to test specimen size, in accordance with AASHTO T87. The test shall be performed in the order shown. Failure to pass any test is grounds for disqualification and shall lead to cessation of the test program for that material.

1. Particle Size Analysis:
   a. Method: ASTM D422.
   b. Number of Tests: One (1) per potential source.
   c. Acceptance Criteria: Gradation within specified limits.
2. Maximum Density Determination:
   a. Method: ASTM D1557, Modified Proctor.
   b. Number of Tests: One (1) per potential source.
3. Re-establish gradation and maximum density of fill material if source is changed during construction.

3.2 PREPARATION

A. Establish required lines, levels, contours and datum.

B. Maintain benchmarks and other elevation control points. Re-establish, if disturbed or destroyed, at no additional cost to the Owner.

C. Establish location and extent of utilities before commencement of grading operations.

3.3 EXCAVATION

A. Excavation shall consist, in general, of the excavation of whatever substance is encountered to the lines, grades and sections shown on the Drawings, including excavation as necessary for grading and other similar features.

B. All suitable materials removed in excavation shall be used in the construction of embankments, subgrade, shoulders, slopes and at such other places as directed. The Engineer shall be the sole judge of what constitutes suitable material.

C. During construction, the grading operations shall be executed in such a manner that the excavation will be well drained at all times. All grading shall be finished on neat, regular lines conforming to the sections and contours shown on the Plans.

D. Removal of materials beyond the indicated subgrade elevations, without authorization by the Engineer, shall be classified as unauthorized excavation and shall be performed at no additional cost to the Owner.

E. Excavation shall be performed in proper sequence with all other associated operations.

F. Maintain the slopes of excavation in a safe condition until completion of the grading operation.

G. All excavation work shall be inspected and approved by the Engineer before proceeding with construction.

H. Any excess excavation shall be removed from the site to disposal areas at the Contractor's expense.

3.4 FILL

A. All site fill shall be "selected fill" unless otherwise shown on the Drawings, or directed by the Engineer. "Select granular fill" shall be placed in lieu of selected fill where directed by the Engineer.

B. Before depositing fills, the surface of the ground shall be cleared of all refuse, brush and large stones. Conform to Section "Site Clearing."

C. Prior to placing fill over undistributed material, scarify to a minimum depth of six (6) inches.

D. Where fills are made on hillsides or slopes, the slope of the original ground upon which the fill is to be placed shall be plowed or scarified deeply or where the slope ratio of the original ground is steeper than 2 horizontal to 1 vertical, the bank shall be stepped or benched.

E. The original ground shall be proof rolled until the underlying soil is thoroughly compacted to the satisfaction of the Engineer before any filling is begun. A steel-wheel tandem roller weighing 8 to 10 tons or equipment capable of obtaining the same effort shall be used to obtain a thoroughly compacted subgrade. Remove or recompact any soft or loose soils as determined by the Engineer prior to filling.

F. A thoroughly and satisfactorily subgrade is defined as having a minimum dry density of 95 percent of the maximum density of the material used. The subgrade material shall be compacted at a moisture content suitable for obtaining the required density.

G. Place backfill and fill materials in layers not more than 12" in loose depth unless shown otherwise on the Drawings. Lift height shall be governed by the ability of the compaction equipment to obtain the required compaction with 12" as a maximum lift height. Before compaction, moisten or aerate each layer as necessary to facilitate compaction to the required density. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost, ice, ponded water or extraneous debris.

H. When work is suspended during periods of freezing weather, measures shall be taken to prevent fill already in place from freezing. Upon resumption of work after any inclement weather, prepare the exposed surface by proof rolling to identify any zones of soft/loose soils. Soft/loose materials or frozen soils shall be removed and replaced by compacted granular fill.

I. Moisture Control:

1. Where fill or backfill must be moisture conditioned before compaction, uniformly apply water to the surface and to each layer of fill or backfill. Prevent ponding or other free water on surface subsequent to, or during, compaction operations.
2. Remove and replace, or scarify and air dry, soil that is too wet to permit compaction to specified density. Soil 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, harrowing or pulverizing, until moisture content is reduced to a value which will permit compaction to the percentage of maximum density specified.

J. All fill shall be thoroughly and satisfactorily compacted to 95 percent of the maximum density of material used.

3.5 GRADING

A. The present and finished grade lines are shown on the contract drawings. Grade over the entire area, as shown on the drawings, shall be to the finished subgrade levels. Upon completion of this work, all debris shall be cleaned out and removed from the premises.

B. All cutting, filling, backfilling and grading necessary shall be done to bring the area to the following grade or subgrade levels:

1. For roadway surface areas: to the finished subgrade levels specified on the Drawings.
2. For areas to be topsoiled and seeded: to within 6 inches of the finished grade.
3. For other surface treatments: as detailed on the Drawings.

C. Sufficient grading must be done during the progress of the work so that the entire site shall be well drained and free from water pockets.

D. Finish grading, including dressing swales, cleaning up excess footing excavation, dressing terraces, disposing of excess material and all other work necessary to prepare the site for topsoil and seeding shall be done after construction of structures and roadway surface areas is substantially complete.

3.6 COMPACTION EQUIPMENT

A. Compaction equipment used for the Work is subject to approval by the Engineer. Any equipment not originally manufactured for compaction purposes and equipment which is not in proper working order will not be approved. Furnish manufacturer's specifications covering data not obvious from a visual inspection of the equipment and necessary to determine its classification and performance characteristics.

B. Vibratory Drum Compactors: A self-propelled compactor classified for use according to the developed compactive force rating (CFR) per linear inch of drum width (PLI). The actual operating frequency of the compactor will determine the PLI rating.

1. Furnish one vibratory reed tachometer for the exclusive use of the Engineer. Tachometers shall have a frequency range adequate to cover the operating frequencies of all vibratory compactors on the project with scale divisions of 50 vibrations per minute or less. The tachometer will be returned by the Owner’s Representative at the closeout of the project.
2. Approval of vibratory compactors usage is contingent upon proper operation of equipment at all times during compaction operations.
3. Compaction equipment other than vibratory drum compactors may be used subject to the approval of the Owner’s Representative. Submit specifications at least two (2) weeks prior to use of this equipment.
4. Do not use vibratory drum compactors after concrete is poured.

3.7 DRAINAGE AND DEWATERING

A. Prevent surface, subsurface or ground water from flowing into excavation and from flooding project area, as well as surrounding areas.

B. Do not allow water to accumulate in excavations. Remove water to prevent soil changes detrimental to the stability of subgrades.

C. Provide and maintain the pumps, well points, sumps, suction and discharge lines, and other dewatering components necessary to convey water away from excavations.

D. Provide and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations by dewatering, to collection or run-off areas.

E. Dewatering operations shall be as directed by the Engineer and performed in accordance with Section "Dewatering."

3.8 FIELD QUALITY CONTROL

A. Notify the Engineer at least one (1) working day in advance of all phases of filling and backfilling operations.

B. Owner will engage and pay for an independent testing agency for compaction testing.

C. Compaction testing shall be performed to ascertain the compacted density of the fill and backfill materials in accordance with the following methods:

1. In-place relative density:

a. Method: AASHTO T238, Nuclear Method

b. Number of Tests: One (1) per 8-inch vertical lift.

D. The Engineer may direct additional tests to establish gradation, maximum density, and in-place density as required by working conditions, at the Contractor's expense.

E. Acceptance Criteria: The sole criterion for acceptability of in-place fill shall be in situ dry density. Minimum dry density for all fill or backfill shall be 95 percent of the maximum dry density. If a test fails to qualify, the fill shall be further compacted and re-tested. Subsequent test failures shall be followed by removal and replacement of the material.

3.9 CLEAN UP

A. Provide and maintain protections or newly filled areas against damage. Upon completion or when directed, correct all damaged and deficient work by building up low spots and remove temporary protections, fencing, shoring and bracing.

B. Remove all surplus excavated material not required for filling and backfilling and legally dispose of same away from premises.

C. Leave the premises and work in clean, satisfactory condition, ready to receive subsequent operations.

END OF SECTION

SECTION 312316.26 – ROCK REMOVAL

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes drilling, blasting, excavation, removal and disposal of rock as necessary for the installation of the Work, and as indicated and specified herein.

1.2 REFERENCES

A. The latest edition of the following standards, as referenced herein, shall be applicable.
   1. "Structure Response and Damage Produced by Ground Vibration from Surface Mine Blasting," U.S. Bureau of Mines Publication RI 8507.

1.3 DEFINITIONS

A. Rock: Limestone, sandstone, shale, granite, quartz, and formations of other varying mineral or aggregate composition in solid beds or masses in its original or stratified position that exceed 1 cubic yard and that cannot be excavated with one of the following:
   1. A crawler tractor having a minimum draw bar pull rated at not less than 71,000 lbs. (Caterpillar D9N or equivalent), and occupying an original volume of at least 1 cubic yards or more.
   2. A backhoe having a break out force rated at not less than 44,000 lbs. (Caterpillar 235D or equivalent), and occupying an original volume of at least 1 cubic yards.

B. Rock Excavation: Removal of rock by means of drilling, or use of pneumatic tools or expansive chemical agents. Removal of materials which, in the opinion of the Engineer, can be loosened and excavated by mechanical means (ripping, etc.) including frozen materials, soft laminated shale or hardpan, pavements, curbs and similar materials shall be classified as earth excavation with the exception of rock face scaling.

B. Unauthorized Excavation: Removal of any material beyond horizontal and vertical limits indicated on the Drawings or as specified herein, without the prior approval of the Engineer.

C. Scaling: Scaling shall be considered the removal of loose and broken rock from the face of rock cuts by mechanical means. Scaling shall be included in Rock Excavation item as defined above.

D. Line Drilling: A controlled blasting method in which a single row of closely spaced, unloaded holes are drilled along the neat excavation line to create a plane of weakness which the primary blast can break. Center-to-center spacing of line drilled holes shall be no more than twice the hole diameter.

1.4 SUBMITTALS

A. General:
   1. Submit Specialty Contractors' qualifications, to the Engineer for approval.
   2. Submit work plans, site safety plans, proposed equipment, and a detailed outline of intended rock removal procedures and any other information listed in this specification to the Engineer for approval. This submittal shall not relieve the Contractor of complete responsibility for the successful performance of the method(s) used.

B. Blast Plan:

1. No blasting is anticipated.

C. Site Safety Plan:

1. Site safety shall be coordinated through the Contractor's office. A written safety plan shall be developed and distributed to all subcontractors, the Owner and the Engineer.

D. Certifications/Licenses:

1. One (1) copy of each certificate, license, permit and proof of insurance required by this specification shall be submitted to the Engineer after award of contract and prior to commencement of work.

E. Quality Assurance:

1. The Contractor shall use the services of an experienced Specialty Contractor to perform all blasting operations.
2. The Blasting Specialty Contractor and the blasting foreman shall be regularly engaged in blasting work of similar magnitude and scope and shall be approved by the Engineer to perform this project. A list of prior work experience for the Blasting Specialty Contractor and foreman shall be submitted with the bid.

1.5 REGULATORY REQUIREMENTS

A. The Blasting Specialty Contractor shall obtain all required permits, certificates, and licenses (City, State, Local etc.) prior to the commencement of any blasting operations.

B. Blasting safety procedures and operations shall comply with Title 29 Code of Federal Regulations

C. Part 1910.109, and all other applicable state and local standards and regulations.

1.6 PROJECT/SITE CONDITIONS

A. Existing Conditions: Existing physical conditions as defined for design purposes are noted on the Drawings and are described in the Information Available to Bidders section of the Contract Documents.

1.7 SEQUENCING AND SCHEDULING

A. Work associated with blasting shall be performed in accordance with the following general sequence:

1. Complete and submit pre-blast survey;
2. Notify all appropriate authorities having jurisdiction of proposed activities;
3. Prepare site for blasting;
4. Notify affected utility owners, operators and nearby residents as required in Part 3 - Execution;
5. Complete test blast program simultaneously with seismic monitoring;
6. Complete production blasting work simultaneously with seismic monitoring; and
7. Complete and submit post-blast survey.

1.8 MAINTENANCE

A. Any and all damage caused by the Blasting operations shall be repaired or replaced to the property Owner's and Engineer's satisfaction at the expense of the Blasting Specialty Contractor within thirty (30) days of completion of the Post-Blast Survey.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.1 PREPARATION

A. All personnel working on-site shall be instructed as to the nature, times, duration, site safety and warning signals concerning blasting operations.

B. Local residents within the Pre-Blast Survey area shall be notified at least 48 hours prior to initial blasting operations and provided with the name and phone number of one full-time, on-site contact person designated by the Contractor for handling all complaints and inquiries. Residents shall be notified of blast schedule and changes on at least a weekly basis throughout the duration of blasting operations. Residents shall also be informed of warning signals identifying an upcoming blast and all-clear signals following completion of a blast as outlined in Site Safety Plan.

C. Explosives and blasting caps shall not be brought onto the site or used without appropriate permits, licenses, certificates and/or prior written approval of authorities having jurisdiction. The Specialty Contractor is solely responsible for handling, storage, and use of explosive materials in accordance with regulatory and permit requirements.

3.2 ROCK REMOVAL

A. Remove rock as indicated by the Drawings and as necessary for the installation of the Work. Provide sufficient clearance, within the limits specified, for the proper execution of the Work.

B. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
   1. 24 inches (600 mm) outside of concrete forms other than at footings.
   2. 12 inches (300 mm) outside of concrete forms at footings.
   3. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
   4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
   5. 6 inches (150 mm) beneath bottom of concrete slabs on grade.
   6. 6 inches (150 mm) beneath pipe in trenches, and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.

C. Fill areas of over-excavated rock to the proposed subgrade elevations as required by Drawings with selected fill in accordance with Section "Trenching and Backfilling" or Section "Earth Moving" Over-excavation beneath foundations shall be filled with footing concrete (f1 = 3000 psi minimum).

D. A test blast shall be performed and monitored prior to commencement of production blasting. Test blast records and seismic records shall be reported to the Engineer prior to continuation of blasting. If test blast indicates that the blasting plan requires modification, such changes shall be reported to the Engineer immediately. Reporting this information to the Engineer shall not relieve the Contractor(s) of complete responsibility for the successful performance of the method(s) used, nor shall the reporting constitute approval by the Engineer for the proposed plans.

E. The Seismic Specialty Contractor shall monitor the vibrations and sound levels caused by Blasting.

F. Seismic monitoring shall be performed for each blast, unless specified otherwise. Monitoring shall be performed at the nearest structure or at locations designated by the Engineer on each field day.

G. If the ground vibrations exceed specified tolerances the Blasting Specialty Contractor's operations shall cease immediately and remain stopped until the Blasting Specialty Contractor has taken all necessary additional measures to protect adjacent property and personnel.

H. All finished rock faces as shown on the Plans shall be line drilled/presplit test sections shall be exposed at the outset of drilling and blasting for the evaluation of the rock faces by the Engineer. The Contractor shall to completely expose the rock face in the test section prior to production blasting operations.

I. All rock slopes shall be thoroughly scaled to the satisfaction of the Engineer. Scaled rock slopes shall be stable and free from possible hazards of falling rocks or rock slides that endanger public or worker safety. If such conditions exist after proper scaling, remedial treatment shall be provided by the Contractor or Blasting Specialty Contractor at no additional expense to the Owner. In the event that natural conditions such as wedge instability are encountered, remedial treatment shall be provided as necessary to stabilize the rock slope. Such treatment may include, but is not necessarily limited to, rock bolting or grouting, shoring or shotcreting. Large scale ripping shall not be permitted within 10 feet of any final rock slope prior to presplitting or line drilling.

J. The Blasting Specialty Contractor shall use steel or rubber blasting mats as may be necessary to control fly-rock.

3.3 EXCAVATION TOLERANCES

A. Blast hole drilling and overblast beyond the vertical limits indicated shall be less than 1.5 feet.

B. Rock removal limits shall include all materials defined as rock whether removal is accomplished by mechanical means (ripping, etc.) or by drilling and blasting.

3.4 VIBRATION AND SOUND TOLERANCES

A. Blast vibrations shall be maintained within safe limits as defined by the Peak Particle Velocity (in./sec.) vs. Blast Frequency (Hz) as described in the United States Bureau of Mines Publication RI-8507, Appendix B ("Siskind Curve").

B. Sound levels shall not exceed 130dB at the nearest structure.

C. Vibrations levels at new concrete structures shall be limited to the following levels:

AGE OF CONCRETE (DAYS)	MAXIMUM ALLOWABLE PPV
Less than 1/2	0.1 (in./sec.)
1/2 to 7	1.0 (in./sec.)
Greater than 7	2.0 (in./sec.)

END OF SECTION

SECTION 312319 – DEWATERING

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes provisions for a dewatering system to continuously lower and control groundwater levels and hydrostatic pressures in order to maintain near-dry conditions for construction of the work as shown on the plans and specified herein.

1.2 SUBMITTALS

A. Submit the following :
1. Description: of proposed dewatering system.
2. Layout: of dewatering system, including location of sumps, deep wells, well points, header pipes, pumps, discharge lines and observation wells.
3. Details: of dewatering system, including installation methods for deep wells, well points and observation wells, depths of wells, material descriptions, pipe sizes, intake screen sizes, and pump capacities.
4. Estimate: of time required to lower groundwater levels after start of pumping

1.3 JOB CONDITIONS

A. Site soil boring data and samples, soil laboratory testing, and any soil reports shall be made available to prospective bidders for study and review. Bidders must make their own interpretation of subsurface conditions that may affect methods or the cost of construction of the Work.

PART 2 – PRODUCTS

2.1 DEWATERING SYSTEM

A. Provide a dewatering system of adequate size and capacity to lower and maintain the groundwater at the specified level. The system shall include standby pumps and power source for continuous operation.
1. Dewatering system shall consist of wellpoints, deep wells, cut-off walls, riser pipes, swing joints, header lines, valves, pumps, discharge lines, and all other necessary fittings, accessories and equipment for a complete operating system. Provide hole punches, sand backfill and clay plugs as required by soil conditions.

B. Observation Wellpoints: Provide groundwater reading wells or piezometers to monitor the groundwater level, as indicated on the approved Shop Drawings or as directed by the Engineer.

C. Sand: Clean concrete sand conforming to ASTM C 33.

PART 3 – EXECUTION

3.1 PREPARATION

A. Install the observation well points at locations indicated on approved Shop Drawings or where directed by the Engineer. Install observation wellpoints in accordance with manufacturer's printed instructions and in accordance with approved Shop Drawings. Provide sand backfill around wellpoint. Test each observation wellpoint to verify that the installation is performing properly.

B. Protect observation well standpipes from damage by construction operations and maintain accessibility to them. Maintain reading wells until groundwater is allowed to return to its normal level.

3.2 INSTALLATION

A. Install the dewatering system in accordance with approved Shop Drawings and as required by site conditions. Locate elements of the system to allow a continuous dewatering operation without interfering with the installation of any permanent project Work.

3.3 OPERATION

A. Keep the system in continuous operation from the time excavation is started in the dewatering area (or before if required by site conditions to lower the groundwater to the elevations specified) until the time backfilling is completed at least 2 feet above the normal groundwater level.
   1. Do not discontinue dewatering operations without specific approval from the Engineer.
   2. Rates of groundwater withdrawal during dewatering operations, shall at all times be below the rate at which soil particles are removed from the existing soils.

B. In the event excavation proceeds subsequent to dewatering as specified above, and the groundwater level is found to be within two feet of the excavation, the dewatering Contractor shall immediately continue to dewater as specified herein, including, but not limited to, additional dewatering and monitoring facilities, at no additional cost to the Owner. The excavation shall not be allowed to proceed below groundwater.

3.4 FIELD CONTROL

A. Maintain a careful check to detect any settlement in existing adjacent Work. Notify the Engineer of any signs of settlement. Establish settlement point bench marks and take periodic readings as directed. The Contractor shall take all such precautions and do any and all Work necessary to protect the stability and integrity of adjacent lands. Pavements, buildings, and utilities from settlement or other movement that may be caused by his dewatering operations. The Contractor shall be solely responsible for any damage or injury to adjacent lands, pavements, buildings, or utilities caused by his dewatering or other operations or his failure to use corrective or preventive procedures or methods.

B. Take and record measurements of the groundwater in each reading and pumping well periodically and when directed by the Engineer.

3.5 DISCHARGE

A. Dispose of all water removed from the excavation in such a manner as not to endanger public health, property, or any portion of the Work under construction or completed.

B. Dispose of water in such a manner as to cause no inconvenience to others on or adjacent to the site.

C. Convey water from the excavation in a closed conduit. Do not use trench excavations as temporary drainage ditches.

D. Disposal of water shall be approved by the Engineer and shall not cause erosion or sedimentation to occur in existing drainage systems. All sedimentation or blocking of existing systems shall be thoroughly cleaned and returned to original condition by the Contractor, at his expense.

E. Provide approved sediment traps when water is conveyed into water courses.

3.6 REMOVAL

A. When system is no longer required, gradually decrease the pumping rate until the water table resumes its natural position so that the velocity of the returning groundwater will be low enough as not to carry fines with it.

B. When the dewatering system is no longer required and when directed by the Engineer, dismantle and remove the system and all appurtenances from the site.

END OF SECTION

SECTION 312333 - TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the excavation of trenching, backfilling, compacting, dewatering, excavation support and disposal, as shown on the Contract Drawings, and herein specified.

B. The Engineer will determine the suitability of materials that are to be used in the work; and should any materials encountered be unsatisfactory for the purpose intended, they shall be removed from the site at the Contractor's expense.

1.2 QUALITY ASSURANCE

A. Reference Standards:
1. The latest edition of the following standards, as referenced herein, shall be applicable.
a. "NJDOT Standard Specifications".
b. "Standard Specifications for Highway Materials and Methods of Sampling and Testing, America Association of State Highway and Transportation Officials (AASHTO)".
c. American Society for Testing and Materials (ASTM).
d. National Electric Code (NEC).

B. The Contractor shall comply with the requirements for soil erosion and sedimentation control and other requirements of governmental authorities having jurisdiction, including the State.

C. The Contractor shall provide and pay for all costs in connection with an approved independent testing facility to determine conformance of soils and aggregate with the specifications, in accordance with Section "Quality Requirements".

1.3 SUBMITTALS

A. Samples:
1. The Contractor shall furnish representative earth materials to the testing laboratory for analysis and report, as directed by the Engineer, or as outlined in the specifications.

B. Test Results:
1. The testing laboratory shall submit written reports of all tests, investigations, findings, and recommendations to the Contractor, Owner, and the Engineer.

1.4 PROJECT REQUIREMENTS

A. Notify the Engineer of any unexpected subsurface condition.

B. Protect excavations by shoring, bracing, sheet piling, or by other methods, as required to ensure the stability of the excavation. Comply with OSHA requirements.

C. Underpin or otherwise support structures adjacent to the excavation which may be damaged by the excavation. This includes service lines.

D. Protection of Existing Utilities:

1. 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. Comply with OSHA requirements.
2. Coordinate interruption and/or termination of utilities with the utility companies and the Owner.
3. Provide a minimum of 48 hours notice to the Owner and receive written notice to proceed before interrupting any utility.

E. Demolish and completely remove from the site any existing underground utilities designated to be removed, as shown on the Drawings or as specified.

F. Repair any damaged utilities as acceptable to the Owner, Engineer, and utility company at no additional cost to the Owner.

G. Contractor shall comply with maintenance and protection requirements as approved by the authority having jurisdiction.

H. Protection of Persons and Property:

1. Barricade open excavations occurring as part of this work and post with warning lights, if required.
2. Operate warning lights as recommended by authorities having jurisdiction.
3. Protect structures, utilities, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.
4. Perform excavation within drip-line of trees to remain by hand, and protect the root system from damage or dryout to the greatest extent possible. Maintain moist conditions for root system and cover exposed roots with burlap. Paint cut roots of 1 inch diameter and larger with emulsified asphalt tree paint.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe Zone Bedding: Select mixture of graded crushed stone, free from organic, frozen or other deleterious and shall be supplied in graded 3/4 inch size, meeting the following gradation requirements (NJDOT Coarse Aggregate No. 57):

SIEVE	**PERCENT PASSING**
1-1/2”	100
1”	95 – 100
1/2”	25 – 60
No. 4	0 – 10
No. 8	0 - 5

B. Pipe Zone Backfill: Sound, durable sand, gravel, stone or blends of these materials, free from organic, frozen or other deleterious materials, meeting the following gradation requirements (NJDOT Soil Aggregate I-5):

SIEVE	PERCENT PASSING
2”	100
3/4”	70 – 100
No. 4	30 – 80
No. 50	10 – 35
No. 200	5 – 12

C. Sand Backfill (Water Service Installation): Provide material conforming to the requirements of NJDOT Section 901.13.B.

PART 3 - EXECUTION

3.1 PRECONSTRUCTION MATERIAL QUALIFICATION TESTING

A. General:

1. Sufficient size samples shall be obtained from the potential borrow source to allow completion of tests listed in paragraph B below. Samples may be obtained from test borings, test pits, or from borrow pit faces provided that surficial dry or wet soil is removed to expose undisturbed earth. Tests listed below shall be performed on each sample obtained. A minimum of three (3) representative samples from each potential borrow source shall be furnished to the testing laboratory for prequalification testing. Test data shall be provided to the Engineer a minimum of 2 weeks prior to construction for approval of borrow source. Three test reports completed within three months prior to construction may be submitted for commercial earth borrow sources or suppliers of stone products (crushed stone or graded stone products) in lieu of prequalification tests as approved by the Engineer.

B. Material Tests:

1. Particle Size Analysis:
   a. Method: ASTM D422.
   b. Number of Tests: One (1) per sample; three (3) per potential source.
   c. Acceptable Criteria: Gradation within specified limits.
2. Maximum Density Determination:
   a. Method: ASTM D1557 – Modified Proctor
   b. Number of Tests: One (1) per sample; three (3) per potential source.
3. Re-establish gradation and maximum density of fill material if source is changed during construction.

3.2 PREPARATION

A. Establish required lines, levels, contours and datum.

B. Maintain benchmarks and other elevation control points; re-establish if disturbed or destroyed at no additional cost to the Owner.

C. Establish location and extent of existing utilities prior to commencement of excavation.

3.3 EXCAVATION

A. All excavation shall be made to such depth as required and of the width shown on the Contract Drawings to provide suitable room for building the structures and laying the pipe(s) they are to contain and for sheeting, shoring, pumping and draining as necessary, and for removing peat, silt or any other materials which the Engineer may deem unsuitable. Hand trench excavation may be required to protect existing utilities and structures.

B. Trench excavation for pipes shall be made by open cut to accommodate the pipe or structure at the depths indicated on the Contract Drawings. Excavation shall be made to such a depth and to the width indicated on the Contract Drawings so as to allow a minimum of 8 inches of pipe zone bedding to be placed beneath the bottom of all structures and barrels, bells or couplings of all pipes installed unless otherwise specified on the drawings.

C. The bottom of the trench shall be accurately graded to provide a uniform layer of bedding materials, as required, for each section of pipe. Trim and shape trench bottoms and leave free of irregularities, lumps, and projections.

D. Stockpile excavated subsoil for reuse where directed or approved.

E. Over excavation/under cut: If, in the opinion of the Engineer, existing material below the trench grade is unsuitable for properly placing bedding material and laying pipe, the Contractor shall excavate and remove the unsuitable material and replace the same with an approved pipe zone bedding material properly compacted.

F. Stability of Excavation: Slope sides of excavations shall 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. Maintain sides and slopes of excavation in safe condition until completion of backfilling.

G. Removal of materials beyond the indicated subgrade elevations, without authorization by the Engineer, shall be classified as unauthorized excavation and shall be performed at no additional cost to the Owner.

3.4 DEWATERING

A. The Contractor shall remove all water from the excavation promptly and continuously throughout the progress of the work and shall keep the excavation dry at all times until the work is completed and excavation is backfilled or have sufficient weight to resist uplift pressures. Groundwater levels shall be depressed to a minimum of 2 feet below excavation subgrade. No pipe or structure is to be laid in water and water shall not be allowed to rise on or flow over any pipe or structure until such time as approved by the Engineer.

B. Provide a suitable point of discharge from dewatering operations shall be conveyed in a non-erosive manner satisfactory to the Engineer.

C. Precautions shall be taken to protect uncompleted work from flooding during storms or from other causes. All pipe lines or structures not stable against uplift during construction or prior to completion shall be thoroughly braced or otherwise protected.

3.5 BEDDING AND BACKFILLING

A. All pipe trenches backfill (pipe zone bedding, pipe zone backfill and trench backfill) shall be compacted by tamping or rolling to achieve a minimum dry density of 90 percent of the modified Proctor maximum dry density of the material used (ASTM D1557). Backfill in pipe trenches to be covered with pavement shall be compacted to a minimum of 95 percent of modified Proctor maximum dry density. Backfill materials shall be placed with water content within plus or minus 4 percent of optimum moisture content per the modified Proctor method (ASTM D1557). Any water used for compaction shall be provided by the Contractor at his own expense. The Contractor is responsible for the repair of any trench settlement at no expense to the Owner.

B. Bedding and backfilling shall be accomplished in three stages unless otherwise specified on the Contract Drawings. The first stage shall involve placement of "pipe zone bedding" as a layer(s) of selected material required to support, or to stabilize unsound or unsatisfactory foundation conditions. The second stage shall involve placement of "pipe zone backfill" from the top of the bedding material up to 1 foot above the pipe. The third stage involves the placement of "trench backfill" in the remainder of the trench up to the surface of the ground or the bottom of any special surface treatment subgrade elevation.

C. The bedding material shall be placed in the trench after the trench has been excavated a minimum of 8 inches below the bell of the pipe to permit the placing of not less than 8 inches of bedding material unless otherwise specified on the Contract Drawings. Where, in the opinion of the Engineer, more than 8 inches of bedding material shall be required, the excavation shall be performed and bedding placed to the depth ordered by the Engineer.

D. Provide uniform bearing and support for each section of pipe at every point along the entire length, except where necessary to excavate for bell holes, pipe joints, or other required connections. Dig bell holes and depressions for joints after trench bottom has been graded. Dig no deeper, longer, wider than needed to make the joint connection properly.

E. The bedding material shall be placed to the full width of trench. The bedding material shall be placed in loose lifts not exceeding 6 inches to the elevation shown on the Contract Drawings or directed by the Engineer. The bedding material shall be tamped and compacted to form a firm and even bearing surface.

F. Pipe zone backfill shall be placed to the elevation shown on the Contract Drawings in loose lifts no-to-exceed 6 inches in thickness, before compaction. The backfill shall be placed on both sides of the pipe at the same time and to approximately the same elevation. Any pipe that is damaged or moved out of alignment, regardless of cause, shall be replaced or realigned at the Contractor's expense. Each layer shall be thoroughly compacted by hand-tamping or mechanical means being careful not to damage the pipe. When the pipe zone backfill reaches 1 foot over the top of the pipe, the entire surface shall be compacted by mechanical means.

G. The remainder, if any, of the trench above the pipe zone backfill shall be backfilled with suitable material in loose lifts not exceeding 6 inches in thickness before compaction. Each layer shall be thoroughly compacted by mechanical means.

   1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

3.6 BACKFILLING AROUND STRUCTURES

A. The Contractor shall not place backfill against any structure without obtaining the approval of the Engineer. No dumping shall be allowed where materials would flow against or around such structures. Backfill material shall be deposited in horizontal layers not exceeding 6 inches in loose thickness or as shown on the Contract Drawings and thoroughly compacted by hand or by mechanical means to the satisfaction of the Engineer.

3.7 SUSPENSION OF WORK

A. Whenever the work is suspended, excavations shall be protected and the roadways, if any, left unobstructed. Within or adjacent to private property, material shall be stored at such locations as will not unduly interfere with traffic of any nature and in no case shall materials be stored in locations which will cause damage to existing improvements.

3.8 DISPOSAL OF MATERIAL

A. Excess and unsuitable materials shall be disposed of by the Contractor on the site in an area approved by the Engineer or legally disposed of off-site at the Contractor's expense.

3.9 FIELD QUALITY CONTROL

A. Notify the Engineer at least three (3) working days in advance of all phases of filling and backfilling operations.

B. In-place density testing shall be performed to ascertain the compacted density of the fill and backfill materials in accordance with the following method. Owner will provide and pay for all tests in connection with an approved independent testing facility.

1. In-place relative density: Method: AASHTO T238, Nuclear Method

C. Perform initial density testing to verify that contractors proposed compaction effort will obtain the minimum required densities.

D. In-place density tests on trench backfills shall be provided for every 500 cubic yards of fill and in vertical lifts no exceeding 2 feet, and at least once daily.

E. One particle size analysis (ASTM D422) and one modified Proctor compaction test (ASTM D1557) shall be completed for every 5,000 cubic yards or material placed.

F. The Engineer may direct additional tests to establish gradation, maximum density, and in-place density as required by working conditions, at the Contractor's expense.

G. Acceptance Criteria: The criteria for acceptability of in-place fill shall be in-situ dry density and moisture content. If a test fails to quality, the fill shall be further compacted and re-tested. Subsequent test failures shall be followed by removal and replacement of the material.

END OF SECTION

SECTION 312500 - SOIL EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section covers work necessary for stabilization of soil to prevent erosion and sedimentation during and after construction and land disturbing activities. The work shall include the furnishing of all labor, materials, tools, and equipment to perform the work and services necessary as herein specified and as indicated on the Drawings. This shall include installation, maintenance, and final removal of all temporary soil erosion and sediment control measures. All erosion and sediment control methods and devices used shall conform to the latest requirements imposed by federal, state and local authorities.

B. Comply with the latest version of "Standards for Soil Erosion and Sediment Control in New Jersey" by the NJ Soil Conservation Committee.

C. The minimum areas requiring soil erosion and sediment control measures are indicated on the Drawings. The right is reserved to modify the use, location, and quantities of soil erosion and sediment control measures based on activities of the Contractor and as the Engineer considers to be in the best interest of the Owner.

D. The Contractor shall be responsible for repair of any damaged caused and shall be financially responsible for any penalties imposed.

1.2 QUALITY ASSURANCE

A. Soil erosion and sediment control measures shall be implemented in accordance with the requirements and procedures outlined in this specification, contract drawings and documents, state standards or guidelines for soil erosion and sediment control, and all regulatory authorities having jurisdiction. Where conflicts between requirements exist, the more restrictive rules shall govern.

B. The contractor shall provide all temporary control measures shown on the drawings, or as directed by the Owner, Owner's representative, or soil conservation district for the duration of the contract. Erosion and sediment control drawings are intended to be a guide to address the stages of work shown. Additional measures not specified on the drawings may be necessary and shall be implemented to address intermediary stages of work and any conditions that may develop during construction at no cost to the Owner.

C. Temporary control provisions shall be coordinated with permanent erosion control features to the extent practical to assure economical, effective and continuous erosion and sediment control throughout the construction and post-construction period.

D. Soil erosion and sediment control measures shall at all times be satisfactory to the Owner's Representative. Owner's Representative will inform the Contractor of unsatisfactory construction procedures and operations if observed. If the unsatisfactory construction procedures and operations are not responded to and corrected within 48 hours, the Owner's Representative may suspend the performance of any or all other construction until the unsatisfactory condition has been corrected. Such suspension shall not be the basis of any claim by the Contractor for additional compensation nor for an extension of time to complete the work. Any complaints, fines, etc. relating to ineffective erosion control, shall be the sole responsibility of the Contractor.

E. The Contractor shall inspect all soil erosion and sediment control measures at least at the beginning and end of each day to ascertain that all devices are functioning properly during construction. Maintenance of all soil erosion and sediment control measures on the project site shall be the responsibility of the Contractor until final stabilization is complete, and until the permanent soil erosion controls are established and in proper working condition.

F. The Contractor shall protect adjacent properties and watercourses from soil erosion and sediment damage throughout construction.

1.3 GENERAL

A. Soil erosion stabilization and sediment control measures consist of the following elements:

1. Maintenance of existing permanent or temporary storm drainage piping and channel systems, as necessary.
2. Installation and maintenance of stabilized construction entrance(s).
3. Construction of new permanent and temporary storm drainage piping and channel systems, as necessary.
4. Construction of temporary erosion control facilities such as silt fences, check dams, etc.
5. Topsoil and Seeding: Placement and maintenance of Temporary Seeding on all areas disturbed by construction. Placement of permanent topsoil, fertilizer, and seed, etc., in all areas not occupied by structures or pavement, unless shown otherwise.
6. Soil Stabilization Seeding: Placement of fertilizer and seed, etc., in areas as Specified hereinafter.

B. The Contractor shall be responsible for phasing work in areas allocated for his exclusive use during this Project, including any proposed stockpile areas, to restrict sediment transport. This will include installation of any temporary erosion control devices, ditches, or other facilities.

C. The areas set aside for the Contractor's use during the Project may be temporarily developed to provide satisfactory working, staging, and administrative areas for his exclusive use. Preparation of these areas shall be in accordance with other requirements contained within these specifications and shall be done in a manner to both control all sediment transport away from the area.

D. Stockpiles remaining in place longer than 14 calendar days shall be considered permanent stockpiles for purposes of erosion and sediment control.

E. All permanent stockpiles shall be seeded with soil stabilization seed and protected by construction of silt fences completely surrounding stockpiles and located within 10 feet of the toes of the stockpile slopes.

F. Sediment transport and erosion from working stockpiles shall be controlled and restricted from moving beyond the immediate stockpile area by construction of temporary toe-of-slope ditches and accompanying silt fences as necessary. The Contractor shall keep these temporary facilities in operational condition by regular cleaning, re-grading, and maintenance.

G. The Contractor shall maintain all elements of the Soil Erosion Stabilization and Sedimentation Control systems and facilities to be constructed during this Project for the duration of his activities on this Project.

H. Formal inspections made jointly by the Contractor and the Engineer shall be conducted every 2 weeks to evaluate the Contractor's conformance to the requirements of these Specifications.

I. Replacement or repair of failed or overloaded silt fences, check dams, or other temporary erosion control devices shall be accomplished by the Contractor within 24 hours after receiving written notice from the Engineer.

J. If the Contractor has not complied with any of the above maintenance efforts to the satisfaction of the Engineer within 2 working days after receiving written notification from the Engineer, the Owner shall have the prerogative of engaging others to perform any needed maintenance or cleanup, including removal of accumulated sediment at constructed erosion control facilities, and deduct from the Contractor's monthly partial payment the costs for such efforts in accordance with the General Condition of the Contract.

1.4 SUBMITTALS

A. Submittals shall be made in accordance with Section "Submittal Procedures".

B. Material Certificates signed by material producer and Contractor, certifying that each material item complies with or exceeds specified requirements.

C. Results of all tests and investigations, including recommendations.

D. Submit product data, samples, specifications and manufacturer's installation procedures for approval as directed by Owner's Representative prior to use.

PART 2 - PRODUCTS

2.1 GENERAL

A. Contractor shall provide all materials necessary to perform the work in accordance with the SWPPP or as shown on the Drawings or specified herein.

2.2 PERMANENT SEED

A. Refer to Section "Turf and Grasses".

2.3 SOIL STABILIZATION AND TEMPORARY SEED

A. Temporary Seed: Rye grass, cereal grasses or other quick growing species suitable to the area as a temporary cover, which will not compete with the grasses specified for permanent cover, or as specified in the SWPPP or on the drawings.

2.4 TOPSOIL

A. Topsoil shall be specified under Section "Soil Preparation".

2.5 FETILIZER

A. Refer to Section "Turf and Grasses".

2.6 LIME

A. Ground dolomite limestone not less than 85 percent total carbonates and magnesium, ground so that 50 percent passes through a No. 100 mesh sieve and 90 percent passes a No. 20 mesh sieve. Coarser material will be acceptable provided the specified rates of application are increased proportionately on the basis of quantities passing the No. 100 mesh sieve.

2.7 STRAW MULCH

A. Threshed straw of oats, wheat, barley, or rye, free from seed of noxious weeds or clean salt hay.

2.8 EROSION CONTROL BLANKET

A. Erosion Control Blanket (ECB) shall be constructed with a layer of 70 percent straw and 30 percent coconut fiber stitched with degradable thread between a heavyweight UV stabilized polypropylene top net (3.0 pounds) and a lightweight photodegradable polypropylene bottom net (1.50 pounds). Both the netting and fiber materials shall be green in color. Acceptable products shall include SC150 Double Net Straw-Coconut Blanket as manufactured by North American Green; Curlex Double Net (Curlex II) as manufactured by American Excelsior Company or an approved equal.

2.9 TURF REINFORCEMENT MATS

A. Permanent Synthetic Turf Reinforcement Mat (TRM) shall be constructed of UV stabilized polypropylene fiber (0.70 pounds/square yard) stitched with permanent polypropylene thread between heavyweight UV stabilized polypropylene top net (5.0 pounds/1000 square feet approximate weight) and bottom net (3.0 pounds/1000 square feet approximate weight). Both the netting and fiber materials shall be green in color. Acceptable products shall include P300 Permanent Turf Reinforcement Mat as manufactured by North American Green; Recyclex TRM by American Excelsior Company or an approved equal.

2.10 HAY BALE

A. Bales shall be tightly bound, staked with 1 inch by 1 inch hardwood stakes. Hay shall be from mowings of acceptable herbaceous growth free from noxious weeds.

2.11 SILT FENCE

A. Silt Fence (SF) shall consist of woven geotextile fabric, posts, wire mesh backing, and fasteners meeting the requirements shown on the plan detail.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall comply with and implement the Stormwater Pollution Plan provided in the contract documents.

B. Review the soil erosion and sediment control drawings as they apply to current conditions. Any deviation from the drawings must be submitted for approval to the site Engineer in writing at least 72 hours prior to commencing that work.

C. Initial soil sediment and erosion control devices shall be in place prior to any land disturbing activity, in their proper sequence, and maintained until permanent protection is established.

D. The limit of the area of any earthwork operations in progress shall be commensurate with the Contractor's capability and progress in keeping the finished grading, mulching, seeding, and other such permanent control measures current and in accordance with the accepted schedule for construction phasing. Should seasonal limitations make such coordination unrealistic, as determined by the Owner's Representative, temporary erosion control measures shall be provided immediately by the Contractor at no expense of the Owner.

E. Temporary erosion control measures shall be used to correct conditions which develop during construction that are needed prior to installation of permanent control features, or that are temporarily needed to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

F. The Contractor shall incorporate all permanent erosion control features (stabilization) into the project at the earliest practical time to minimize the need for temporary controls.

G. A stabilized construction entrance (SCE) shall be installed and maintained at any point where construction vehicles enter a public right-of-way, street or parking area. The SCE shall be used to eliminate mud from the construction area onto public right-of-way. The SCE shall be constructed as shown on the drawings. Any mud or debris tracked on streets shall be cleaned up immediately.

H. Dust Control: The Contractor shall provide a commercial grade; enclosed broom mechanical street sweeper to control sediment and/or dust that is tracked on to the adjacent streets. The street sweeper shall be equipped with a water storage tank to wet the area prior to sweeping. Where on site controls do not prevent material from being tracked on to adjacent street, the street sweeper shall be used to clean the adjacent streets immediately. In addition, at a minimum, the adjacent streets shall be swept at the end of each day or as directed by the Engineer.

I. Any disturbed or stockpiled areas that will be left exposed more than 14 days or less according to State NPDES General Stormwater Permits shall immediately receive temporary or permanent seeding. Mulch/straw shall be used if the season prevents the establishment of a temporary cover. Disturbed areas shall be limed and fertilized prior to temporary seeding.

J. Permanent vegetation shall be established as specified on all exposed areas within 7 days or less according to State NPDES General Stormwater Permits after final grading. Mulch as necessary for seed protection and establishment. Lime and fertilize seedbed prior to permanent seeding.

K. Slopes shall be permanently seeded and mulched. Any slopes that erode easily shall be temporarily seeded and mulched. Any slopes deeper than 3:1 or steeper or as indicated on drawings shall be protected with Erosion Control Blanket per specifications.

L. All storm drainage outlets must be stabilized, as specified, before the discharge points become operational. Equip all inlets with inlet protection immediately upon construction.

M. Discharge from dewatering operations for the excavated areas shall not be directed to surface waters without first properly removing the suspended sediment through filtration and/or settlement. The Contractor shall obtain any required permits associated with dewatering activities.

N. Silt fence shall be installed at locations on the drawings and any additional location necessary for proper sediment control. The Contractor shall maintain the silt fence until the project is stabilized and shall remove and dispose of the silt fence and silt accumulation when 1/3 the height of the fence is reached.

O. Soil erosion and sediment control shall include but not be limited to the approved measures. The Contractor shall be responsible for providing all additional measures that may be necessary to accomplish the intent of the drawings.

P. Comply with all other requirements of authorities having jurisdiction.

Q. Soil Stabilization and Temporary Seeding:

1. Soil stabilization seeding shall consist of the application of the following materials in quantities as further described herein for stockpiles and disturbed areas left inactive for more than 14 days.
   a. Lime.
   b. Fertilizer.
   c. Seed.
   d. Mulch.
   e. Maintenance.
2. Hydroseeding will be permitted as an alternative method of applying seed and associated soil conditioning agents described above. Should the Contractor elect to apply soil stabilization seeding by hydroseeding methods, he shall submit his operational plan and methods to the Engineer.
3. Temporary Seeding is to be placed and maintained over all disturbed areas prior to Permanent Seeding. Maintain Temporary Seeding until such time as areas are approved for Permanent Seeding. As a minimum, maintenance shall include the following:
   a. Fix-up and reseeding of bare areas or re-disturbed areas.
   b. Mowing for stands of grass or weeds exceeding 6 inches in height.

R. Topsoil and Permanent Seeding: conform to the requirements of Section "Soil Preparation" and "Turf and Grasses".

END OF SECTION

SECTION 315000 – EXCAVATION SUPPORT AND PROTECTION

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes, but is not limited to, the following:
   1. Shoring and bracing necessary to protect existing buildings, streets, walkways, utilities, and other improvements and excavation against loss of ground or caving embankments.
   2. Maintenance of shoring and bracing.
   3. Removal of shoring and bracing, as required.

B. The purpose of this work is to insure the safety of workmen and the public exposed to the hazard of falling or sliding material. It shall be the Contractor's responsibility to provide protection adequate for this purpose. Details of this sheeting must conform with the requirements of Title 29 Code of Federal Regulations, Part 1926, Safety and Health Regulations for Construction (OSHA). The Engineer shall reserve the right to increase the minimum requirements set forth therein, depending on the hazard.

1.2 PERFORMANCE REQUIREMENTS

A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.
   1. Delegated Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
   2. Prevent surface water from entering excavations by grading, dikes, or other means.
   3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
   4. Monitor vibrations, settlements, and movements.

1.3 SUBMITTALS

A. Delegated-Design Submittal: For excavation support and protection system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

B. Layout drawings for excavation support system and other data prepared by, or under the supervision of, a qualified professional engineer.

C. System design and calculations must be acceptable to local authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Engineer Qualifications: A professional engineer legally authorized to practice in jurisdiction where Project is located, and experienced in providing successful engineering services for excavation support systems similar in extent required for this Project.

B. Regulations: Comply with codes and ordinances of governing authorities having jurisdiction.

1.5 PROJECT CONDITIONS

A. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the data

1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection.
2. The geotechnical report is [included] [referenced] elsewhere in the Project Manual.

B. Before starting work, verify governing dimensions and elevations. Verify condition of adjoining properties. Take photographs or video tape to record any existing settlement or cracking of structures, pavements, and other improvements. Prepare a list of such damages, verified by dated photographs or video tape, and signed by Contractor and others conducting investigation.

C. During excavation, resurvey benchmarks weekly, maintaining accurate log of surveyed elevations for comparison with original elevations. Promptly notify Engineer if changes in elevations occur or if cracks, sags, or other damage is evident.

D. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

1.6 EXISTING UTILITIES

A. Protect all existing active utility services and structures.

B. Notify municipal agencies and service utility companies having jurisdiction. Comply with requirements of governing authorities and agencies for protection, relocation, removal, and discontinuing of services.

C. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify **Engineer and Owner no fewer than two** (2) days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without **Owner's** written permission

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 GENERAL

A. In general, this item will be required wherever an excavation exceeds five feet in depth and the side slopes are not laid back to a safe gradient as set forth in Title 29 Code of Federal Requirements, Part 1926, Safety and Health Regulations for Construction (OSHA).

B. Wherever shoring is required, locate the system to clear permanent construction and to permit forming and finishing of concrete surfaces. Provide shoring system adequately anchored and braced to resist earth and hydrostatic pressures.

3.2 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.

1. Remove excavation support and protection systems to a minimum depth of 48 inches (1200 mm) below overlaying construction and abandon remainder.
2. Fill voids immediately with approved backfill compacted to density specified in Section "Earth Moving" or “Trenching and Backfilling”.
3. Repair or replace, as approved by Engineer adjacent work damaged or displaced by removing excavation support and protection systems.
4. Leave excavation support and protection systems permanently in place.

END OF SECTION

SECTION 321116 - SUBBASE COURSES

PART 1 - GENERAL

1.1 SUMMARY

A. The work shall consist of furnishing, placing and compacting pavement subbase courses under roadway pavements and walks where indicated on the Contract Documents.

B. Proof rolling of subgrade for walks and pavements is included in this section.

C. Final grading of pavement subbase is specified in this section.

D. Replacement of unsuitable subgrade materials is included in Section "Earth Moving."

1.2 REFERENCES

A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. NJDOT Standard Specifications Division 300 "Subbase and Base Course".
   2. "Standard Specifications for Highway Materials and Methods of Sampling and Testing, American Association of State Highway and Transportation Officials (AASHTO)."
   3. American Society for Testing and Materials (ASTM).

1.3 SUBMITTALS

A. Source Quality Control Test Reports: Submit test reports directly to Engineer from the testing agency, with copy to Contractor.

B. Field Testing Reports: Submit results of field testing directly to Owner and Engineer with copy to Contractor. Reference testing location to plan, and cross-reference to all retesting required to accept installed subbase material.
   1. Note action taken next to all sub-standard test results.

1.4 QUALITY ASSURANCE

A. Testing Laboratory Qualifications: To qualify for acceptance, the soil testing laboratory must demonstrate to Engineer's satisfaction, based on evaluation of laboratory-submitted criteria conforming to the latest ASTM requirements governing such work, that it has the experience and capability to conduct the required testing without delaying the progress of the Work.

B. Field Testing and Inspection Service: Contractor shall retain the services of an independent soil testing laboratory used for source qualification testing.

C. Owner will provide soil testing during pavement subbase installation.

PART 2 - PRODUCTS

2.1 SOURCE QUALIFICATION TESTING

A. Contractor shall employ and pay for a qualified independent soil testing laboratory to perform soil testing services for source qualification.

1. Obtain a 100-pound minimum representative sample from each potential borrow source. Obtain samples for each different material gradation known to exist in the pit. Mix each sample thoroughly in accordance with AASHTO T87, and submit to the testing laboratory for reduction to specimen size. The laboratory shall perform the following tests in the order shown. Each material shall pass all tests in order to qualify.

a. Particle Size Analysis:

(1) Method: ASTM D422.

(2) Number of Tests: Two (2) per potential source.

(3) Acceptance Criteria: Gradation within specified limits.

b. Plasticity Index Determination:

(1) Method: ASTM D424.

(2) Number of Tests: One (1) per particle size analysis on material passing no 40 mesh

(3) Acceptance Criteria: Plasticity Index within specified limits.

c. Maximum Density Determination:

(1) Method: ASTM D1557 Modified Proctor.

(2) Number of Tests: Two (2) per potential source.

B. NJDOT Pre-Qualified Material Sources: Contractor may submit, in lieu of independent laboratory test results, a copy of recent NJDOT Materials Bureau certification of proposed source.

1. Engineer may require additional testing by an independent testing laboratory when:

a. The latest test for the source is two (2) years old.

b. A change in the character of the material occurs.

c. The Engineer determines that additional testing is necessary due to the observed properties of the supplied material.

2.2 MATERIALS

A. Gradation for dense graded aggregate subbase course shall conform to NJDOT Standard Specification 910.10 “Dense Graded Aggregate” meeting the following gradation:

SIEVE SIZE	TOTAL PERCENT PASSING BY WEIGHT
1-1/2”	100
3/4"	55 – 90
No. 4	25 – 50
No. 50	5 – 20
No. 200	3 – 10

1. The portion passing the No. 40 sieve shall be non-plastic when tested in accordance with AASHTO T 90.

PART 3 - EXECUTION

3.1 PREPARATION

A. Establish required lines, levels, contours, and datum.

B. Maintain benchmarks and other elevation control points. Re-establish, if disturbed or destroyed at no additional cost to the Owner.

C. Proof-roll existing subgrade to the satisfaction of the Engineer. Replace unstable or weak subgrade materials with suitable material as provided in the Specifications.

3.2 INSTALLATION

A. Place subbase material in uniform horizontal layers, with a maximum compacted thickness of 6 inches.

B. Place subbase in a manner to avoid segregation. Uncontrolled spreading shall not be permitted.

C. If, in the opinion of the Engineer, existing material below the subgrade is unsuitable for properly placing the pavement subbase and asphalt pavement, the Contractor shall excavate and remove the unsuitable material, as directed by the Engineer. The Contractor shall then replace the over-excavated area with an approved fill material or additional pavement subbase, properly compacted, as approved by the Engineer.

D. Where ordered by the Engineer or shown on the Drawings, pavement subbase material shall be installed as trench backfill.

3.3 COMPACTION

A. Where subbase courses must be moisture-conditioned before compaction, uniformly apply water to the surface. Prevent free water from appearing on the surface during or subsequent to compaction operations.

B. Compact all portions of each layer to a density not less than 100 percent of the maximum density.

C. Do not cease compaction until the top surface of the subbase course does not extend more than 1/4 inch above nor more than 1/4 inch below the specified grade at any location.

3.4 TRAFFIC ON SUBBASE

A. The movement of vehicular traffic over the final surface of the subbase may be permitted at locations designated by, and under such restrictions as ordered by the Engineer, provided such movements take place prior to the final finishing of this course to the specified tolerance. The movement of construction equipment on this course may be permitted, at locations designated by and under such restrictions as ordered by the Engineer. At locations where permission is granted for such movement, the temporary surface of the course upon which the construction traffic is running, shall be placed and maintained at least 2 inches above the final surface of the course. Just prior to paving, and after all construction traffic not required for the removal, has ceased, remove the 2 inch protective layer, prepare the exposed surface of the course, and compact to the specified tolerance.

B. Should the subbase become mixed with the subgrade or any other material, through any cause whatsoever, remove such mixture and replace it with the specified subbase material.

3.5 FIELD QUALITY CONTROL

A. Notify the Engineer at least one (1) working day in advance of all phases of subbase installation.

B. Comply with the requirements of this Section for in-place relative density testing.

1. In-place relative density:

a. Method:

(1) AASHTO T191, Sand Cone Method.

(2) AASHTO T238, Nuclear Method.

b. Number of Tests: One (1) per specified interval.

c. Acceptance Criteria: ±2 percent of specified percent compactions.

2. Compaction tests shall be provided for every 150 cubic yards of fill for each lift.

3. The Engineer may direct additional tests to establish gradation, maximum density, and in-place density as required by working conditions.

4. Acceptance Criteria: The sole criterion for acceptability of in-place subbase shall be in situ dry density. Minimum dry density for all subbase shall be 100 percent of the maximum dry density. If a test fails to qualify, the fill shall be further compacted and re-tested. Subsequent test failures shall be followed by removal and replacement of the material.

END OF SECTION

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes provisions for hot-mixed asphalt concrete paving over prepared subbase.

B. This section includes provisions for replacing pavement removed during the course of the Work, or damaged resulting from Contractor's operations.

1.2 REFERENCES

A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:

1. 2007 NJDOT Standard Specifications, Section 401 "Hot Mix Asphalt Courses".
2. "Standard Specifications for Highway Materials and Methods of Sampling and Testing, American Association of State Highway and Transportation Officials (AASHTO)".
3. American Society for Testing and Materials (ASTM).

1.3 SUBMITTALS

A. Material Certificates signed by material producer and Contractor, certifying that each material item complies with or exceeds specified requirements.

B. Field Test Reports: Submit results of field testing directly to the Engineer.

1.4 SITE CONDITIONS

A. Weather Limitations: Apply tack coats when ambient temperature is above 50°F (10°C) and when temperature has not been below 35°F (1°C) for 12 hours immediately prior to application. Do not apply when base is wet or contains an excess of moisture.

B. Construct hot-mixed asphalt concrete surface course when atmospheric temperature is above 40°F (4°C) and when base is dry. Base course may be placed when air temperature is above 30°F (minus 1°C) and rising.

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

D. In no instance shall the materials and thicknesses of pavement and subbase courses replaced be less than that removed, unless approved by the Engineer.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate the placement of asphalt concrete pavement with the completion of underground work by other trades.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Subbase course shall be in accordance with Section "Subbase Courses".

B. Base Course – HMA 19M64, see NJDOT Standard Specification Section 902.02.

C. Prime Coat – Cut back asphalt, Grade MC-30, see 2007 NJDOT Standard Specification Section 902.01.02.

D. Surface Course – HMA 12.5M64, see NJDOT Standard Specification Section 902.02.

E. Tack Coat – Emulsified asphalt, Grade RS-1, see 2007 NJDOT Standard Specification Section 902.01.03.

F. General – Asphalt and all related items shall meet the requirements of 2007 NJDOT Standard Specifications, Section 401.

PART 3 - EXECUTION

3.1 GENERAL

A. Asphalt shall not be applied on a wet surface or when the combinations of laydown and base surface temperatures are within NJDOT Standard Specification Subsection 401.03.03, unless otherwise directed, or when weather conditions would prevent proper construction.

B. All application equipment, methods, and installation shall conform to NJDOT Standard Specification Section 401, unless otherwise specified.

3.2 PREPARATION

A. The subbase shall be placed and compacted true to line and grade as shown on the drawings and conforming to Section "Subbase Courses".

B. Proof roll prepared subbase surface with a 10 ton static steel wheel roller, to check for unstable or otherwise unsuitable areas, as determined by the Engineer. Replace and recompact all unsatisfactory areas, as approved by the Engineer, prior to commencement of paving operations.

C. Notify the Engineer 48 hours prior to commencing paving.

D. Apply prime coat, at a rate of 0.1 to 0.35 gallons per square yard, to contact surfaces of previously constructed asphalt or Portland cement concrete and surfaces abutting or projecting into the asphalt pavement.

E. Apply tack coat, at a rate of 0.02 to 0.08 gallons per square yard, to contact surfaces of previously constructed asphalt or Portland cement concrete and surfaces abutting or projecting into the asphalt pavement.

3.3 INSTALLATION

A. Place and compact asphalt pavement courses in accordance with NJDOT Standard Specification Section 401, unless specified.

B. Place inaccessible and small areas by hand, and compact with hot hand tampers or vibrating plate compactors.

C. Compaction shall be by means of static steel wheel roller only, unless otherwise approved by the Engineer, based upon work conditions.

D. If during placement of any asphalt course the mixture or surface is deemed unsatisfactory by Engineer, such areas shall be removed and patched at the Contractor's expense. Removal of hardened or set asphalt shall be by saw cutting.

E. Tack coat shall be placed between successive courses if more than 48 hours have elapsed after placing the preceding course.

F. The asphalt course shall be rolled/compacted until the finished surface is free from depressions, waves or other defects that would prevent proper drainage. The finished surface shall be uniform in texture and appearance.

G. After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Prior to installing tack coat and/or pavement against any existing surfaces (pavement, curbs, manhole frames, etc.), the existing surfaces shall be cleaned free of dirt or any other substances which would prevent bonding with the new pavement.

END OF SECTION

SECTION 321613.16 CONCRETE CURB

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section includes the installation of concrete curbing as shown on the Drawings or as specified herein.

B. The materials and methods specified herein are directly intended for placement of "new" concrete curbing. Where existing curbing is removed and replaced during construction, modifications to these specifications to match existing conditions shall be made as directed by the Engineer.

1.2 QUALITY ASSURANCE

A. Reference Standards:
   1. The latest edition of the following standards, as referenced herein, shall be applicable.
      a. This section supplements Section 607 "Curb", of the NJDOT Standard Specifications.
      b. American Society of Testing and Materials (ASTM).
      c. American Concrete Institute (ACI).

B. The Owner shall provide and pay for all costs in connection with an approved independent testing facility to determine conformance of materials with the specifications, if at any time during the Work, materials appear unsuitable in the opinion of the Engineer.

1.3 SUBMITTALS

A. Concrete:
   1. The Contractor shall furnish the name and location of the concrete supplier.
   2. Submit the design mix for each class of concrete prior to use in the Work.

B. Product Data:
   1. Submit manufacturer's catalog cuts, specifications, and installation instructions.

C. Test Results:
   1. The testing laboratory shall submit written reports of all tests, investigations, and recommendations to the Contractor and Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete:
   1. Concrete shall be as shown on the Drawings and Class B concrete in accordance with Section 903.03 of the NJDOT Standard Specifications with a 28 day compressive strength of 4,000 psi.
   2. Concrete shall be proportioned using methods 1 or 2 as outlined in ACI-301.
   3. The approved mix design shall be used throughout this project unless changes are ordered or approved by the Engineer.

B. Premoulded Expansion Joint Filler:

1. Concrete curbing shall be provided with a 1/2 inch premoulded expansion joint filler conforming to ASTM D 1751.
2. The premoulded expansion joint filler shall be "pre-cut" to match the concrete curbing cross-sectioned dimensions as detailed on the Drawings.

C. Curing Materials: See NJDOT Standard Specification Section 903.10.

D. Sealants: Joint Sealers: ASTM D 1850.

E. Forms:

1. Curb forms shall be of wood or steel, straight, and of sufficient strength to resist springing during depositing and consolidating the concrete. The outside forms shall have a height equal to the full depth of the curb. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form.
2. Straight forms of wood shall be surfaced plank, 2 inch nominal thickness, straight and free from warp, twist, loose knots, splits, or other defects. Wood forms shall have a nominal length of 10 feet, with a minimum of three stakes per form, at maximum spacing of 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Radius bends may be formed with 3/4 inch boards, laminated to the required thickness.
3. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Form ends shall be interlocked and self- aligning. Forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Forms shall have a nominal length of 10 feet, with minimum of two welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips, designed for use with steel forms.
4. Rigid forms shall be provided for curb returns, except that benders of thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together.

PART 3 - EXECUTION

3.1 INSPECTION

A. The Contractor shall notify the Engineer 24 hours before placing concrete in order to give the Engineer an opportunity to inspect the formwork and related items prior to placement of the concrete.

B. Delivery tickets shall show the amount of cement, brand, and amount of all admixtures, in addition to information required by ASTM C94, Section 14. Water added on the job shall be approved and the amount noted on the delivery ticket and initialed by the Contractor.

3.2 SUBBASE PREPARATION

A. Concrete curbing shall be constructed on a compacted granular subbase as shown on the Drawings.

B. The subbase shall be maintained in a smooth, compacted condition in conformity with the required section and established grade, until the concrete is placed.

C. The subbase shall be in a moist condition when concrete is placed.

D. The subbase shall be prepared and protected so as to produce a subbase free from frost when the concrete is deposited.

3.3 FORMWORK

A. Earth cuts may not be used as forms for vertical surfaces.

B. All forms shall be built mortar tight and of materials sufficient in strength to hold concrete without bulging between supports. Forms shall be maintained to eliminate the formation of joints due to shrinkage of the forms. Concrete, misshapen by bulges or deformations caused by inadequate forms, shall be removed or corrected as ordered by the Engineer. All replacements or corrections shall be made at the Contractor's expense.

C. All surfaces of wooden forms that will be in contact with exposed concrete shall be thoroughly treated with an approved lacquer in the procedure recommended by the manufacturer. Forms so treated shall be protected from being damaged or dirtied prior to placing of the concrete.

D. Metal forms shall be treated with an approved form lacquer or may be treated with an approved form oil. The metal used for forms shall be of sufficient thickness to remain true to shape. All bolt and rivet heads shall be designed to hold the forms rigidly together and to allow removal, without injury to the concrete. Metal forms which do not have smooth surfaces, correct alignment and clean surfaces shall not be used.

E. The forms on the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished as specified for concrete finishing.

3.4 CONCRETE PLACEMENT AND FINISHING

A. Preparation:
1. Set approved forms true to line and grade. Cast curb in 20 foot long sections. If curbs abut existing pavement, locate construction joints opposite existing pavement joints as directed.
2. Provide cut to size joint filler between 20 foot sections and where curb abuts existing concrete paving and fixed structures or appurtenances. Protect the top edge of the joint filler during concrete placement with a temporary cap and remove after concrete has been placed.
3. Expansion joints shall be constructed at right angles to the line of the curb.

B. Concrete Placement:
1. Concrete shall be placed in layers not to exceed 6 inches.
2. Concrete shall be thoroughly consolidated by tamping and spading or with approved mechanical vibrators, eliminating all air pockets, stone pockets and honeycombing.
3. Place concrete in accordance with ACI 301 unless otherwise specified herein.
4. Cold Weather Concreting: Comply with ACI 306 for placement at temperatures of, or expected to be, below 40˚F.
5. Hot Weather Concreting: Comply with ACI 305 for placement at temperatures of, or expected to be, above 90˚F.

C. Concrete Finishing:
1. The top of the curb shall be rounded with an edging tool to a radius of 1/2 inch and the surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes.

2. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The surface, while still wet, shall be brushed in the same manner as the curb top. Except at grade changes or curbs, finished surfaces shall not vary, from the testing edge of 10 foot straightedge, more than 1/8 inch for gutter and entrance and 1/4 inch from top and face of curb. Irregularities exceeding the above shall be satisfactorily corrected.
3. Visible surfaces and edges of finished curb shall be free of blemishes and form and tool marks, and shall be uniform in color, shape, and appearance.
4. No plastering shall be permitted.
5. Curbing forms shall be left in place at least 24 hours, or until the concrete has sufficiently set so that, in the opinion of the Engineer, the forms can be removed without injury to the curbing.

3.5 CURING

A. See NJDOT Standard Specifications Subsection 607.

3.6 SEALING JOINTS

A. The approximately horizontal sections of expansion joints shall be sealed with joint sealer. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing shall be done so that the material will not be spilled on exposed surfaces of the concrete.

B. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50ºF at the time of application of joint-sealing materials. Excess material on exposed surfaces of the concrete shall be removed immediately and exposed concrete surfaces cleaned.

3.7 BACKFILLING AND RESTORATION

A. After curing, debris shall be removed, and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

B. All lawns, pavements, driveways, shrubs, or other improvements affected by curbing placement shall be restored to their original condition.

3.8 PROTECTION

A. The Contractor shall protect the curbing and keep it in alignment and “first class” condition until the completion of the Contract. Any curbing, which is damaged prior to final acceptance of the Work, shall be removed and replaced at the Contractor’s expense.

END OF SECTION

SECTION 321630 CONCRETE SIDEWALKS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the installation of concrete sidewalk and concrete driveway apron as shown on the Drawings, or as specified herein.

B. The materials and methods specified herein are directly intended for placement of "new" concrete sidewalk. Where existing sidewalk is removed and replaced during construction, modifications to these specifications to match existing conditions shall be made as directed by the Engineer.

1.2 QUALITY ASSURANCE

A. Reference Standards:
1. The latest edition of the following standards, as referenced herein, shall be applicable.
a. "NJDOT Standard Specifications", Section 606 "Sidewalks, Driveways, and Islands".
b. American Society of Testing and Materials (ASTM).
c. American Concrete Institute (ACI).

B. The Owner shall provide and pay for all costs in connection with an approved independent testing facility to determine conformance of materials with the specifications, if at any time during the Work, materials appear unsuitable in the opinion of the Engineer.

1.3 SUBMITTALS

A. Detectable Warning Surface:
1. Detectible warning surface shall be cast in place units. Warning surface shall be Cast in Place Replaceable system as manufactured by ADA Solutions, Inc., or approved equal.

B. Concrete:
1. The Contractor shall furnish the name and location of the concrete supplier.
2. Submit the design mix for each class of concrete prior to use in the Work.

C. LEED Submittals:
1. 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.
2. Design Mixtures for Credit ID 1: For each concrete mixture containing fly ash as a replacement for Portland cement or other Portland cement replacements. For each design mixture submitted, include an equivalent concrete mixture that does not contain Portland cement replacements, to determine amount of Portland cement replaced.

D. Product Data:
1. Submit manufacturer's catalog cuts, specifications, and installation instructions.

E. Test Results:
1. The testing laboratory shall submit written reports of all tests, investigations, and recommendations to the Contractor and the Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete:

1. All cast-in-place concrete shall be ready mixed concrete meeting the following criteria (NJDOT Standard Specifications Class B Concrete, Tables 903.03.06-1 and 903.03.06-2):

a. 28 day compressive strength: 4,500 psi.

b. Air entrainment: 6 percent.

c. Slump: 4 inch.

d. Total weight of cementitous materials shall be in accordance with ACI Table 4.2.3 "Requirements for Concrete Exposed to Deicing Chemicals."

B. Premoulded Expansion Joint Filler:

1. Concrete curbing shall be provided with a 1/2 inch premoulded expansion joint filler conforming to ASTM D1751.

2. The premoulded expansion joint filler shall be “pre-cut” to match the concrete sidewalk cross-sectioned dimensions as detailed on the Drawings.

C. Fabric Reinforcement:

1. Flat sheets of 6 by 6 - W 2.9 x W 2.9, ASTM A185, welded wire fabric.

D. Sealants:

1. Joint Sealers: NJDOT Standard Specification Section 914.02 “Joint Sealer.”

E. Forms:

1. Sidewalk forms shall be of wood or steel, straight of sufficient strength to resist springing during depositing and consolidating concrete, and of a height equal to the full depth of the finished sidewalk.

2. Wood forms shall be surfaced plank, 2 inch nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 10 feet, with a minimum of three stakes per form, at maximum spacing of 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Radius bends may be formed with 3/4-inch boards, laminated to the required thickness.

3. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Form ends shall be interlocked and self- aligning. Forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Forms shall have a nominal length of 10 feet, with a minimum of two welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips, designed for use with steel forms.

PART 3 - EXECUTION

3.1 INSPECTION

A. The Contractor shall notify the Engineer 24 hours before placing concrete in order to give the Engineer an opportunity to inspect the formwork, reinforcing and related items prior to placement of the concrete.

B. Delivery tickets shall show the amount of cement, brand, and amount of all admixtures, in addition to information required by ASTM C94, Section 14. Water added on the job shall be approved and the amount noted on the delivery ticket and initialed by the Contractor.

3.2 SUBBASE PREPARATION

A. Concrete sidewalk shall be constructed on a compacted granular subbase as shown on the Drawings.

B. The completed subbase shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

C. The subbase shall be maintained in a smooth, compacted condition in conformity with the required section and established grade, until the concrete is placed.

D. The subbase shall be in a moist condition when concrete is placed.

E. The subbase shall be prepared and protected so as to produce a subbase free from frost when the concrete is deposited.

3.3 FORMWORK

A. Earth cuts may not be used as forms for vertical surfaces.

B. All forms shall be built mortar tight and of materials sufficient in strength to hold concrete without bulging between supports. Forms shall be maintained to eliminate the formation of joints due to shrinkage of the forms. Concrete, misshapen by bulges or deformations caused by inadequate forms, shall be removed or corrected as ordered by the Engineer. All replacements or corrections shall be made at the Contractor's expense.

C. All surfaces of wooden forms that will be in contact with exposed concrete shall be thoroughly treated with an approved lacquer in the procedure recommended by the manufacturer. Forms so treated shall be protected from being damaged or dirtied prior to placing of the concrete.

D. Metal forms shall be treated with an approved form lacquer or may be treated with an approved form oil. The metal used for forms shall be of sufficient thickness to remain true to shape. All bolt and rivet heads shall be designed to hold the forms rigidly together and to allow removal, without injury to the concrete. Metal forms which do not have smooth surfaces, correct alignment and clean surfaces shall not be used.

E. Side forms shall not be removed for less than 12 hours after finishing has been completed.

3.4 CONCRETE PLACEMENT AND FINISHING

A. Preparation:

1. Set forms true to line and grade and anchor rigidly in position.
2. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Longitudinal expansion joints shall be installed between concrete sidewalk and abutting concrete curb, continuously. Transverse expansion joints shall be installed equally at not more than 25 feet on center, unless otherwise directed by the Engineer, or as detailed on the Drawings.

3. Transverse expansion joints shall be filled with 1/2 inch joint filler strips. Joint filler shall be placed with top edge 1/4 inch below the surface and shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Protect the top edge of the joint filler during concrete placement with a temporary cap and remove after concrete has been placed.
4. Expansion joints shall be formed about structures and features that project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. The filler shall be installed in such manner as to form a complete, uniform separation between the structure and sidewalk pavement.

B. Placement of Fabric Reinforcement:
1. Prior to placement, clean reinforcement thoroughly of mill and rust scale and of coatings which could destroy or reduce bond. Where there is a delay in depositing concrete after the positioning of reinforcement, reclean reinforcement, if necessary.
2. Place reinforcement midway between top and bottom of the slab and secure against displacement.
3. Lap edges and ends of adjoining sheets of fabric reinforcement at least half the mesh width. Offset end laps in adjacent sheets to prevent continuous joints at ends. Interrupt reinforcement at expansion joints, stopping 2 inches from edges.

C. Concrete Placement:
1. Concrete shall be placed in the forms in one layer of such thickness that when compacted and finished the sidewalk will be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted.
2. The concrete shall be tamped and consolidated with a suitable wood or metal tamping bar, and the surface shall be finished to grade with a wood float. Finished surface of the walk shall not vary more than 3/16 inch from the testing edge of a 20 foot straightedge.
3. Irregularities exceeding the above shall be satisfactorily corrected. The surface shall be divided into rectangular areas by means of contraction joints spaced at intervals shown on the drawings.
4. Place concrete in accordance with ACI 301 unless otherwise specified herein.
5. Cold Weather Concreting: Comply with ACI 306 for placement at temperatures of, or expected to be, below 40°F.
6. Hot Weather Concreting: Comply with ACI 305 for placement at temperature of, or expected to be, above 90°F.

D. Concrete Finishing:
1. After straight edging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, or as otherwise shown on the drawings.
2. All slab edges, including those at formed joints, shall be finished carefully with an edger having a radius of 1/8 inch. Corner and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.
3. The completed surface shall be uniform in color and free of surface blemishes and tool marks.
4. Scoring (grooving) shall be in accordance with NJDOT Standard Specification Section 606.
5. Provide 4 inch wide area parallel to and on each side of each score joint and expansion joint.

3.5 CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 pounds/square feet x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete in accordance with NJDOT Standard Specifications, Section 606.

3.6 SEALING JOINTS

A. At the end of the curing period, expansion joints shall be carefully cleaned and filled with joint sealer. Concrete at the joint shall be surface dry, and the atmospheric and pavement temperatures shall be above 50˚F, at the time of application of joint sealing materials.

B. Joints shall be filled flush with the concrete surface in such manner as to minimize spilling on the walk surface. Spilled sealing material shall be removed immediately and the surface of the walk cleaned. Dummy groove joints shall not be sealed.

3.7 CURB RAMPS

A. Curb ramps and curb ramp delineation shall be installed to the dimensions shown on the plans and details.

3.8 BACKFILLING AND RESTORATION

A. After curing, debris shall be removed, and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

B. All lawns, pavements, driveways, shrubs, or other improvements affected by sidewalk placement shall be restored to their original condition.

3.9 PROTECTION

A. The Contractor shall protect the curbing and keep it in alignment and “first class” condition until the completion of the Contract. Any curbing, which is damaged prior to final acceptance of the Work, shall be removed and replaced at the Contractor’s expense.

END OF SECTION

SECTION 321813 - SYNTHETIC TURF PLAYING FIELD SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. ***The owner will provide the synthetic turf, rubber and sand infill materials through a cooperative purchase agreement.*** The contractor shall provide all the labor and equipment to install the owner provided Synthetic Turf Field System including but not limited to::

1. The synthetic turf, inlays, painted lines, any finish work, rubber and sand infill, perimeter anchor system, edge drains, dynamic stone base, panel drains and geotextile**.**

1.2 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern.

1. American Association of State Highway and Transportation Officials (AASHTO):
   a. T 89 - Determining the Liquid Limit of Soils.
   b. T 90 - Determining the Plastic Limit and Plasticity Index of Soils.
2. Occupational Safety and Health Administration (OSHA).
3. Department of Transportation Standard Specifications
4. American Society for Testing and Materials (ASTM):
   a. D 395 - Rubber Property – Compression Test.
   b. D 418 - Pile Yarn Floor Covering Construction.
   c. D 2256 - Breaking Load (Strength) and Elongation of Yarn by the Single-Strand Method.
   d. D 3776 - Mass Per Unit Area (Weight) of Woven Fabric.
   e. D 3786 - Hydraulic Bursting Strength of Knitted Goods and Non-Woven Fabrics: Diaphragm Bursting Strength Tester Method.
   f. D 4491 - Water Permeability of Geotextiles by Permitivity.
   g. D 4533 - Trapezoid Tearing Strength of Geotextiles.
   h. D 4632 - Breaking Load and Elongation of Geotextiles (Grab Method).
   i. D 4833 - Index Puncture Resistance of Geotextiles, Geo-membranes, & Related Products.
   j. F 355 - Shock Absorbing Properties of Playing Surface Systems and Materials.
   k. F 405 - Corrugated Polyethylene (PE) Tubing and Fittings.
   l. F 449 - Subsurface Installation for Agricultural Drainage or Water Table Control.
   m. F 667 - 8, 10, 12 and 15-inch Corrugated Polyethylene Tubing and Fittings.
5. Current “NCAA” playing rules for soccer.

1.3 DEFINITIONS

A. Subgrade: The undisturbed earth or the compacted soil layer immediately below proposed drainage fill or playing field materials.

B. Dynamic Stone Base & Topping Stone: As required by section “Athletic Field Subsurface Drainage System” and in conformance with manufacturers requirements.

1.4 SUBMITTALS

A. Manufacturer's Product Data: Submit manufacturer's specifications and installation instructions for all products in the playing field system, including certifications and other data as may be required to show compliance with the Contract Documents. Included but not limited to the following; drainage pipe material, panel drains, geotextile fabric perimeter turf anchoring system, irrigation system heads, valves, boxes, fittings, wire connectors, pipe and appurtenances, goal post system and foundation sleeve and dynamic stone base.

B. Material Certifications: Manufacturer's or vendor's certified analysis for rubber and sand infill amendments.

C. Material samples. Submit three samples each of the following:
   1. Geotextile fabric approximately 7"x11".
   2. Panel drain product approximately 6 inches in length, full width.
   3. Gravel Materials – See Section 1.8, "Quality Control".

D. Synthetic Turf Material Samples and Test Reports:
   1. Synthetic Turf – Three samples, approximately 7" x 11".
   2. Rubber/Sand Mix with proper ratio or Rubber - three samples, approximately 8-ounces each.
   3. Submit to Owner for approval - quality assurance information as delineated in paragraphs 1.5 Quality Assurance below.
   4. Certified list of successful existing installations, including Owner representative and telephone number, attesting compliance with quality assurance information.
   5. Certified copies of independent (third-party) laboratory reports on ASTM tests as follows:
      a. Pile Height, Face Weight & Total Fabric Weight - ASTM D418.
      b. Primary & Secondary Backing Weights – ASTM D418.
      c. Tuft Bind – ASTM D1335.
      d. Grab Tear Strength – ASTM D1682.
      e. Dynamic Cushion Test (G-max) - ASTM F-355, Procedure A (system)
   6. Seam – Sewn or glued per manufacturers' recommendation.
      a. 24 inches in length.
   7. Color: Submit sample of line markings for approval by Owner.

E. Supplier List: Submit list of procured and contracted suppliers of all materials required for the Playing Field System.

F. Shop Drawings:
   1. Sample Warranty.
   2. Seam layout of the field.
   3. Striping plan: Submit one for each field.
   4. Layout for Owner designated sports, showing any field lines, markings, boundaries and logos.
   5. Construction detail sketches, especially those that may deviate from the plans and specifications. Include but not limited to the following; perimeter turf anchor details, details at irrigation valves, valve boxes, other inserts or fixed features, etc.

G. Manufacturer's Review: submit written statement, signed by Contractor and synthetic field surfacing installer stating that the Drawings and Specifications have been reviewed by qualified representatives of the materials manufacturer, and that they are in agreement that the materials and system to be used for synthetic field surfacing are proper and adequate for the applications shown

H. Statement of Supervision: Upon completion of the Work, Contractor to submit a written statement signed by the synthetic turf manufacturer stating that the field supervision by the manufacturer's

representative was sufficient to insure proper application of the complete system and materials, that the Work was installed in accordance with the Contract Documents, and that the installation is acceptable to the manufacturer.

1.5 QUALITY ASSURANCE

A. The sports field contractor/manufacturer shall have a minimum of six installations in the past 5 years of the specified product on athletic fields larger than 50,000 square feet.

B. The sports field contractor shall have previously installed at least six (6) artificial turf infill fields larger than 50,000 square feet in the last (5) years.

1. The sports field contractor is responsible for the subgrade fine grading, installation of fabric, installation of field drainage system, installation of the perimeter nailing system, installation of field irrigation system and installation of the dynamic stone base.

2. The sports field contractor shall be a Shaw Sports Turf qualified installer and shall meet all the requirements as described herein.

C. The synthetic field turf installation shall be performed by a firm and crew having completed at least six (6) fields in the last three (3) years on projects of similar size and type to this project. The firm shall have the approval of the synthetic field surfacing materials manufacturer. The synthetic field installation superintendent shall provide a list of the five (6) projects for which he was responsible.

D. The Sports Field Contractor and the Synthetic Turf Manufacturer/Supplier must have been in business under the same ownership for at least three years, and shall have been installing similar sports fields for that entire period.

E. Provide test results from certified laboratory certifying capability of aggregate base course (dynamic stone) to meet permeability and stability requirements before construction.

F. Lay test strip and establish compaction and density rates for each course with nuclear gauge before beginning permanent work.

G. The turf manufacturer/supplier shall submit a list of all completed products, using the specified turf system, in the Mid Atlantic/NJ region of the United States. The list shall include references for at least six of the projects.

H. The synthetic field surfacing manufacturer shall provide evidence indicating that the specified materials have been successfully utilized on work of similar scope to that shown and specified for this Project.

1.6 QUALITY CONTROL

A. Prior to construction: Submit samples of each of the following materials to establish Baseline specification and ratios for the remainder of the testing process.

1. Gravel Drainage Material: Provide a one-gallon sample of each gravel drainage source and for each type of gravel material to be used for testing. This could include:

a. Gravel trench drainage material.

b. Dynamic Base Stone.

c. Topping Stone.

B. During Construction: Submit samples of each of the following during mass production of gravel materials for performance testing and prior to shipping. All costs associated with materials testing shall be paid for by the Contractor.

1. Earthwork Material Qualification and Testing
   a. If found necessary, submit the following test data for each potential borrow source.
      1) Particle Size Analysis:
         a) Method: AASHTO D422.
         b) Number of Tests: Three (3) per potential source.
         c) Acceptance Criteria: Gradation within specified limits.
      2) Maximum Density Determination:
         a) Method: Modified Proctor Test - ASTM D 1557.
         b) Number of Tests: Three (3) per potential source.
   b. Re-establish gradation and maximum density of fill material if source is changed during construction.
2. Earthwork/Compaction Testing
   a. All compaction testing shall be performed by as required in Section 31200 "Earth Moving" and Section 312333 "Trenching and Backfilling".
   b. Compaction testing shall be performed to ascertain the compacted density of the fill and backfill materials in accordance with the following methods:
      1) In-place relative density:
         a) Method: ASTM D-1556, Sand Cone Method.
         b) ASTM D-2922, Nuclear Method.
      2) Number of Tests:
         a) One (1) per 5,000 SF in each vertical lift.
   c. The Engineer may direct additional tests to establish gradation, maximum density, and in-place density as required by working conditions.
   d. Acceptance Criteria: The sole criterion for acceptability of in-place fill shall be in situ dry density. Minimum dry density for all fill or backfill shall be 95 percent of the maximum dry density as determined by the Modified Proctor Test (ASTM D-1557). If a test fails to qualify, the fill shall be further compacted and re-tested. Subsequent test failures shall be followed by removal, replacement of the material and retesting.
3. Gravel Drainage/Dynamic Stone/Topping Stone Material:
   a. A minimum of one-gallon sample for every 500 cubic yards of each material used shall be tested by the Playing Field Testing Agent for general compliance with the established Baseline specifications.

C. Testing Agents:
   1. The Owner shall contract with, and pay for, an independent testing agent to certify and make recommendations regarding compaction, concrete, geotechnical and other items required by the Work. The Playing Field Contractor shall notify the Owner regarding timing, scheduling and use of these agents.

   2. Playing Field Testing Agent:
      a. The Owner shall hire an independent Testing Agent to perform testing of the field system material components, as well as to certify the capability of the dynamic stone base course to meet permeability and stability requirements before construction. This Agent shall be A2LA accredited and insured.
      b. Gravel Materials Test Reports: The Playing Field Testing Agent is to report/submit test results as they are known and simultaneously to the Playing Field Contractor, the Owner and its representatives.

1.7 DELIVERY, STORAGE AND HANDLING

A. All materials shall be delivered and stored within the Contractor's work limits or in an area approved by the Owner. Materials shall be inspected for damage immediately upon delivery.

B. All material shall be stored in strict accordance with the manufacturer's recommendations.

C. Special care shall be exercised during delivery and storage to avoid damage to the products.

D. Products that are damaged will be removed and replaced, unless the product can be repaired in an acceptable manner by the Contractor, at his expense.

E. Packaged Materials:
   1. Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.

F. Drainage Gravel and Dynamic Stone Base:
   1. Deliver tested and approved lots in clean, washed and covered trucks to eliminate contamination during transportation. Place directly on playing field. Do not stockpile on site.

1.8 COMPLETION AND ACCEPTANCE

A. General: Field completion shall be separated into 2 phases, "Preliminary Completion" and "Substantial Completion."

B. Preliminary Completion: Scheduled date for preliminary completion shall be at least 10 calendar days before Substantial Completion. Notify the Playing Field Designer/Engineer and Owner in writing, 3 days prior to scheduled date for observation for "Preliminary Completion." To be considered "Preliminarily Complete" the following items shall be provided:
   1. Drainage system installed.
   2. Dynamic stone base in place, compacted and to grade.
   3. Synthetic turf installed inclusive of infill materials, field markings and logos.
   4. Goal Achors installed.

C. Substantial Completion: After "Preliminary Completion" observation, the Playing Field Designer/Engineer and Owner shall prepare and submit to the Contractor, a punch list of items to be completed to achieve "Substantial Completion". Contractor shall notify the Playing Field Designer/Engineer and Owner in writing, 5 days prior to a requested date for a site observation to meet "Substantial Completion." To be considered "Substantially Complete" or "Playable" the following items shall be provided:
   1. All "Preliminary Completion" punch list items are complete.
   2. Submit five (5) copies of written operating and maintenance instructions. Provide format and contents as directed by the Engineer.
   3. Submit (5) copies of all certified surveys performed during construction for Quality Control.
   4. Instruct the Team or Owner's personnel in the operation of the irrigation and other systems.
   5. Smooth, level playing surface level to grading tolerances.
   6. Written warranties/guarantees.
   7. Stockpiling or storage of required "attic stock" materials.
   8. Upon completion of the synthetic field surface, the contractor shall provide the owner with 2 hours of maintenance training that shall be recorded on a video tape and supplied to the Owner.

1.9 WARRANTY/GUARANTEE

A. General: Warranties / Guarantees specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and are in addition to and run concurrent with other warranties/guarantees made by the Contractor under requirements of the Contract Documents.

B. The following are inclusive of the term "Playing Field System" for provisions of the guarantee:
   1. Final grade tolerances to one-quarter inch in the length of 25' of finish grade in any direction.
   2. Synthetic turf product as specified and represented by the Turf manufacturer/vendor.
   3. Working functions of the drainage system.
   4. All materials and products specified.
   5. Dynamic stone base shall be guaranteed to have a percolation rate greater than 6 inches per hour.

C. Installer Guarantee: Provide in writing a "Full System Guarantee" agreement. The President(s) of the synthetic turf manufacturer (if different) shall sign this document and it shall include the following:
   1. All work executed under this section will be free from defects of material and workmanship for a period of eight (8) years from date of Substantial Completion.
   2. Any defects will be remedied on written notice at no additional cost to the Owner.
   3. Guarantee shall include removal and replacement of materials (parts and labor) as required to repair synthetic field surfacing at no cost to the Owner.
   4. The 8 year warranty shall not be prorated and be provided by third party non-cancelable insurance policy.
   5. At no time in the life of the Guarantee shall the G-Max exceed 165 at any one point on the field.

D. Statement of Supervision: Upon completion of the Work, Contractor to submit a written statement signed by the synthetic turf manufacturer stating that the field supervision by the manufacturer's representative was sufficient to insure proper application of the complete system and materials, that the Work was installed in accordance with the Contract Documents, and that the installation is acceptable to the manufacturer.

E. G-Max Testing: The synthetic surface manufacturer shall retain a third party certified testing laboratory and shall perform G-Max testing during the first year of the life of the Guarantee.
   1. Testing shall be performed at within 10' of mid center, at the goal locations for soccer and lacrosse, and at 10 yards inside the corners of the overlaid rectangle fields. This results in a total of 9 tests. The testing shall be performed between 90 and 120 days after substantial completion. (These tests are paid for by the Contractor).
   2. Testing shall consist of shock attenuation per ASTM F-355 procedure A.
      a. G-Max shall not change more than 5% (five percent) at any one location per year over the life of the Guarantee.
         1) In cases where the results of the above testing exceed the specified values, the condition shall be corrected by the synthetic surface manufacturer. The synthetic surface manufacturer shall provide adequate information to confirm that the mitigation measures were effective.
      b. At no time in the life of the Guarantee shall the G-Max exceed 165 at any one point on the field.
   3. Future testing shall be performed by a certified independent lab and paid for by the Owner.

1.10 SPARE PARTS/ATTIC STOCK

A. Stockpile Materials: Provide the following additional materials stored as directed by the Owner.

Material	**Quantity**
Rubber Infill	2 tons

PART 2 - PRODUCTS

2.1 EARTHWORK MATERIALS

A. Earthwork materials shall meet the requirements of Specification "Earthwork" and "Athletic Field Subsurface Drainage".

2.2 PERIMETER TURF ANCHOR/NAILER

A. The perimeter turf anchor/nailer shall be located at the field perimeter or turf edges and shall be as per drawings, or approved equal.

2.3 SYNTHETIC INFILL TURF PRODUCT

A. Shaw "Legion" Bolt
1. A UV stable, extruded "spined" monofilament polyethylene fiber and Strenex slit film fibers system ".
2. Finish pile height 2.00" min. inches
3. Permeability 15" per hr. min.
4. G-max at install 100-135 max
5. G-max over life of field 165 max

B. Shock Pad: The field shall be underlain by a resilient shock pad
1. The pad shall be the Schmitz shock pad, ProPlay 23. The pad shall be 0.9" thick thermally bonded closed cell polyethylene foam pad.

C. Appearance/Feel:
1. The finished playing surface shall appear as mowed grass with no irregularities and shall afford excellent traction for conventional athletic shoes of all types.
2. The finished surface shall resist abrasion and cutting from normal use.

D. Infill Materials
1. All products shall utilize their mixture of graded dust-free, rounded silica sand and SBR rubber crumb or cryogenic rubber.
2. Rubber shall be dust toxics & metal free. Particle sizes shall be consistent in size and shape, between .25 and 3 mm.

3. Sand shall meet the following gradation:

Sieve Size	% Retained
2 mm	0
.5 mm	20-30
.25 mm	40-50
.15 mm	30-40
.05 mm	5-10

4. Infill material shall be as recommended by the turf system MFR. The sand component shall be as recommended by the turf system MFR.
5. The exposed fiber height shall be 1/2" ± 1/4" after 40 hours of field use or 90 days after placement.

E. Tufted and inlaid lines

1. All products shall use tufted lines to the maximum extent. Inlaid lines shall be installed by cutting and gluing or sewing all lines and markings such that the inlays are completely flush with the surrounding turf fibers. Shaving the turf down to the backing and gluing the inlays in place is not permitted.

F. Glued seams

1. Adhesives for bonding tufted synthetic turf shall be as recommended by the synthetic turf manufacturer. Adhesives shall be one-part moisture cured polyurethane.

G. Sewn Seams

1. Cord for sewing seam turf shall be as recommended by the synthetic turf manufacturer.

2.4 SYNTHETIC INFILL TURF MAINTENANCE EQUIPMENT

A. Provide (one) turf sweeping unit including all necessary tools and equipment to properly maintain the synthetic turf system including the alternate systems:

1. Supply a 6' wide field sweeper with magnet, which shall include a towing mechanism compatible with a field utility vehicle. The field sweeper shall be the LitterKat 760 sweeper, or equivalent.
2. Supply one turf groomer. Turf groomer shall be 6' wide and be the Sportsturf Groomer 720-SDE by Greens Groom or the G7 Groomer by Go Groomer Go, or equal.

PART 3 - EXECUTION

3.1 EXAMINATION AND PROTECTION

A. Verification of Conditions: Examine areas and conditions under which all work of this Section is being performed. Do not proceed with any work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of all areas and conditions.

B. Protection of Work: Protect all on-going work, so as not to delay work due to weather or project related construction. This includes but is not limited to the use of tarps, geotextile, plywood and other protective measures.

C. Protection of Persons and Property: Provide all necessary measures to protect workmen and passersby. Barricade open excavations occurring as part of the work, as required by municipal or other authorities having jurisdiction.

1. Protect adjacent construction throughout the entire operation. Protect newly graded areas from destruction by weather or runoff. Protect structures, utilities, pavements, and other improvements from damage caused by settlement, lateral movement, undermining and washout.

D. Unanticipated Conditions: Notify the Engineer immediately upon finding evidence of previous structures, filled materials that penetrate below designated excavation levels, or other conditions which are not shown or which cannot be reasonably assumed from existing surveys and geotechnical reports. Secure the Engineer's instruction before proceeding with further work in such areas.

E. Installation of synthetic field surfacing shall be done only after excavation and construction work which might injure it has been completed. Damage caused during construction shall be repaired before acceptance.

F. The Contractor shall coordinate the installation of the synthetic field surface and the surrounding surfaces for optimum interface at all edges.

3.2 EARTHWORK EXECUTION / SUBGRADE

A. Preparation
1. Establish required lines, levels, contours and datum. Sports Field Contractor shall coordinate and ensure that the final grade of various materials such as the Dynamic Stone Base, turf infill, etc., will result in the final field grades shown on the Contract Drawings when the complete system is installed.
2. Maintain benchmarks and other elevation control points. Re-establish, if disturbed or destroyed, at no additional cost to the Owner.
3. Establish location and extent of utilities before commencement of grading operations.
4. Surface Water Control
   a. All earthwork operations shall be conducted in a manner to prevent surface water from infiltrating into the subgrade and base. Drainage is to be maintained in all parts of the site to drain surface water without ponding at all times. The Contractor, at his own expense, shall undercut soils saturated by ponding and backfill per this Section at the direction of the Engineer.

B. Grading:
1. The finished grade lines are shown on the contract drawings. Upon completion of this work, all debris shall be cleaned out and removed from the premises.
2. Grade Verification: Upon completion of the field subgrade, dynamic stone base and the finished synthetic surface, the Contractor shall provide drawings, completed by a licensed surveyor, sharing the elevations at each of the phases. Elevations shall be taken on a 25' grid across the entire field area.
3. All cutting, filling, backfilling and grading necessary shall be done to bring the area to the following grade or subgrade levels:
   a. The final elevation of the Subgrade shall be within one-half inch on a 25 foot by 25 foot grid of the finished grades indicated on the Contract Drawings. Laser controlled or indicated equipment shall be used for this part of the work.
   b. Subgrade shall mirror the final finish elevation of the field surface in regards to slope except where noted on the drawings.
   c. All surfaces shall be graded to drain to drainage structures with no ponding. Grading tolerances given above do not relieve the Contractor from this requirement.
4. Sufficient grading must be done during the progress of the work so that the entire site shall be well drained and free from water pockets.

3.3 TURF PERIMETER NAILER/ANCHOR

A. Install approved anchoring system at entire perimeter/edges of turf installation.

B. Install anchoring/nailing "collar" around other in place or installed items (quick coupler boxes, power/communication boxes, etc.), as appropriate to installation sequencing.

3.4 INSTALLATION OF DYNAMIC STONE BASE/TOPPING STONE

A. Install tested and approved material at a uniform depth as indicated on drawings.

B. Placement of the dynamic stone base shall proceed from a stable area next to the geotextile fabric and systematically worked outward onto the field area.
   1. The cover material shall be pushed forward and not dumped onto the liner.
   2. Laser operated equipment shall be utilized.
   3. All equipment used in spreading or traveling on the cover layer shall exert low ground pressures and shall be approved by the manufacturer and Engineer.
   4. During placement and spreading:
      a. A minimum depth of 6 inches of granular material shall be maintained at all times between the fabric and wheels of trucks or spreading equipment.
      b. Dozer blades, etc. shall not make direct contact with the fabric. If tears occur in the fabric during the spreading operation, the granular material shall be cleared from the fabric and the damaged area repaired as previously described.
      c. All equipment traveling on the cover layer shall avoid making sharp turns, quick stops or quick starts.
      d. Care shall be taken to not disturb, displace or damage the geotextile fabric or the drainage system.

C. Placement of the Topping Stone: This stone layer shall be placed over the dynamic stone base at an approximate depth of one-half inch to produce a level/smooth surface prior to the placement of the synthetic turf.

D. Finish grade for Dynamic Stone Base and Top Dressing Stone shall be verified using laser operated survey instrument with a tolerance of +/- one-quarter inch over 25 feet in any direction.
   1. A survey of the finished spot grades is to be developed by a State licensed surveyor over the entire surface in a 25 foot grid. The survey shall be certified (signed) and submitted to the Owner and its representatives for approval prior to installing the synthetic turf.

3.5 INSTALLATION OF SYNTHETIC TURF

A. Synthetic turf shall be installed by crews employed by the Synthetic Turf manufacturer, in strict accordance with manufacturer's recommendations and instructions including but not limited to, fabric, adhesives, seaming and abutting or attaching to adjacent materials.

B. Field markings and lining of synthetic field surfacing shall be laid out as shown on the drawings and as approved by the Owner with Contractor submitted drawings.

C. Turf panel seams shall be sewn with high strength thread using a double loop stitch or glued with an adhesive as recommended by the synthetic turf manufacturer and installed per manufacturer's instructions. All seams shall be flat, tight and permanent with no separation or fraying.

D. All inlaid lines shall be backed using seaming tape with a width of 12 inches. All inlays shall be flush with adjacent turf. Shaving turf down to backing and gluing in lines and markings is NOT acceptable.

E. Anchor turf edges at perimeter as shown on drawings and as recommended per synthetic turf manufacturer.

F. At the end of each day, remove all scraps and other debris created by the synthetic turf installation from the playing field area.

G. Infill materials shall be applied at a uniform depth and at an ultimate finish grade tolerance of ¼ inch at any point over the entire playing field area. Fill to a depth so that minimum of ½ inch to a maximum of ¾ inch of fiber is visible.

H. Fiber shall not be buried or trapped below infill material when complete.

I. Anchor turf edges at field curb and at field perimeter as shown on drawings.

J. The finish turf surface shall have a permeability test performed on 5 locations on the field.

K. The permeability test shall utilize a dual ring infiltrometer in accordance per ASTM test method. All test results must be greater than 6 inches per hour.

3.6 FIELD MARKINGS

A. The field lines shall be tufted or inlaid per Owner designated sports. The final field markings shall meet the NCAA standards as shown on the striping plan drawings.

3.7 CLEAN UP

A. Remove all surplus excavated material not required for filling and backfilling, trash, and debris and dispose of it properly off of the Owner's property at Contractor's expense.

END OF SECTION

SECTION 321814 – SYNTHETIC TURF SUBSURFACE DRAINAGE SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes installation of the Athletic Field Subsurface Drainage System, as indicated on the Contract Drawings and as specified herein.

1.2 REFERENCES

A. Comply with applicable requirements of the following standards. Should the standards conflict with other specified requirements, the most restrictive requirement shall govern.
   1. American Association of State Highway and Transportation Officials (AASHTO).
   2. American Society for Testing and materials (ASTM):
      a. F 405, Corrugated Polyethylene (PE) Tubing and Fittings.
      b. F 449, Subsurface Installation for Agricultural Drainage or Water Table Control.
      c. F 667, 8, 10, 12 and 15-inch Corrugated Polyethylene Tubing and Fittings.
   3. Occupational Safety and Health Administration (OSHA).

1.3 SUBMITTALS

A. Manufacturer's Product Data
   1. Provide certifications stating that the material used to comprise the system comply with the system comply with the requirements.
   2. Material Samples: Submit three samples of each:
      a. Geotextile Fabric (6" x 11").
      b. Panel Drain 6" length.
      c. Gravel Materials:
         1) 1 gallon samples of dynamic stone and topping stone.

1.4 QUALITY ASSURANCE

A. All piping and appurtenances shall be new, clean and in accordance with material specifications, unless specifically noted on the plans.

B. Size and classification shall be shown on the plans or as specified herein.

C. The contractor who performs this work shall have installed six similar installations in the last three years. Submit complete list of projects, including project description, date of completion, and contact information.

1.5 PRODUCT DELIVERY

A. Take all required measures to ensure that all piping and related appurtenances are protected from damage.

B. Special care shall be exercised during delivery and storage to avoid damage to the products.

C. All materials shall be delivered and stored within the Contractor's work limits or in an area approved by the Owner.

D. Products that are damaged will be removed and replaced, unless the product can be repaired in an acceptable manner by the Contractor, at his expense.

PART 2 – PRODUCTS

2.1 SPORTS FIELD SUBDRAINAGE SYSTEM

A. All specific pipes are noted on the Contract Drawings.

B. 4-Inch through 10 inch solid wall and perforated drainpipe shall be smooth interior wall conforming to AASHTO M 252.

C. 12-Inch through 36 inch solid wall and perforated drainpipe shall be smooth interior wall conforming to AASHTO M 294 Type S.

D. Fittings and couplers shall be split couplings or snap couplings manufactured by the same manufacturer as the corrugated polyethylene pipe.

E. Panel Drains shall be a 3- dimensional rigid HDPE (1-inch-by-12-inch flat panel pipe).

2.2 DYNAMIC STONE BASE AND TOPPING STONE

A. The dynamic stone base shall conform to the turf vendor's standard specifications subject to the engineer's approval and meet the following gradation equal to AASHTO No. 57 stone:

SIEVE SIZE	**PERCENT PASSING BY WEIGHT**
1-1/2"	100
1"	95-100
1/2"	25 – 60
¼"	0 - 10
No. 8	0 - 5
No. 200	0 – 2

B. The topping stone must conform to the turf vendor's standard specifications, is subject to the Engineer's approval, and meets the following gradation equal to AASHTO No. 8 stone:

SIEVE SIZE	PERCENT PASSING BY WEIGHT
1/2"	100
3/8"	85 – 100
No. 4	10 - 30
No. 8	0 - 10
No. 16	0 - 5
No. 200	0 – 2

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions under which the subsurface drainage system work is to be installed. Correct any and all conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until satisfactory conditions have been corrected.

3.2 EXCAVATION FOR PIPE

A. Excavation shall consist of the removal of all material of every description to the depths and grades designated on the plans and specified herein.

B. If the material at or below the designated grade for which the pipe is to be laid is unsuitable for pipe foundation, then the material shall be removed to such depths and widths as required and replaced with approved foundation material.

C. Excavation for installation of pipes shall be in trenches to the lines, grades and widths as per the Contract Drawings and in accordance with Safety and Health Regulations (OSHA). In all cases, trenches shall be excavated in a manner to ensure the proper and timely completion of the work.

3.3 INSTALLATION

A. Once said trench has been excavated to the proper lines, grades and widths, the geo-membrane shall be installed as per Manufacturer's Specification.

B. Underdrain pipe shall be installed according to ASTM F 499, recommended installation practices and as recommended by the pipe manufacturer.

C. Pipe laying work shall commence at the main collector line and shall proceed upgrade. Pipe shall be laid true to line and grade in such a manner as to assure a close concentric joint with the adjoining pipe.

D. Trenches shall be kept free of water and debris. Pipe shall not be laid when the condition of the trench or weather is unsuitable for such work.

E. Install panel drains as shown on drawings.

F. At the completion of each underdrain line installation, place a cap or plug in the up stream end as to prevent unwanted material and debris from entering the pipe.

3.4 INSPECTION

A. After installation of pipe, inspect to determine whether line displacement or other damage has occurred.

B. Make inspections after lines have been installed prior to backfilling and during the backfilling process and again at the completion of backfilling. Backfill material shall conform to the material as specified in Specification Section 312333 – "Trenching & Backfilling."

C. If inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects, take whatever steps are necessary to correct such defects.

END OF SECTION

SECTION 321815 – ATHLETIC CHANNEL DRAIN SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes install a precast, interlocking polymer concrete trench drainage system as specified and as shown on the working drawings.

B. System Description: Modular trench drain system precast from a corrosion resistant polymer including interlocking modular components for on-site installation.

1.2 QUALITY ASSURANCE

A. Warranty:
   1. Channel drain system is included under the Project Warranty.

1.3 SUBMITTALS

A. Contractor will submit shop drawings showing a plan of the total drainage system listing all parts being provided with exact center-line dimensions suitable for installation. Copies of the manufacturer's recommended method of installation, assembly, and anchorage shall be submitted for review.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Physical and Mechanical Characteristics of Polymer Concrete Channel Units:
   1. Top unit width - Approximately 6.1 inches.
   2. Internal width - Approximately 4.0 inches.
   3. Unit depth - Approximately 9.8 inches.
   4. Compressive strength of specified polymer concrete - 14,000 psi min.
   5. Flexural strength of specified polymer concrete - 3,000 psi min.
   6. Water absorption rate - not to exceed 0.1%.

B. Channel Profile shall include positive interlocking tongue and groove connections which can be sealed to provide water tight connections. Each precast polymer channel shall be an approximately 1 meter unit and be available in curved and straight sections.

C. Catch Basins shall be precast polymer concrete, 39.37" in length and include a plastic grating.

D. Channel Drainage System:
   1. Turf to track and turf to curb applications. ACO Sport – System 4020 or equal with 9.9" depth.
   2. Track to track applications – Aco Sport System 2000 or equal.

E. Grates:
   1. Grates are to be high density Polyethylene.

2. Grate locking devices are to be galvanized steel.
   a. Turf to track and turf to curb applications: ACO Sport Model No. 494 Grate combined drain and anchoring system grate, by Aco Sport or equal.

PART 3 – EXECUTION

3.1 SITE PREPARATION

A. Excavate the area for channel placement wide enough to accommodate the channel size with a minimum of six inch concrete encasement. Channels require a minimum of six inches concrete support, and top of channel must be evenly aligned to the surface of the surrounding surface on both sides, as well as underneath the channel.

3.2 INSTALLATION

A. Install precast channel drain in accordance with the details on the plans and the manufacturer's instructions.

B. Channel sections are installed from the outlet ends of the system, working from the catch basins. Insert channels from above to allow ends to interlock. Channel sections shall be placed on brick, rebar basket, channel chair, low slump concrete grout slurry, or suspended to obtain correct finished elevation. Cutting will be made, if required, by masonry or concrete saw. Cover top of channel with tape, plastic, or plywood strips to protect the channel surface from concrete during pouring.

C. Finishing and Cleanup:
   1. Following final set of concrete, remove protection covering top of channels.
   2. Install drain system in strict accordance with manufacturer's recommendations and shop drawings.

END OF SECTION

SECTION 323113 – CHAIN LINK FENCE AND 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 DESCRIPTION

A. The Contractor shall provide all labor, materials, equipment, and services necessary for, and incidental to, the installation of chain link fence and gates, as shown on the Drawings and as specified herein.

B. All chain link fence shall be thermally-bonded polyvinyl chloride (PVC), plastic resin finish over galvanized steel wire.

C. All gates and gate hardware shall be powder coated.

1.3 QUALITY ASSURANCE

A. Comply with standards of the Chain Link Fence Manufacturer's Institute.

B. Provide steel fence and related gates as a complete system produced by a single manufacturer, including necessary erection accessories, fittings and fastenings.

C. Comply with ASTM A-53 for requirements of Schedule 40 piping.

D. Height of fence shall be measured from the top of concrete footing to the top of post.

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. Fence and gate posts, rails and fittings
   2. Chain link fabric, reinforcements, and attachments.
   3. Gates and hardware.

B. Shop Drawings: Show locations of 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 anchorages, attachment, bracing, and other required installation and operational clearances.

C. Samples for Verification: for each type of chain-link fence and gate indicated.
   1. PVC coated steel wire (for fabric) in 6-inch (150-mm) lengths on shapes for posts, rails, wires and gate framing.
   2. Two-stage powder coat finish, in 6-inch (150-mm) lengths on shapes for gate framing.

D. Product Certificates: For each type of chain-link fence 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. Maintenance Data: For the following to include in maintenance manuals:
   1. Polymer Finishes
   2. Galvanized Finishes
   3. Powder Coat Finishes.

1.5 Quality Assurance:

A. Installer Qualifications: An experienced installer who has completed chain-link fences and 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.

1.6 Project Conditions:

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

PART 2 – PRODUCTS

2.1 STEEL FRAME WORK

A. Unless noted otherwise on drawings, minimum Nominal Framework Sizes shall be the following:

FENCE HEIGHT	**LINE POSTS**	**END, CORNER & PULL POSTS**	**RAILS & BRACES**	**GATE FRAMES**	***GATE POSTS**	**CONCRETE FOUNDATION DIA.**		**DEPTH**
						Diameters	**Corner/End**	
						LINE POSTS	**PULL & GATE POSTS**	
3’	1-1/2”	2”	1-1/4”	1-1/2”	3”	12”	12”	4’
3’-6”	2”	3”	1-1/4”	1-1/2”	4”	12”	12”	4’
4’	2”	3”	1-1/4”	1-1/2”	4”	12”	12”	4’
4’-6”	2”	3”	1-1/4”	1-1/2”	4”	12”	12”	4’
5’	2”	3”	1-1/4”	1-1/2”	4”	12”	12”	4’
6’	2”	3”	1-1/4”	1-1/2”	4”	12”	18”	4’
8’	2”	3”	1-1/4”	1-1/2”	4”	12”	18”	4’
10’	3”	4”	1-1/4”	1-1/2”	4”	18”	18”	4’
12’	3”	4”	1-1/4”	1-1/2”	4”	18”	18”	5’
16’	3-1/2”	4”	1-1/4”	1-1/2”	4”	18”	18”	5’

SCHEDULE 40 STEEL PIPE TABLE		
NOMINAL SIZE (IN.)	**ACTUAL OUTSIDE DIAMETER (IN.)**	**WEIGHT *(LB/FT)**
1	1.315	1.67
1-1/4	1.660	2.27
1-1/2	1.900	2.71
2	2.375	3.65
2-1/2	2.875	5.79
3	3.500	7.58
3-1/2	4.000	9.11

50,000 PSI HOT DIPPED ALUMINIZED STEEL TUBING		
NOMINAL SIZE (IN.)	**ACTUAL OUTSIDE DIAMETER (IN.)**	**WEIGHT *(LB/FT)**
1	1.315	
1-1/4	1.660	1.83
1-1/2	1.900	2.28
2	2.375	3.12
2-1/2	2.875	4.64
3	3.500	5.71
3-1/2	4.000	6.56

2.2 CHAIN LINK FABRIC

A. General: Height indicated on Drawings. Provide fabric in one-piece heights for fence heights up to 10 feet measured between top and bottom of outer edge of selvage knuckle or twist. Comply with ASTM A 392, CLFMI CLF 2445, and requirements indicated below:

1. Steel Wire Fabric: <Galvanized or Polymer-coated> wire.
   a. 0.148 inch (9 gauge) core diameter for fences and gates.
   b. 0.192 inch (6 gauge) core diameter for backstops.

B. Mesh Size:

1. 2 inches for fences.
2. 1-3/4 inches for tennis court fencing.

C. Selvages: Knuckled top and bottom.

2.3 SWING GATE FRAMES

A. Assemble gate frames with fully coped welds as shown on the Drawings or on Shop Drawings approved by the Engineer.

1. All ferrous metal components shall be blast cleaned to and SSPC-6 commercial blast clean.

2.4 GATE HARDWARE

A. Hinges: Non-lift-off type, offset to permit 180-degree swing, and of suitable size and weight to support gate. Provide 1-1/2 pair of hinges for each leaf over 6 feet high.

B. Latch: Provide plunger bar type complete with flush plate set in concrete for all double gates and single gates over 10 feet. Padlock eye shall be an integral part of latch construction.

1. Provide plunger bar complete with flush plate set in concrete on each gate leaf.
2. Provide flush plate set in concrete for both the full open position and full closed position.

C. Keeper for Vehicle Gates: Provide keeper which automatically engages the gate leaf and holds it in open position until manually released.

2.5 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Post Tops: Steel, wrought iron, or malleable iron.

B. Stretcher Bars: One piece equal to full height of fabric, minimum cross-section 3/16 inch by 3/4 inch.

C. Metal Bands (for stretcher bars): Steel, wrought iron, or malleable iron, to secure stretcher bars to end, corner, pull and gate posts.

D. Wire Ties:
   1. For tying fabric to line posts, rails and braces: 9 gauge steel wire.

E. Truss Rods: 3/8-inch diameter.

F. Angle Beams, I Beams and Steel Shapes: ASTM A-36.

G. Bolts and Nuts: ASTM A-307, Grade A.

2.6 FINISHES

A. Steel Framework:
   1. PVC Coated Pipe:
      a. Metallic coating: Weight of Zn-5-Al-MM Aluminum-Mischmetal Alloy Coating, ASTM F 1345, Type III, Class 2, 1.0 OZ./SQ. ft. (305 g/sq. m).
      b. Thermally-bonded polyvinyl chloride (PVC), plastic resin finish, ASTM F 668, Class 2, not less than 10 mils (.010") thick over metallic-coated steel wire.
      c. Color: < Green, Olive Green, Brown, Black>, complying with ASTM F 934.

B. Chain Link Fabric:
   1. PVC Coated Chain Link Fabric:
      a. Metallic coating: Weight of Zn-5-Al-MM Aluminum-Mischmetal Alloy Coating, ASTM F 1345, Type III, Class 2, 1.0 OZ./SQ. ft. (305 g/sq. m).
      b. Thermally-bonded polyvinyl chloride (PVC), plastic resin finish, ASTM F 668, Class 2, not less than 10 mils (.010") thick over metallic-coated steel wire.
      c. Color: < Green, Olive Green, Brown, Black>, complying with ASTM F 934.
      d. Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer's standard clear protective coating.

C. Gates:
   1. Colored Powder Coated Framework:
      a. Powder for coating shall be a polyester-based thermal setting resin.
      b. Powder coat system shall meet or exceed the following test requirements:
         1) Direct Impact Resistance: ASTM D 2794-93, up to 160 in.-lbs.
         2) Flexibility: ASTM D 522-93, Method B, equal to or less than a ¼ inch mandrel.
         3) Pencil Hardness: ASTM D 3363-93a, HB-2H.
         4) Crosshatch Adhesion: ASTM D 3359-97, Method B, 5B.
         5) Salt Spray Resistance: ASTM B 117, plus 1,000 hours.
         6) Humidity Resistance: ASTM D 2247, plus 1,000 hours.
   2. Chain Link Fabric on gate same as finish same for fencing.

D. Fence and Gate Hardware, Miscellaneous Materials, Accessories:

1. Fence Hardware, Materials and Accessories:
   a. Per fence finish requirements.
2. Gate Hardware, Materials and Accessories:
   a. Per gate finish requirements.
3. Angle Beams, I Beams, and Steel Shapes: Galvanized in accordance with ASTM A-123, 2.0 oz zinc per sq. ft.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of property lines and legal boundaries, site clearing, earthwork, pavement work and other conditions affecting performance.

1. Begin installation in general site areas or those not directly adjacent to the playing field only after final grading including topsoiling and paving is completed in that area or as otherwise permitted by Engineer.
2. For installation directly adjacent to the playing field, coordinate footing installation timing with final installation of playing field materials so as not to contaminate, destroy or displace these playing field materials.
3. If unsatisfactory conditions are present, proceed with installation only after they have been corrected.

3.2 PREPARATION

A. Coordinate fence and gate installation with completion of finished grading and installation of adjacent finish field materials.

B. Stake locations of fence lines, gates and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, irrigation system, underground structures, benchmarks and property monuments.

3.3 INSTALLATION

A. Space posts equidistant in the fence line with a maximum of 10 feet on center or as shown on drawings.

B. Footings: Excavate holes as indicated for fence and gate posts. Excavate footings to depths and widths as noted in Specifications or on drawings. Install gravel drainage material in bottom of hole as shown on the drawings.

C. Setting Posts and Footings at Concrete Areas: Set posts in center of hole. Embed post so that bottom of post is flush with the bottom of concrete footing and in gravel drainage layer. Fill hole with concrete. Plumb and align posts. Vibrate or tamp concrete for consolidation. Finish elevation on top of footing to be coordinated with construction of concrete adjacent to posts or as shown on drawings. Do not attach fabric to posts until concrete has cured a minimum of 7 days.

D. Setting Posts and Footings at Warning Track Areas: Set posts in center of hole. Embed post so that bottom of post is flush with the bottom of concrete footing and in gravel drainage layer. Fill hole with concrete. Plumb and align posts. Vibrate or tamp concrete for consolidation. Finish elevation on top of

footing to be set below finish grade. Do not attach fabric to posts until concrete has cured a minimum of 7 days.

E. Setting Posts and Footings in Grass Areas: Set posts in center of hole. Embed post so that bottom of post is flush the bottom of concrete footing and in gravel drainage layer. Fill hole with concrete. Plumb and align posts. Vibrate or tamp concrete for consolidation. Finish concrete in a dome shape above ground to shed water. Do not attach fabric to posts until concrete has cured a minimum of 7 days.

F. Locate corner posts at corners and at changes in direction. Use pull posts at all abrupt changes in grade and at intervals no greater than 500 feet. On runs over 500 feet, space pull posts evenly between corner or end posts. On long curves, space pull posts so that the strain of the fence will not bend the line posts.

G. Install top rail continuously through post caps or extension arms, bending to radius for curved runs. Install expansion couplings as recommended by fencing manufacturers.

H. Install intermediate rails in one piece between posts and flush with post on fabric side using special offset fittings where necessary.

I. Diagonally brace corner posts, pull posts, and terminal posts to adjacent line posts with truss rods and turnbuckles.

J. Attach fabric to playing field side of fence. Bottom of fabric to be set on finished grade of curb, track or playing field except when indicated otherwise. Thread stretcher bars through fabric using one bar for each gate and end post and two for each corner and pull post. Pull fabric tight so that the maximum deflection of fabric is 2 inches when a 30 pound pull is exerted perpendicular to the center of a panel. Maintain tension by securing stretcher bars to posts with metal bands spaced 15 inches oc. Fasten fabric to steel framework with wire ties spaced 12 inches oc for line posts and 24 inches oc for rails and braces. Bend back wire ends to prevent injury. Tighten stretcher bar bands, wire ties, and other fasteners securely.

K. Position bolts for securing metal bands and hardware so nuts are located opposite the fabric side of fence. Tighten nuts and score excess threads.

1. Secure post tops, extension arms, and caps with one-way cadmium plated steel screws.

L. Install gates plumb and level and adjust for full opening without interference. Install ground-set items in concrete for anchorage, as recommended by fence manufacturer. Adjust hardware for smooth operation and lubricate where necessary. Attach fabric as for fencing. Install ground-set items in concrete as shown on the drawings.

M. Touch Up: Small nicks or other blemishes shall be touched up with paint materials suitable for and matching the finish of the damaged material. Severely damaged fencing /gates deemed as unacceptable at the sole discretion of the Owner or its representatives shall be replaced at the contractor's expense.

END OF SECTION

SECTION 328424 – MANUAL SPORTS FIELD IRRIGATION SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

A. The work of this Section consists of providing and installing an underground irrigation system as shown and specified. The work includes:
   1. Manual irrigation system including piping, fittings, valves, quick couplers, and accessories.
   2. Testing.
   3. Excavating and backfilling irrigation work.

1.2 REFERENCE STANDARDS

A. Materials, equipment, and methods of installation shall comply with the following codes and standards:
   1. All local and State codes.
   2. National Fire Protection Association, (NFPA): National Electrical code.
   3. American Society for Testing and Materials, (ASTM).
   4. National Sanitation Foundation, (NSF).
   5. The Irrigation Association, (IA).

B. Installer's qualifications: minimum of 3 years of experience installing irrigation systems of comparable size.
   1. The contractor must provide a list of the last 3 projects done within the last 3 years that are of similar size and complexity. Name, address and phone numbers shall be included.

1.3 SUBMITTALS

A. General: Submit the following in accordance with the Conditions of Contract and Division 1 Specification Sections.

B. Submit manufacturer's product data and installation instructions for each of the system components including but not limited to manual valves, quick coupling valves, valve boxes, pipe, fittings, quick couplers, etc.

C. Upon irrigation system acceptance, submit 5 copies of written operating and maintenance instructions, including winterization procedure. Provide format and contents as directed by the Engineer.

D. Record Drawings:
   1. The Contractor shall provide and keep up to date a complete set of "As Built" record set of prints which shall be corrected as the work progresses, and show every change from the original drawings and specifications and the actual "As Built" dimensions and kinds of equipment. This set of drawings shall be kept on site and shall be used only as a record set.
   2. These drawings shall also serve as progress sheets, and the Contractor shall make neat and legible annotations thereon as the work proceeds, showing the work as actually installed. These drawings shall be available at all times for inspection and shall be kept in the Contractor's mobile office on location at all times for inspection.

3. Record drawings shall show the location of all quick couplers, valve boxes, valve markers, pipe, trenches, and all pertinent material buried and not visible to the eye. Record drawings shall indicate dimensions from two permanent points of easily identifiable nature, if possible, such as sprinkler heads, permanent markers, concrete pads, corner of buildings, large caliper trees, etc.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver irrigation system components in manufacturer's original undamaged and unopened containers with labels intact and legible.

B. Deliver plastic piping in bundles, packaged to provide adequate protection of pipe ends.

C. Store and handle materials to prevent damage and deterioration.

D. Provide secure, locked storage for valves, and similar components that cannot be immediately replaced, to prevent installation delays.

1.5 PROJECT CONDITIONS

A. Known underground and surface utility lines are indicated on other drawings.

B. Protect existing trees, plants, lawns, and other features designated to remain as part of the final landscape work.

C. Promptly repair damage to adjacent facilities caused by irrigation system work operations. The cost of repairs shall be at the Contractor's expense.

D. Irrigation system layout is diagrammatic. Exact locations of piping, sprinkler heads, valves, and other components shall be established by the Contractor in the field at the time of installation.
   1. Space system components as indicated on the drawings.
   2. Minor adjustments in system layout may be necessary to clear existing and proposed fixed obstructions. Final system layout shall be acceptable to the Engineer.

E. Cutting And Patching:
   1. Cut through concrete and masonry for conduits with core drills. Jack hammers are not permitted.
   2. Materials and finishes for patching shall match existing cut surface materials and finish. Exercise special care to provide patching at openings in exterior walls water tight.
   3. Methods and materials used for cutting and patching shall be acceptable to the Engineer.

1.6 WARRANTY

A. For a period of one (1) year from the date of final acceptance of the irrigation system, the contractor shall promptly furnish and install any parts which prove defective due to faulty product or faulty installation by the contractor.

B. During the warranty period, the contractor shall extend to the Owner, any and all warranties that apply to equipment found to be defective in either materials or workmanship, as extended by the manufacturer and/or distributor to the contractor. The limits of this equipment warranty shall be expressly stated by the appropriate manufacturer/distributor in writing.

1.7 COORDINATION

A. Coordinate work of this Section with that of other trades, under this and other Contracts with the Owner, affecting or affected by this work, and cooperate with the other trades as is necessary to assure the steady progress of work.

B. Before proceeding with installation work, inspect all project conditions and all work of other trades to assure that all such conditions and work are suitable to satisfactorily receive the work of this Section and notify the Engineer in writing of any which are not. Do not proceed further until corrective work has been completed or waived.

C. Do not interrupt existing services without Owner's approval. Schedule interruptions in advance, according to Owner's instructions. Interruptions shall be scheduled at such times of day and work so that they have minimal impact on Owner's operations.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: As specified and approved.

B. Manufacturer's products shall conform to the specifications and shall be deemed acceptable by the Engineer.

2.2 MATERIALS

A. General:
   1. All irrigation pipes, fitting and quick couplers shall be clearly marked as non-potable water.
   2. Provide only new materials, without flaws or defects and of the highest quality of their specified class and kind.
   3. Comply with pipe sizes indicated. No substitution of smaller pipes will be permitted. Larger sizes may be used subject to acceptance of the Engineer.
   4. Provide pipe continuously and permanently marked with manufacturer's name or trademark, size schedule and type of pipe, working pressure at 73 DegF and National Sanitation Foundation (NSF) approval.

B. Pipe, Fittings, And Connections:
   1. Polyvinyl chloride pipe: ASTM D2241, Type 1, Grade 1 rigid, unplasticized PVC, extruded from virgin parent material, conforming to CS256-63. Provide pipe homogeneous throughout and free from visible cracks, holes, foreign materials, blisters, wrinkles, and dents.
      a. All piping for sleeves under roadways, sidewalks, etc., shall be PVC, Schedule 80, unless otherwise stated on the plans.
      b. All main line piping shall be polyvinyl chloride pipe and shall be SDR 21, Class 200, integrated bell and spigot type rubber gasketed joint.
      c. All lateral pipe shall be polyvinyl chloride pipe and shall be SDR 21, Class 200, solvent weld bell end.

2. Fittings:
   a. Fittings for PVC main line piping shall be ductile iron gasketed fittings. The ductile iron fittings shall have deep bell push on joints with gaskets meeting ASTM F-477. These fittings shall be for change of direction and or tapped service tees. These fittings shall be manufactured by Harco Manufacturing or approved equal.
   b. Fittings for PVC lateral piping shall be schedule 40 PVC fittings, suitable for solvent weld and threaded connections.

C. Valves, And Associated Equipment:
   1. Cast Iron Ball Valve: Valves shall be 200 psi CWP and USA manufactured, valves to basically meet AWWA C-509. Body and bonnet are to be of cast iron alloy ASTM A-126 Class B. Valve to be epoxy coated inside and outside. Two upper o-ring stem seals. Sealed counter sunk body bonnet bolts providing no exposure of bonnet bolts. Stems to be stainless steel. Cast iron 2" square operating nut. Valve ends shall be IPS PVC push-on joint.
   2. Quick Coupler: Toro 476, 1 1/2" Quick Coupler or equal.
   3. Valves: Valves shall be Hunter HBV 3" brass globe valve or approved equivalent.

2.3 ACCESSORIES

A. Drainage fill shall be 1/2" to 3/4" crushed stone.

B. Fill shall be clean soil free of stones larger than 2" diameter, foreign matter, organic material and debris.
   1. Provide imported fill material as required to complete the work. Obtain rights and pay all costs for imported materials.
   2. Suitable excavated materials removed to accommodate the irrigation system work may be used as fill material subject to the Engineer's review and acceptance.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine final grades and installation conditions. Do not start irrigation system work until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Layout and stake the location of each pipe run and all sprinkler heads and sprinkler valves. Obtain Engineer's acceptance of layout prior to excavating.

B. All sleeves required for the installation of the irrigation system are to be installed by this contractor. Wires are to be installed in separate sleeves.

3.3 INSTALLATION

A. Excavation And Backfill:
   1. Excavation shall include all materials encountered.
   2. Excavate trenches of sufficient depth and width to permit proper handling and installation of pipe and fittings.
   3. Excavate to depths required to provide 2" depth of earth fill or sand bedding for piping when rock or other unsuitable bearing material is encountered.

4. Fill to match adjacent grade elevations with approved earth fill material. Backfilling will be done by hand placing soil under, around and above pipe so that it is hand tamped to a point 6" above the pipe. Special care shall be taken to insure that this layer is completely free of stones and other deleterious material. The remainder of the trench may be machine filled with appropriate available soil. Machine placed backfill shall be compacted to a suitable density by machine tamping and approved rolling to prevent settlement in trench.
    a. If within 1 year from the date of final acceptance, settlement due to improper compaction occurs and an adjustment in pipes, valves and sprinkler heads, turf or paving is necessary to bring the system, turf or paving to the proper level of the permanent grades, the Contractor, as part of the work under this contract, shall make said adjustments without extra cost to the Owner.
5. Except as indicated, install irrigation mains outside of the building with a minimum cover of 36" based on finish grades, unless otherwise noted.
6. Excavate trenches and install piping and fill during the same working day. Do not leave open trenches or partially filled trenches open overnight.
7. Where it is necessary to cross existing sidewalks, pipe shall be installed by boring under the walkways. Proper boring equipment shall be used so that undermining of the walkways does not occur.
8. Pipe shall be installed strictly in accordance with the printed recommendations of the manufacturer, including bedding of pipe in the bottom of trench and securely thrusting of any main line fittings at changes in direction of the pipe.
9. All main line piping shall be located outside the primary playing areas. All valve boxes shall be located no closer than 10 feet outside of the playing surfaces.
10. Where pipe is to be installed through walls, core drill wall of sufficient diameter to install pipe and conduit. Once pipe and conduit is installed, seal opening around pipe with non-shrinking grout. Openings shall be watertight.
11. Existing plant material and turf shall be protected during installation. If excavation is necessary in turf areas, remove and replace sod. Any existing planting material and turf damaged during the installation shall be repaired and or replaced at Contractor's expense.

B. Plastic Pipe:
1. Pipe lines shall be installed of the size shown on the drawings and/or specifications and of the materials and workmanship herein specified.
2. All main line piping outside of buildings to be installed in trenches as per the provisions of Section 3.3.A. Lateral piping may either be installed in trenches as above or by pipe pulling.
3. Pipe shall be installed strictly in accordance with the printed recommendations of the manufacturer, including bedding of pipe in the bottom of trench.

C. Sleeves:
1. All sleeves for installation of the irrigation system are to be installed by this contractor. All wire shall be installed in separate sleeves.

D. Testing:
1. The Contractor shall be responsible for all hydraulic pressure testing of main lines and lateral lines. The testing shall be on a continuous basis commencing when the first section of the installation is complete and available for testing and prior to the installation of the pipe insulation. Final testing of the whole system under full operating conditions to be done following complete installation of all main and lateral piping, valves and sprinklers.

2. Prior to testing of the main line pipe, pipe shall be backfilled. Testing for all main line pipe and interior lateral pipe shall consist of a continuous application of water at a pressure of 100 PSI to the piping for a one hour period without visual evidence of leaks. If a leak is discovered within this period, the Contractor shall immediately repair the break and the system then retested for the period described above in this section. Testing of lateral lines located outside of building shall be done on a zone by zone operating basis with any leaks or breaks repaired when evidenced.

E. Service:

1. The Contractor shall return to the site during the Fall seasons of the warranty period and winterize the system. Drain all water from the system and blow out the system with compressed air.
2. The Contractor shall return to the site during the Spring seasons of the warranty period, start-up the system and demonstrate to the Owner the proper procedures for the system start-up, operation, and maintenance.

3.4 SPARE PARTS

A. Above and beyond the installation requirement, the Contractor shall leave with the Owner, the following loose equipment:

1. (1) Valve box wrench.
2. (2) Quick coupler keys.

3.5 DISPOSAL OF WASTE MATERIAL

A. Transport unsuitable excavated material, including rock, to designated disposal areas. Stockpile or spread as directed. Remove from site and legally dispose of trash and debris.

3.6 ACCEPTANCE

A. Test and demonstrate to the Engineer and Owner, the satisfactory operation of the system free of leaks.

B. Instruct the Owner's designated personnel in the operation of the system, including adjustment of sprinklers, controllers and valves.

C. Upon acceptance, the Owner will assume operation of the system.

3.7 CLEANING

A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, soil, debris, and equipment. Repair damage resulting from irrigation system installation.

END OF SECTION

SECTION 329113 – SOIL PREPARATION

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes provisions for the placement of topsoil in conformance with the lines, grades and thicknesses as shown on the Drawings and as herein specified.

B. Minimum thickness is six (6) inches, for all areas disturbed during construction and not receiving other surface treatment.

C. The Contractor shall furnish all materials and perform all work in accordance with these specifications, drawings, and instructions provided by the Owner.

1.2 SUBMITTALS

A. Samples: Furnish earth materials to the testing laboratory for analysis and report, as directed by the Engineer or as outlined in the specifications.

B. Quality Control Submittals:
   1. Test Reports: The testing laboratory shall submit written reports of all tests, investigations, and recommendations to the Contractor and the Engineer. Indicate quantities of materials necessary to bring topsoil into compliance with textural/gradation requirements. Indicate quantity of lime and quantity and analysis of fertilizer.

1.3 REFERENCES

A. Comply with the latest edition of the following standards:
   1. "Standard Specifications, Construction and Materials, New York State Department of Transportation, Office of Engineering."
   2. "Standard Specifications for Highway Materials and Methods of Sampling and Testing, American Association of State Highway and Transportation Officials (AASHTO)."
   3. ASTM International (ASTM):
      a. C33, Standard Specification for Concrete Aggregates.
      b. C602, Standard Specification for Agricultural Liming Materials.
   4. U.S. Bureau of Reclamation (USBR):
      a. 514.4.4, Reclamation Instructions, Series 510—Land Classification Techniques and Standards, Part 514—Laboratory Procedures, Chapter 4—Particle-Size Analyses.
      b. 14.8.7, Reclamation Instructions, Series 510—Land Classification Techniques and Standards, Part 514—Laboratory Procedures, Chapter 8—Soil Chemical Tests.

1.4 QUALITY ASSURANCE

A. Contractor shall provide and pay for all costs in connection with an approved independent testing facility to determine conformance of soils and aggregate with the specifications.

1.5 PROJECT CONDITIONS

A. Coordinate the placement of topsoil with the completion of all underground work including that of the other trades.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Topsoil: Natural, friable, fertile, fine loamy soil possessing the characteristics of representative topsoils in the vicinity which produces a heavy growth; free from subsoil, objectionable weeds, litter, sods, stiff clay, stones larger than 1 inch in diameter, stumps, roots, trash, toxic substances, or any other material which may be harmful to plant growth or hinder planting operations. Contractor is to verify amount stockpiled and supply any additional as needed:

1. Topsoil shall contain not less than 6% nor more than 20% organic matter as determined by the wet combustion method (chronic acid reduction); topsoil shall have a pH value of not less than 5.5 nor more than 7.0.
2. Topsoil shall meet the following mechanical analysis:

SIZE OF SCREEN	% OF SOIL RETAINED	% OF SOIL PASSING
1”	0	100
1/4	3	97
No. 100	40-60	40-60

3. Imported topsoil in which more than 60% of the material passing a No. 100 sieve shall be rejected. All percentages are to be based on the dry weight of the samples.
4. Laboratory tests of the topsoil shall be performed by a certified testing laboratory, and shall perform tests for the following:
   a. Sieve particle size analysis and gradient of mineral content
   b. Chemical analysis of the following:
      1) pH and buffer pH
      2) percent of organic content
      3) nutrient levels of phosphorus, potassium magnesium, manganese, iron, zinc and calcium
      4) soluble salt
      5) cation exchange capacity (CEC).
   c. Recommended fertilizer and rate of application for low and medium level nutrient soils.

2.2 MATERIAL ACCEPTANCE

A. Topsoil may be acquired from approved sites that are designated on the Drawings. If no sites are designated, material proposed for use as topsoil must be stockpiled, sampled, and tested prior to use.

B. Topsoil containing foreign material may be rejected on the basis of visual examination by the Engineer, prior to testing.

C. Acceptance of topsoil shall be based upon test results. Tested topsoil must be approved in writing by the Engineer before any material is used.

2.3 SOIL AMENDMENT

A. Textural Amendments: Amend as necessary to conform to required composition by incorporating sand, peat, manure, or sawdust.

B. Fertilizer: Shall be delivered to the site, mixed as specified, in the original unopened standard size bags showing weight, analysis and name of manufacturer. Store fertilizer in a weatherproof place and in such a manner that it shall be kept dry and its effectiveness shall not be impaired.

1. Percentages of nitrogen, phosphorus and potash shall be based on laboratory test recommendations. For the purpose of bidding, assume 10% nitrogen, 6% phosphorus and 4% potash by weight. At least 50% of the total nitrogen shall contain no less than 3% water-insoluble nitrogen. At least 60% of the nitrogen content shall be derived from super-phosphate containing not less than 18% phosphoric acid or bone meal containing 25% - 30% phosphoric acid and 2% - 3% nitrogen. Potash shall be derived from muriate of potash containing 55% - 60% potash.
2. Grass or sodded areas shall have fertilizer applied according to soil text report or as specified on the drawings.

C. Organic Matter: Leaf matter and yard waste composted sufficiently to break down all woody fibers, seeds, and leaf structures, and free of toxic and non-organic matter. Organic matter shall be commercially prepared compost. Coarse sand shall be clean, sharp, natural sands free of limestone, shale and slate particles, ASTM C-33 fine aggregate with a Fines Modulus Index of 2.75 or greater.

D. Lime: Shall be ground palletized, or pulverized lime manufactured to meet agricultural standards and contain a maximum of 60 percent oxide.

PART 3 – EXECUTION

3.1 STOCKPILING

A. Stockpile topsoil from on-site sources or provide from off-site sources and stockpile, if on-site quantities are deficient.

B. Stockpiles are to contain not less than 200 cu. yds. or the minimum required for the project.

C. Stockpiles are to have a height of at least 4' and be trimmed to uniform surfaces and slopes.

D. The sites of all stockpiles and adjacent areas, which have been disturbed are to be graded and put into an acceptable condition by seeding, as directed by the Engineer.

3.2 PREPARATION

A. Preparation - Disk, drag, harrow or hand rake subgrade to a depth of 3 inches to provide bond for topsoil. Topsoil, which must be transported across finished walks, shall be delivered in such a manner that no damage will be done to the walks. The Contractor shall be responsible for the repair of such damage.

B. Before placing topsoil, rake subsoil surface clear of stones larger than 1½ inches, debris, and roots. Compact topsoil to form a layer with minimum depth of 4 inches in lawn areas and 12 inches in shrub beds. Topsoil shall be placed so that after final settlement there will be good drainage (and conforming to elevations shown on drawings). Contractor is to maintain surfaces and place any additional topsoil necessary to replace that which may have eroded before acceptance.

C. Locations containing unsuitable subsoil shall be treated in one of the following manners:

1. Where unsuitability within the construction site is deemed by the Owner to be due to excessive compaction caused by heavy equipment or by the presence of boards, mortar, concrete or other construction materials in subgrade, and where the natural subsoil is other than A.A.S.H.T.O. classification of A6 or 7, the Contractor shall loosen such areas with spikes, discs, or other means to loosen the soil to a condition acceptable by the Owner. The Contractor shall also remove all debris and objectionable material. Soil should be loosened to a minimal depth of 12 inches with additional loosening as required to obtain adequate drainage. Contractor may introduce peat moss, sand, or organic matter into the subsoil to obtain adequate drainage should he so desire. All such remedial measures shall be considered as incidental to the work and no extra payment shall be made for this part of the work.
2. Where subgrade is deemed by the Owner to be unsuitable because the natural subsoil falls into an AASHTO classification of A6 or 7 and contains moisture in excess of 30%, then such a condition shall be rendered suitable by installation of a subdrainage system or by other means described elsewhere in these specifications. Where such conditions have not been known or revealed prior to planting time and where they have not been recognized in the preparation of drawings and specifications, then the Owner shall issue a change order to install the proper remedial measures, all of which shall be in addition to the contract sum.

3.3 TOPSOIL PLACEMENT

A. Do not place topsoil when subsoil or topsoil is frozen, excessively wet, or otherwise detrimental to the work.

B. Mix soil amendments, lime, and fertilizer with topsoil before placement or spread on topsoil surface and mix thoroughly into entire depth of topsoil before planting or seeding. Delay mixing of fertilizer if planting or seeding will not occur within 3 days.

C. Place 1/2 of total depth of topsoil and work into subgrade soil to create a transition layer. Place remainder of topsoil to depth after compacting to 75 percent where seeding and planting are scheduled.

D. Uniformly distribute to within 1/2 inch of final grades. Fine grade topsoil eliminating rough or low areas and maintaining levels, profiles, and contours of subgrade to ensure positive drainage.

E. Remove stones exceeding 1 inch, roots, sticks, debris, and foreign matter during and after topsoil placement.

F. Remove surplus subsoil and topsoil from Site. Grade stockpile area as necessary and place in condition acceptable for planting or seeding.

3.4 CLEANING

A. Remove all surplus subsoil and topsoil from project site.

B. Leave the site in clean, satisfactory condition ready to receive subsequent operations.

END OF SECTION

SECTION 329200 – TURF AND GRASSES

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the preparation of ground surfaces, fertilization of applicable areas, seeding, mulching of applicable surface areas, and maintenance of turf areas until such time as project is accepted by Owner and Engineer. Applicable areas shall include those identified on the Contract Drawings.

B. Seed shall be sown from April 1 to June 15, or from August 15 to October 15 of given calendar year, unless otherwise approved by Engineer.

1.2 SUBMITTALS

A. Quality Control Submittals:
   1. Certification:
      a. Submit manufacturer's or vendor's certified analysis for soil amendments and fertilizer materials.
      b. Submit vendor's certified analysis for each grass seed mixture required, stating botanical and common name, percentages by weight, percentages by purity, germination, and weed seed.

B. Maintenance Instructions: Submit instructions recommending procedures to be implemented for maintenance of landscaped work for one (1) full year. Submit prior to expiration of Contractor's maintenance period.

C. Submit description of planned mulching techniques and corresponding manufacturer's installation recommendations for approval by Engineer.

1.3 QUALITY ASSURANCE

A. All turf and grasses work shall be performed by one Contractor, with proven expertise in this type of construction**.**

B. Package standard products with the manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.

C. The Contractor shall provide and pay for all costs in connection with an approved independent testing facility to determine conformance of materials with the specifications.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials in containers, showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery, and while stored on site.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Fertilizer:

1. Commercial fertilizer (5-10-5) inorganic, or organic, containing not less than five (5) percent nitrogen, ten (10) percent available phosphoric acid, and five (5) percent water soluble potash.
2. If, as an alternative, the Contractor wishes to substitute for commercial fertilizer 5-10-5, another commercial fertilizer with a 1-2-1 ratio, such as 10-20-10 or 6-12-6, they may do so with the approval of the Engineer and the rate of fertilizer to be used shall be whatever amount is required to furnish the same amount of nitrogen as would be supplied by the 5-10-5.

B. Seed:

1. Seed shall be fresh, clean, new-crop seed mixed in the proportions specified for species and variety, conforming to Federal and State Standards.
2. Use the following standard mixture blue seal classic, unless a special mixture is otherwise indicated or approved by the Engineer.

SPECIES	**% BY WEIGHT**	**% BY PURITY**	**% BY GERMINATION**
Kentucky Bluegrass*	80	85	80
Tall Fescue	20	95	85
**Kentucky Bluegrass must consist of a minimum of two varieties.*			

3. Weed seed content shall not exceed 0.25%.

C. Mulch:

1. Provide and install a mulch adequate to protect the seeding during its growing period. It shall be the responsibility of the Contractor to determine the appropriate mulching techniques for the particular site conditions and acquire approval of the same from the Engineer.
2. Clean straw for gentle slopes, consisting of stalks of oats, wheat, rye, or other approved crops which are free of noxious weed seeds. Weight shall be based on a fifteen (15) percent moisture content.
3. Mulching blanket for steep slopes and drainage swales: "Curlex Blanket" by American Excelsior, "Ero-Mat" by Contech Construction Products, Inc, or approved equal.
4. Bonded fiber matrix for mulching in areas where slopes are 1.5H:1V or greater, or cut or fill slopes 20 feet (6m) or more in height. Product shall be EcoAegis as manufactured by Canfor, or approved equal meeting U.S. DOT Standard Specification FP-96, Section 713.05(h).
   a. Package Weight: 50 pound (18.6kg) bags.
   b. Moisture Content: 12 +/- 3 percent by weight.
   c. Minimum Water Holding Capacity: Approximately 10 times dry weight.
   d. Composition:
      1) Refined Softwood Fiber: (90% by weight).
      2) Blended Hydrocolloid-based Binder: (9% by weight).
      3) Mineral Activator: (1% by weight).
   e. Color: Natural – No Dye Products.

D. Water: Clean and potable.

2.2 ACCESSORIES

A. Soil Amendments: Soil amendments are not to be made without review and authorization by the Engineer.

1. Lime: Natural limestone containing not less than 85% of total carbonates, ground so that not less than 90% passes a 10-mesh sieve and not less than 50% passes a 100-mesh sieve.
2. Aluminum Sulfate: Commercial grade.
3. Peat Humus: FS Q-P-166 and with texture and pH range suitable for intended use.
4. Bonemeal: Commercial, raw, finely ground; 4% nitrogen and 20% phosphoric acid.
5. Superphosphate: Soluble mixture of treated minerals; 20% available phosphoric acid.
6. Sand: Clean, washed sand, free of toxic materials.
7. Perlite: Conforming to National Bureau of Standards PS 23.
8. Vermiculite: Horticultural grade, free of toxic substances.
9. Sawdust: Rotted sawdust, free of chips, stones, sticks, soil, or toxic substances and with 7.5 pounds (2.8 kg) nitrogen uniformly mixed into each cubic yard of sawdust.
10. Manure: Well rotted, unleached stable or cattle manure containing not more than 25% by volume of straw, sawdust, or other bedding materials and containing no chemicals or ingredients harmful to plants.
11. Commercial Fertilizer: Complete fertilizer of neutral character, with some elements derived from organic sources and containing available plant nutrients.
12. Composted Organic Material: Shall have a minimum organic matter content of 60 percent, as determined by ASTM D-2974, and screened to ¾-inch (1.9 cm).

PART 3 – EXECUTION

3.1 PREPARATION OF TOPSOIL

A. Clean topsoil of roots, plants, stones, clay lumps and other extraneous materials harmful or toxic to plant growth.

B. Mix fertilizer into top 2 inches (5 cm) of topsoil at a rate of 10 pounds (3.7 kg) per 1,000 square feet (92.9 m^2).

C. Mix approved soil amendments into top 2 inches (5cm) of topsoil at necessary rates.

D. Water dry topsoil to depth of 4 inches (10cm) at least 48 hours prior to seeding to obtain a loose friable seed bed.

3.2 PREPARATION OF UNCHANGED GRADES

A. Where lawns are to planted in areas not altered or disturbed by excavating, grading, or stripping, prepare soil for seeding as follows:

1. Till to a depth of not less than 6 inches (15cm).
2. Apply soil amendments and initial fertilizers as specified.
3. Remove high areas and fill in depressions.
4. Till soil to a homogeneous mixture of fine texture, free of lumps, clods, stones, roots, and other extraneous matter.
   a. Prior to preparation of unchanged areas, remove existing grass, vegetation and turf. Dispose of such materials off the site; do not turn over into soil being prepared for lawns.

b. Apply specified commercial fertilizer at rates specified and thoroughly mixed into upper 2 inches (5 cm) of topsoil. Delay application of fertilizer, if lawn planting will not follow within one week.

3.3 SEEDING

A. Apply seed only when wind velocities are less than five (5) miles per hour (9km/hr).

B. Sow half the seed with mechanical seeder.

C. Sow remaining half of the seed at right angles to the direction of the first seeding pattern, using the same method.

D. Apply seed at the rate of 4 pounds (1.5 kg) per 1,000 square feet (92.9 sq. meters) of disturbed area.

E. Cover seed to a depth of ⅛-inch (3mm) by raking, harrowing, or cultipacking.

F. Roll seeded area with roller weighing no more than 150 pounds per foot of roller width.

G. Water seeded areas to a depth of four (4) inches (10cm) as required during the maintenance period.

3.4 MULCHING

A. Spread straw uniformly over seeded area with 75% ground coverage and at least 1-½ inches loose depth.
   1. If, in the opinion of the Engineer, wind will disrupt the mulching, apply asphalt emulsion at a rate of 10 gallons (37.81) per 1,000 square feet (92.9 m^2).

B. Place mulching blanket in accordance with submitted manufacturer's recommendations.

C. Place bonded fiber matrix mulch material, EcoAegis, at a rate of 3,500 to 4,100 pounds per acre, based on manufacturer's recommendations.

3.5 HYDROSEEDING

A. Mix specified seed, fertilizer, and pulverized mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

B. Apply slurry uniformly to all areas to be seeded. Rate of application as required to obtain specified seed sowing rate.

3.6 PROTECTION

A. Immediately after seeding, erect barricades and warning signs as required to protect newly planted areas from pedestrian and vehicular traffic. Maintain barricades throughout maintenance period until grass and/or turf is established.

B. Repair or replace damaged landscape work as directed by Engineer.

3.7 MAINTENANCE

A. Begin maintenance immediately after seed placement.

B. Watering:
   1. Keep soil moist during seed germination period.
   2. Supplement rainfall to produce a total depth penetration of 2 inches per day after germination.
   3. Prevent erosion and displacement of seed.

C. Mowing:
   1. When grass reaches 4 inches in height, mow to 2-½ inches in height.
   2. Maintain grass between 1-½ inches and 2-½ inches in height.
   3. Do not cut off more than 30% of grass leaf in a single mowing.
   4. Remove grass clippings.

D. Reseed and mulch spots larger than 1 square foot not having uniform coverage.

E. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regardening, and replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas.

F. Maintain and protect all seeded areas until final acceptance of the Contract. Final acceptance of "Turf and Grasses" will not be made until an acceptable uniform stand of grass is obtained in all new lawn areas, except that the Engineer at their discretion may accept a portion or portions of the "Turf and Grasses" at various times. Upon acceptance by the Engineer of a seeded area, the Owner will immediately assume responsibility for maintenance and protection of that portion of the Contract Seeding.

END OF SECTION

SECTION 329300 – PLANTINGS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the installation and maintenance of exterior plantings including all trees, shrubs, vines and ground covers as shown on the Drawings, or as specified herein.

1.2 SUBMITTALS

A. Before plant material is shipped to the project site, submit a complete itemized list of all plants including the source of supply.

B. Samples for Verification: For each of the following:
   1. 5 lb (2.2 kg) of mulch for each color and texture required, in labeled plastic bags.
   2. Edging materials and accessories, of manufacturer's standard size, to verify color selected.

C. Material Test Reports: For existing surface soil and imported topsoil.

D. Planting Schedule: Indicating anticipated planting dates for exterior plants.

E. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of exterior plants during a calendar year. Submit before expiration of required maintenance periods.

1.3 QUALITY ASSURANCE

A. All landscaping work shall be performed by one (1) Contractor, with proven experience in this field.

B. Reference Standards:
   1. The latest edition of the following standards, as referenced herein, shall be applicable.
      a. "Standardized Plant Names," American Joint Committee of Horticultural Nomenclature.
      b. "American Standard for Nursery Stock," American Association of Nurserymen, Inc.
      c. American National Standards Institute (ANSI).

C. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

D. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity (CEC); sodium absorption ratio; deleterious material, pH; and mineral and plant-nutrient content of topsoil.
   1. Report suitability of topsoil for plant growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to product a satisfactory topsoil.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Preparation for Delivery:

1. Balled and burlapped (B&B) trees and shrubs shall be dug and prepared for shipment in a manner that will not damage roots, branches, shape and future development after replanting. The trees and shrubs shall be balled with firm, natural balls of soil and wrapped with burlap and tied in accordance with ANSI Z60.1.
2. All container grown shrubs shall be healthy, vigorous, well rooted, and established in the container in which they are growing. They shall have tops of good quality and be in a healthy growing condition. A container shrub shall be in that container a sufficient time that fibrous roots are formed so the shape will remain and the medium will hold together when removed from the container. All shrubs sold in containers shall meet Contract Documents for both plant size and container size. The plant size shall agree with sizes specified in the American Standard for Nursery Stock.
3. Ground covers shall be supplied in pots or flats; plants shall be 1 year old cuttings (min.) with well established root systems.

B. Furnish the following with each planting material delivery:

1. An invoice indicating sizes, quantity, genus, species and variety of exterior plant material.
2. All certificates of inspection required by State and Federal agencies.
3. Labels for each plant or bundles of plants indicating name and size.

C. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants and trees in shade, protect from weather and mechanical damage, and keep roots moist.

D. Deliver fertilizer in manufacturer's standard sized bags showing weight, analysis, and manufacturer's name. Store under a waterproof cover or in a dry place as approved by the Engineer.

1.5 PROJECT REQUIREMENTS

A. Plant tree, shrubs, vines and ground covers after finish grades are established and before lawns are seeded, unless otherwise acceptable to the landscape architect.

B. Plant trees, shrubs, vines and ground covers only when weather and soil conditions are suitable in accordance with locally accepted practice.

C. Planting Season:

Spring:	Deciduous -	April 1 to May 20
	Evergreen -	April 1 to May 20
Fall:	Deciduous -	October 1 to November 15
	Evergreen -	Only on approval of the Landscape Architect

PART 2 – PRODUCTS

2.1 MATERIALS

A. Plants:
   1. Furnish nursery-grown exterior plants complying with ANSI Z60.1. Provide well-formed and shaped, true to type, and free from disease such as knots, sun-scald, windburn, injuries, abrasions or disfigurement.
   2. Comply with the "PLANTING SCHEDULE" as shown on the Drawings.

B. Planting Soil:
   1. Mix three (3) parts acceptable topsoil with one (1) part peat moss.

C. Topsoil:
   1. ASTM D 5268, pH range of 5.5 to 7, a minimum of 10 percent organic material content; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth.

D. Peat:
   1. Finely divided or granular texture, with a pH range of 6 to 7.5, containing partially decomposed moss peat, native peat, or reed-sedge peat and having a water-absorbing capacity of 1100 to 2000 percent.

E. Fertilizer:
   1. Bonemeal - Commercial, steamed finely ground material with a minimum of 1.0 percent nitrogen and a minimum of 11 percent phosphoric acid.
   2. Commercial Fertilizer (10-6-4) - Containing not less than 10 percent nitrogen, 6 percent available phosphoric acid and 4 percent water soluble potash.

F. Top Mulch:
   1. 3" depth on all plant pits or beds, on top of weed control fabric placed inside of plant pits as approved.

G. Wrapping Material:
   1. Trunk-Wrap Tape: Two layers of crinkled paper cemented together with bituminous material, 4-inch (100-m-) wide minimum, with stretch factor of 33 percent.
   2. Lightly tarred medium or course sisal yarn. Nylon twine or rope is <u>not</u> acceptable.
   3. Rodent guards, as approved by Engineer or Landscape Architect.

H. Guying and Staking Material:
   1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, redwood, or pressure-preservative-treated softwood, free of knots, holes, cross grain, and other defects, 2 by 2 inches (50 by 50 mm) by length indicated, pointed at one end.
   2. Guy and Tie Wire: ASTM A 641/A 641M, Class 1, galvanized-steel wire, 2-strand, twisted, 0.106 inch (2.77 mm) in diameter.
   3. Guy Cable: 5-strand, 3/16-inch- (4.8-mm-) diameter, galvanized-steel cable, with zinc-coated turnbuckles, a minimum of 3 inches (75 mm) long, with two 3/8-inch (10-mm) galvanized eyebolts.

4. Hose Chafing Guard: Reinforced rubber or plastic hose at least 1/2 inch (13 mm) in diameter, black, cut to lengths required to protect tree trunks from damage.
5. Flags: Standard surveyor's plastic flagging tape, white, 6 inches (150 mm) long.

I. Water:
1. Clean, Potable.

J. Weed Control Barriers:
1. Polyethylene Sheeting: ASTM D 4397, black, 0.006-inch- (0.15 –mm-) minimum thickness.
2. Non-woven Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. (101 g/sq. m) minimum.
3. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a non-woven polypropylene fabric, 4.8 oz./sq. m).

K. Antidesiccant:
1. Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

PART 3 – EXECUTION

3.1 INSPECTION

A. Verify final grades have been established prior to beginning planting operations.

B. Inspect trees and ground covers for injury, insect infestation or improper pruning. Do not begin planting until deficiencies have been corrected, or plants replaced.

C. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake out all exterior plant locations and planting areas.

B. Do not begin excavation until stakeout is approved by the Engineer.

C. Excavate pits for trees to the dimensions as detailed on the Drawings and for ground covers as required. Dispose of excavated material off site unless otherwise approved by the Engineer.

3.3 PLANTING

A. Center the plant in the pit and face for best effect. Set the plant plumb and hold in position until planting soil has been tamped firmly around ball or roots. Complete backfilling with planting soil and settle continuously with water. Form saucers during the growing season and remove before winter.

B. Balled Plants - Set plants in position and backfill 1/3 depth of ball. Remove burlap and wire baskets from tops of root balls and partially from sides and adjust to eliminate air pockets. Complete backfilling while settling with water.

C. Bare Root Plants - Set plants in position and place planting soil around roots while settling with water. Use care to avoid breaking roots when firming soil.

D. Set potted and container-grown stock plumb and in center of pit or trench with top of root ball flush with adjacent finish grades.

1. Carefully remove root ball from container without damaging root ball or plant.
2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planing soil mix.

3.4 MULCHING

A. Mulch to thicknesses as shown on the Drawings for trees, shrubs, vines, or to 2 inches for ground covers on top of weed control fabric. Water thoroughly after mulching.

3.5 WRAPPING

A. Wrap all deciduous trees within four (4) days after planting.

B. Wrap from the ground line to the height of the second branches, overlapping 1-1/2 inches, and tie the wrapping securely in place. Wrap trees of 2 inch caliper and larger with tree trunk wrap tape.

3.6 STAKING

A. Upright Staking and Tying: Stake trees of 2- through 5-inch (50-through 125-mm) caliper. Stake trees of less than 2-inch (50-mm) caliper only as required to prevent wind tip-out. Use a minimum of 2 stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation and to extend at least 72 inches (1830 mm) above grade. Set vertical stakes and space to avoid penetrating root balls or root masses. Support trees with two strands of tie wire encased in hose sections at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree. Use the number of stakes as follows:

1. Use 2 stakes for trees up to 12 feet (3.6 m) high and 2-1/2 inches (63 mm) or less in caliper; 3 stakes for trees less than 14 feet (4.2 m) high and up to 4 inches (100 mm) in caliper. Space stakes equally around trees.

B. Guying and staking: Guy and stake trees exceeding 14 feet (4.2 m) in height and more than 3 inches (75 mm) in caliper, unless otherwise indicated. Securely attach no fewer than 3 guys to stakes 30 inches (760 mm) long, driven to grade.

1. For trees more than 6 inches (150 mm) in caliper, anchor guys to pressure-preservative-treated deadmen 8 inches (200 mm) in diameter and 48 inches 1200 mm) long, buried at least 36 inches (900 mm) below grade. Provide turnbuckles for each guy wire and tighten securely.
2. Attach flags to each guy wire, 30 inches (760 mm) above finish grade.
3. Paint turnbuckles with luminescent white paint.

3.7 MAINTENANCE

A. Begin maintenance immediately after each item is planted and continue throughout the Contract.

B. Maintenance shall consist of keeping plants in a healthy, growing condition by watering, weeding, cultivating, pruning, spraying, tightening of guys, weeding, remulching and by any other necessary operations.

C. Water all plants at least once per week between April 1 and October 31 with approximately 5 gallons per square yard (1 inch layer of water) per watering unless otherwise specified. Provide additional watering during dry periods as required or directed by the Engineer.

D. Keep planting saucers and beds free of weeds, grass and other undesired vegetation.

E. Apply fertilizers and herbicides with good horticultural methods to promote growth and control insects, disease or rodents.

END OF SECTION

SECTION 330500 – COMMON WORK RESULTS FOR UTILITIES

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes the installation of buried piping.

1.2 REFERENCES

A. The following references shall be applicable:
1. American Society of Testing and Materials (ASTM).
2. American National Standards Institute (ANSI).
3. American Water Works Association (AWWA).
4. Uni-Bell Plastic Pipe Association.

1.3 SUBMITTALS

A. Submit for approval a schedule for all proposed testing. Include proposed testing procedures indicating the sequence in which pipe sections will be tested and description of methods and equipment to be used.

B. Field Test Reports: Submit results of field testing directly to Engineer with copy to Contractor.

1.4 STORAGE, AND HANDLING

A. Deliver and store materials within the Contract limits, as approved by Engineer.

B. Handle materials carefully with approved handling devices in accordance with manufacturer's recommendations. Special care shall be exercised during delivery and storage to avoid damage to the materials.

C. Do not drop or roll products off trucks. Products are not to be otherwise dragged, rolled, or skidded.

D. Materials shall be stored on heavy wood blocking or platforms in accordance with the manufacturer's instructions and recommendations. Materials shall not be in contact with the ground and their interiors shall be maintained free from dirt and other foreign matter.

E. Products cracked, gouged, chipped, dented, or otherwise damaged will not be approved and are to be removed and replaced at the Contractor's expense, unless the product can be repaired in a manner acceptable to the manufacturer and the Engineer. All repairs shall be at the Contractor's expense.

1.5 COORDINATION

A. Contractor shall be responsible for coordinating site utility work with other trades to ensure building service connection locations are verified and coordinated prior to commencing site construction.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Conform to individual pipe specification(s).

B. Pipe transition fittings: Shall be as indicated on the drawings. If not specifically indicated selection shall be based on pressure requirements of the system and types of materials being joined. Product selection shall be approved by the engineer.

C. Grout:
   1. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
      a. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
      b. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
      c. Packaging: Premixed and factory packaged.

D. Flowable Fill:
   1. Description: Low-strength-concrete, flowable-slurry mix.
      a. Cement: ASTM C 150, Type I, portland.
      b. Density: 115- to 145-lb/cu. ft. (1840- to 2325-kg/cu. m)
      c. Aggregates: ASTM C 33, natural sand, fine and crushed gravel or stone, coarse.
      d. Aggregates: ASTM C 33, natural sand, fine.
      e. Admixture: ASTM C 618, fly-ash mineral.
      f. Water: Comply with ASTM C 94/C 94M.
      g. Strength: 100 to 200 psig (690 to 1380 kPa) at 28 days.

PART 3 – EXECUTION

3.1 UTILITY DEMOLITION

A. Disconnect, demolish, and remove piped utility 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. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material.
   3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.
   5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

3.2 BURIED PIPE INSTALLATION

A. General:
   1. Installation of all pipe, fittings, valves, specials and appurtenances shall be subject to the review and/or approval of the Engineer.
   2. Install piping valves and fittings as shown, specified and as recommended by the manufacturer and in conformance with referenced standards, and approved Shop Drawings.
   3. Request instructions from Engineer before proceeding if there is a conflict between the manufacturer's recommendations and the Drawings or Specifications.
   4. All piping and appurtenances shall be inspected by the Engineer prior to installation. Engineer's inspection will not relieve Contractor or manufacturer from responsibility for damaged products.

5. Present all conflicts between piping systems and equipment, structures or facilities to Engineer for determination of corrective measures before proceeding.
6. Take field measurements prior to installation to ensure proper fitting of Work. Uncover the existing pipelines sufficiently in advance of the proposed Work in order that the type and location of the existing pipes and joints and other information required to fabricate the proposed piping can be determined. Obtain whatever information is required to complete the connections of the proposed pipelines to the existing pipelines.
7. Carefully examine all piping for cracks, damage or other defects before installation. Immediately remove defective materials from the site, unless the defective materials can be repaired in a manner acceptable to the manufacturer and Engineer. Remove, replace or repair at the Contractor's expense piping found to be broken or defective.
8. Inspect interior of all piping and mating surfaces and remove all dirt, gravel, sand, debris or other foreign material before installation. Maintain the interior of all piping clean until acceptance of the completed Work. Prevent foreign matter from entering joint space.
9. Install buried piping accurately to line and grade shown, specified or directed, unless otherwise approved by the Engineer. Use accurate means of determining and checking the alignment and grade subject to the approval of the Engineer. Remove and relay piping that is incorrectly installed at Contractor's expense.
10. Do not lay piping in water, unless approved by the Engineer. Ensure that the water level in the trench is at least 6 inches below the bottom of piping. Maintain a dry trench until jointing and backfilling are complete, unless otherwise specified in these Specifications or approved by the Engineer.
11. Pipe laying work shall be conducted so that trenching operations are not advanced too far ahead of the pipe laying operation resulting in excessive lengths of open trench. In general, open trench ahead of pipe laying shall not exceed 50 feet.
12. Start laying piping at lowest point and proceed toward the higher elevations, unless otherwise approved by the Engineer. Slope piping uniformly between elevations shown on the Drawings or as otherwise provided by the Engineer.
13. Where pipe crossings occur, the lower pipe shall be laid first and all backfill thoroughly compacted to the level of the higher pipe before the higher pipe is installed. Backfill material under such conditions may be earth, broken stone, or 2500 psi concrete.
14. Install piping so that the barrel of the piping and not the joints receives the bearing pressure from the trench bottom, or other bedding condition.
15. No piping shall be brought into position until the preceding length, valve, fitting, or special has been bedded and secured in place.
16. Whenever pipe laying is not actively in progress, the open ends of the piping shall be closed by a temporary plug or cap to prevent soil, water and other foreign matter from entering the piping.
17. Where required for inserting valves, fittings, special appurtenances, and closures, shall be made with a machine specially designed for cutting piping and in accordance with the manufacturer's instructions for field cutting of pipe. Make cuts carefully, without damage to piping, so as to leave a smooth end at right angles to the axis of the piping. Taper cut ends and file off sharp edges until smooth. Flame cutting will not be permitted. Replace and repair damaged piping.
18. Blocking under piping will not be permitted unless specifically approved by Engineer for special conditions.
19. Touch up protective and linings and coatings prior to installation.
20. Rotate piping to place outlets in proper position.

B. Bedding and Backfilling:

1. Bedded and installed piping in conformance with Section "Trenching and Backfilling" and as shown, except as otherwise specified.

2. No piping shall be laid until Engineer approves the bedding condition.
3. Excavation in excess of that required as shown on the Drawings or specified, which is not authorized by the Engineer, shall be at the Contractor's expense. Backfilling and compaction of the overexcavated areas shall be at the Contractor's expense.
4. Carefully and thoroughly compact all pipe bedding and fill up to the pipe centerline with hand-held pneumatic compactors.

C. Restraints, Supports, and Thrust Blocks:
1. Install restrained joints as shown, specified, required, and as recommended by manufacturer. Assembly of restrained joints shall be in strict accordance with manufacturer's recommendations.
2. Provide concrete and metal cradles, collars, and blocks as shown on the Drawings or otherwise required by Engineer.
3. Thrust Blocks:
   a. Provide concrete thrust blocking to resist test pressure on all plugs, caps, tees, bends and other fittings in pressure piping systems unless otherwise shown on the Drawings.
   b. Conform to the details for concrete thrust blocks and tie rods.
   c. Concrete: 3000 psi, placed around the fittings to completely fill the space between the fittings and the undisturbed walls of the trench. Do not overlap any joint with concrete and place concrete so as not to interfere with removing or installing any of the jointing hardware.
4. Retainer Glands (for water distribution and sewer forcemain piping):
   a. Provide retainer glands for joint restraint of all fittings and valves.
   b. Retainer glands shall be Megalug Series 1100 as manufactured by EBAA or approved equal.

D. Transitions From One Type of Pipe to Another:
1. Provide all necessary adapters, specials and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

E. Work Affecting Existing Piping:
1. Location of Existing Piping:
   a. Locations of existing piping shown shall be considered approximate. Contractor shall perform all necessary subsurface investigation to verify actual locations in the field.
   b. Determine exact location of existing piping to make connections, relocate, replace or which may be disturbed during earth moving operations, or which may be affected by work in any way.
   c. Coordinate all excavations with utility companies, Owner and Engineer.
2. Taking Existing Pipelines Out of Service:
   a. Do not take pipelines out of service unless specifically approved by Engineer.
   b. Notify Engineer at least 48 hours prior to taking any pipeline out of service.

3.3 SPECIFIC PIPE INSTALLATION

A. Polyvinyl Chloride Pipe (PVC):
1. Water Distribution/Pressure Sewers: Install all PVC pipe in accordance with AWWA Standard C605 "Underground Installation of PVC Pressure Pipe and Fittings for Water".
2. Lay pipe with bell and spigot joints with bells upstream.
3. Completely clean all jointing surfaces and adjacent areas prior to making joint.
4. Field cut pipe for shorter than standard pipe lengths. Cut ends square and perpendicular to the pipe axis. Remove and smoothly bevel ends. Field spigots shall be stop marked with a felt tip mark or

wax crayon for proper length of assembly insertion. The angle and depth of field bevels, and lengths to stop marks, shall be comparable in quality to factory made spigots.

5. Assemble all joints in accordance with recommendations of the manufacturer. If a lubricant is required to facilitate assembly it shall have no detrimental effect on the gasket or on the pipe when subjected to prolonged exposure.
6. Rotate the spigot by hand or with a strap wrench to verify proper jointing. If unusual joining resistance is encountered or if the insertion mark does not reach the flush position, disassemble the joint, inspect for damage, reclean the joint components and repeat the assembly steps.
7. Use a bar and wood blocking to properly seat pipe joints. DO NOT USE BACKHOE BUCKET, OR SIMILAR MACHINERY, TO FORCE JOINT ASSEMBLY.

B. High Density Polyethylene Pressure Pipe (HDPE):

1. Install HDPE in accordance with ASTM D-2774 "Standard Practice for Underground Installation of Thermoplastic Pressure Pipe".
2. Install HDPE Water Piping in accordance with ASTM F-645 "Standard Guide for Selection Design and Installation of Thermoplastic Water – Pressure Piping Systems".
3. All joints shall be butt fusion welded in accordance with ASTM F-2620 "Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings", and the manufacturer's recommendations. Guarantee the integrity of all fused joints for one year.
4. HDPE pipe can be jointed at ground level and lowered into the trench. Precautions shall be taken not to drop the pipe or to "kink" the pipe due to exceeding the minimum acceptable bending radius. Replace damaged pipe.
5. When pulling HDPE pipe is necessary, either a pulling head or a suitable wraparound sleeve with rubber protective cover shall be used to prevent the pulling cables from damaging the pipe.
6. Do not install HDPE piping above grade or within buildings.

C. High Density Polyethylene Gravity Piping (HDPE):

1. Install in accordance with the pipe manufacturer's specifications.
2. Completely clean all jointing surfaces and adjacent areas prior to making joints.
3. Field cut pipe for shorter than standard pipe lengths. Cut ends square and perpendicular to the pipe axis. Remove and smoothly bevel ends.
4. Assemble all joints in accordance with recommendations of the manufacturer. If a lubricant is required to facilitate assembly, it shall have not detrimental affect on the gasket or on the pipe when subjected to prolonged exposure.

3.4 FIELD QUALITY CONTROL

A. General:

1. Notify Engineer at least 48 hours in advance of all testing.
2. Provide all testing apparatus including pumps, hoses, gauges, fittings, temporary bulkheads, plugs, compressors and miscellaneous other required items.
3. Provide temporary blocking and bracing or approved thrust and joint restraint to prevent joint separation and pipe movement during testing.
4. Unless otherwise approved, conduct all tests in the presence of the Engineer and in the presence of local authorities having jurisdiction.
5. Water Source:
   a. Provide all water for testing, flushing and other water uses. The source of the water shall be subject to the approval of the Engineer.

b. The point of introduction of water for conducting tests shall be subject to the approval of the Engineer.

6. All costs for tests shall be included in the Contractor's bid.
7. Locate, and repair or replace, section of piping which fail the test and retest until acceptance.

B. Required Tests for Waterlines and Force Mains:

1. Perform the following after the pipe has been installed and prior to final acceptance:
   a. Pressure Test.
   b. Leakage Test.
2. Presumptive hydrostatic tests may be performed when the system is partially backfilled to "check" the work, but final acceptance shall be based on hydrostatic tests performed on the finished system after it is completely backfilled.
3. Pressure Test:
   a. Test piping to 1.5 times the pipe working pressure, or 150 psi, whichever is greater. Measure test pressures at the lowest point in the pipe section and correct to the elevation of the gauge.
   b. Relieve trapped air at the section high points through hydrants, or taps installed for this purpose, provided temporary installations are removed and plugged after acceptance.
   c. Maintain the test pressure for a period of two (2) hours. At the end of the test period, if the test pressure remains constant, the pipe section shall have passed the test. If the pressure has dropped, it shall be brought back to the test pressure by pumping a known volume of water (by pumping from a graduated container or by metering) back into the pipe. The volume of water thus used, representing leakage from the pipe, shall be recorded. If the leakage is less than the allowable leakage specified below, the pipe shall have passed the test. If the leakage exceeds the allowable leakage specified, the Contractor shall locate the leak, permanently repair the section of pipe where the leak is occurring to the satisfaction of the Engineer, and retest the pipe as specified above.
4. Leakage Test:
   a. Conduct the leakage test concurrently with the pressure test.
   b. The maximum allowed leakage is determined by the following formula:

$$\frac{L = N \times D \times P^{1/2}}{7400}$$

where L = allowable leakage, in gph
where N = No. of joints in test section
where D = nominal pipe diameter, in inches
where P = average test pressure, in psig

5. Acceptance shall be determined on the basis of allowable leakage. If any pipe section discloses leakage greater than that specified, locate, repair and retest until the leakage is within the limits specified.
6. Make all visible leaks tight regardless of the amount of leakage, and if the lines do not meet the above leakage test, repair and retest as necessary until the leakage requirement is met. Repair or replace all defective work.

C. Disinfection of Potable Water Mains:

1. Disinfect all potable water mains in accordance with the latest version of AWWA C651, except that the placement of chlorine powder or tablets inside the pipe during installation shall not be allowed. Disinfect water mains after the piping has passed the pressure and leakage testing.

2. Flush the pipe with water at a minimum velocity of 2.5 feet per second (fps) to clear all foreign material from the pipe.
3. Apply a chlorine solution with a concentration between 50 parts per million (ppm) and 100 ppm. The chlorine solution shall remain in the piping for a minimum of 24 hours. The concentration at the end of this period shall be at least 25 ppm in all sections of the main. Repeat the entire procedure if the residual is less than 25 ppm.
   a. While the chlorinated water is being added, all appurtenances (valves, hydrants, etc.) shall be operated so as to completely disinfect the new work.
   b. Position valves so that the chlorine solution in the section being disinfected will not flow into water mains in active service.
   c. Chlorine residual samples shall be taken as directed by the Engineer.
4. After the twenty four (24) hour retention period, flush the main until residual testing indicates that the chlorine concentration is approximately that of the neighboring service area.
   a. Dispose of heavily chlorinated water into sanitary sewer or tank truck.
   b. The Owner and the owner of the sanitary sewer system shall be notified a minimum of twenty-four (24) hours prior to the discharge of any water to the sanitary sewer. Contractor shall submit to the Engineer written confirmation that the owner of sanitary sewer system has approved the discharge of water to its sanitary sewer.
   c. Under no circumstances will the emptying of water onto roadways, or into ditches, culverts, streams or wetlands be allowed.
5. After disinfection and final flushing, and prior to placing the lines in service, the Contractor shall collect bacteriological samples (both coliform and heterotrophic plate count) and submit samples to an approved testing laboratory. Two consecutive sets of samples shall be taken at least 24 hours apart in accordance with AWWA C651. The collection points shall be as directed by the Engineer and local authority having jurisdiction.
   a. The testing laboratory performing the bacteriological analysis shall be acceptable to the Engineer.
   b. Submit three (3) copies of the laboratory analysis to the Engineer.
   c. Should safe results not occur after laboratory tests, the Contractor shall, at his expense, repeat the disinfection procedure until safe results are obtained. This includes a positive result for coliform or a measured heterotrophic plate count of greater than 500 colony-forming units per ML.
   d. Contractor shall pay for all testing required.
6. All precaution shall be taken to maintain dry and sanitary conditions and prevent contamination of any piping. If, in the opinion of the Engineer, contamination has occurred, the Contractor shall repeat the disinfection procedure and testing at his cost and expense.

D. Required Tests For Storm Sewers:
1. Perform the following tests after the storm drainage pipe has been installed and prior to final acceptance:
   a. Alignment Test, for all pipe.
2. Based upon visual observations, the Engineer may order additional testing, including the following:
   1) Television Inspection, if required by the Engineer.
   2) Deflection Test, if required by the Engineer.
   3) Water-tight field test ASTM F1417, if required by the Engineer.
3. Perform tests prior to placement of pavement, or other construction which may, in the opinion of the Engineer, be detrimentally effected by excavation required for repairs.
4. Submit details prior to making tests of proposed testing procedures with a description of methods and equipment to the Engineer for approval.

5. Alignment Test:
   a. All storm drainage pipe will be subject to a visual inspection in order to identify proper alignment, grade and excessive deflection.
   b. The Engineer may choose to perform an alignment test using the hand-lamp method, in which case the full diameter of the pipe shall be visible when viewed between consecutive structures.
6. Deflection Test:
   a. The Engineer will notify the Contractor in writing which completed sewers shall be tested by the deflection method.
   b. The Contractor shall commence the deflection test within 15 days of the Engineer's written notification. The Contractor shall notify the Engineer at least 5 days prior to commencement of television inspection.
   c. No Deflection testing shall be performed without the Engineer or his representative present to witness the test.
   d. The deflection test shall be performed on flexible drainage pipe with a "go/no-go" mandrel with a diameter equal to 95% of the inside diameter of the pipe being tested.
   e. The maximum pipe deflection shall be 5%.
   f. The Engineer will review the Deflection Test results and will instruct the Contractor, to repair any conditions which, in the opinion of the Engineer, are detrimental to the proper function and service of the storm pipe.
7. Visual Inspection: Prior to final acceptance, a visual inspection of all appurtenance structures, i.e. manholes, chambers, etc., will be required. Repair visual leaks, regardless of their magnitude.

END OF SECTION

SECTION 330513 MANHOLES AND STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:
   1. Installation of manholes, catchbasins, precast concrete structures, frames, grates, covers, steps, and piping connections as shown on the Drawings and as specified herein.
   2. Alteration of existing structures as shown on the Drawings and as specified herein.
   3. This Section supplements Section 602 of the NJDOT Standard Specifications.

1.2 QUALITY ASSURANCE

A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. American Society of Testing and Materials (ASTM).
   2. American National Standards Institute (ANSI).
   3. Occupational Health and Safety Administration (OSHA).

1.3 SUBMITTALS

A. Shop Drawings: Submit the following for approval:
   1. Design and construction details of all precast concrete units.
   2. Fabrication, assembly and installation details for all castings and miscellaneous metal works.
   3. Precast concrete structure design calculations verifying the structures have been designed to withstand the burial, submergence and anticipated live and dead loads. Design calculations for uplift forces shall incorporate a minimum factor of safety of 1.15.

B. Product Data:
   1. Manufacturer's catalog cuts, specifications, and installation instructions.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the site to prevent interruption of the Work.

B. All materials shall be inspected by the Contractor upon delivery to the site. The Contractor shall notify the Engineer of any loss or damages. Replace loss or repair damage to new condition at the Contractor's expense.

C. Store materials to allow easy access for inspection and identification.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

A. Design: In accordance with ASTM C890 – Minimal Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.

B. Loading: AASHTO HS20 with 30 percent impact and 130 pounds/cubic foot equivalent soil pressure.

2.2 PRECAST CONCRETE DRAINAGE STRUCTURES

A. Precast catch basin units shall conform to the dimensions shown on the Drawings and as detailed in Shop Drawings approved by the Engineer.

B. Unless otherwise specified precast concrete units shall conform to ASTM C478.

C. A precast concrete slab, as necessary for proper frame and grate placement, shall be provided at the top of the catch basin unit. The slab shall be designed for an H-20.

2.3 PRECAST CONCRETE MANHOLES

A. All precast concrete manhole units shall be as manufactured by Atlantic Concrete, or approved equal.

B. Precast manhole units shall conform to the dimensions shown on the Drawings and as detailed in Shop Drawings approved by the Engineer.

C. Unless otherwise specified, manhole sections shall conform to ASTM C478.

D. Precast structure bases shall be of the "base unit" type, with an integral base and barrel section. The barrels shall be constructed in increments of 1 foot to provide the indicated height with the fewest joints. Openings for pipe connections will not be permitted closer than 1 foot to the nearest joint. Mark the date of manufacture and name or trademark of manufacturer in the inside of each section.

E. Manholes barrels, servicing pipes less than 27 inch diameter, shall be 48 inch diameter. Manholes barrels, servicing pipes 27 inch diameter and larger shall be 60 inch diameter. Larger diameter manholes barrels shall be provided as indicated on the Drawings or as specified herein.

F. Joints shall be rubber and concrete using O-ring gaskets (ASTM C443) or butyl rubber gaskets (ASTM C443), or tongue and groove buttered with 1:2 cement mortar (ASTM C270, Type M).

G. A precast eccentric cone, or precast slab where shown, shall be provided at the top of the manhole barrel to receive the frame and cover. The slab or cover shall be designed for an H-20 loading.

2.4 MANHOLE STEPS

A. Manhole sections shall contain manhole steps at 12 inches on center for all structures over 3 feet 6 inches in height. The steps shall be embedded in the concrete and accurately positioned both vertically and horizontally.

B. Steps shall be capable of withstanding a 300 pound concentrated live load without permanent distortion, conforming to the requirements of ANSI A14.3, OSHA, and the details shown on the Drawings.

C. Manhole rungs shall be steel reinforced copolymer polypropylene plastic. Rungs shall be 14 inches wide, M.A. Industries type PS2-PF or equal. Copolymer polypropylene shall be type II, grade 16906 meeting ASTM Specification D4101. Steel reinforcing shall be 3/8 in. diameter, grade 60 conforming to ASTM Specification A615 and shall be continuous throughout the rung. The portion of the legs to be embedded in the precast section shall have fins and be tapered to insure a secure bond.

2.5 FRAMES AND COVERS/GRATES

A. Frames and covers/grates shall be cast iron, ASTM A48, Class 30, free from flaws or unsightly defects.

B. Frames and covers shall conform to the details on the Drawings and have "SANITARY SEWER" or "STORM SEWER" cast on every cover.

C. Frames and covers/grates shall be designed for an H-20 loading, and be machined to ensure correct fit and even bearing.

D. Frames and covers/grates: shall be as shown on the on the Drawings. Otherwise, conform to the standard detail of the regulatory authorities having jurisdiction for the project (if applicable).

2.6 GRADE ADJUSTMENTS

A. Grade Rings: Reinforced-concrete rings, 3 to 12 inch total thickness, to match diameter of manhole frame and cover.

B. Materials shall conform to the requirements of NJDOT Standard Specifications, Section 602 Drainage Structures. Refer to Drawings for specific casting details, locations, and requirements.

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 (34.5-MPa), 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Earthwork shall be in accordance with Section "Trenching and Backfilling" or Section "Earth Moving."

3.2 PRECAST MANHOLE SECTIONS

A. Base units shall be placed on a minimum 12 inch foundation of pipe zone bedding material, and be set at the proper elevation, carefully leveled, and aligned.

B. Barrel units shall be set vertical with steps and sections in proper alignment. All joints shall be sealed with cement mortar inside and out, and troweled smooth to the contour of the wall surface. Joints shall be installed in accordance with manufacturer's recommendations.

C. Lifting holes shall be sealed tight with a tapered solid rubber plug driven into the hole and the remaining void filled with mortar on the outside only.

3.3 GRADE RINGS

A. Grade rings placed upon the eccentric cone or slab shall be used for all manholes to provide the potential for future adjustment.

B. Grade rings shall be placed in a combined thickness of at least 4 inches but not more than 12 inches, in order to bring the manhole frame to proper grade.

C. Consecutive grade ring layers shall be laid on an even mortar bed.

3.4 PIPE CONNECTIONS

A. Pipe connections to manholes shall be installed true to line and grade as shown on the Drawings. Wall fittings shall be watertight, compatible with the sewer pipe joint. Connections shall conform to the details shown on the Drawings.

3.5 INVERT CHANNEL AND BENCH WALLS

A. An invert channel and bench walls shall be constructed as shown on the Drawings to provide a smooth transition in flow through the manhole. The invert channel and bench wall shall be constructed of 3,000 psi concrete. Benches shall be built-up to the height called for on the Drawings, or as directed by the Engineer, and given a steel trowel finish. Care shall be taken to slope all benches for proper drainage to the invert channel.

3.6 FRAMES

A. Frames shall be firmly set and bonded at the proper grade to conform with the finished grade shown on the Drawings.

B. Frames for manholes in unpaved areas shall be set at an elevation higher than finished grade as shown on the Drawings, or as directed by the Engineer.

3.7 WATERTIGHTNESS

A. All manholes shall be free of visible leakage. Each manhole shall be inspected, and all leaks shall be repaired in a manner approved by the Engineer.

3.8 CONNECTION TO EXISTING STRUCTURES

A. The Contractor shall make connections to existing manholes as shown on the Drawings or as specified herein.

B. For connections to precast or cast-in-place concrete manholes, the Contractor shall core drill a hole 1 inch larger than the O.D. of the sewer pipe into the existing manhole at the location and elevation shown on the Drawings.

C. For connections to masonry manholes, the Contractor shall open the sidewall of the existing manhole by removing masonry units no more than necessary to accommodate the sewer pipe.

D. Connection methods shall be in accordance with the details shown on the Drawings. Any open spaces around the new pipe entry shall be sealed with non-shrink grout to prevent leakage.

E. The existing bench and channel shall be removed and reconstructed to permit flow through the manhole as it now exists and also for the new sewer pipe. Bench and channel reconstruction shall conform with the details on the Drawings, or as directed by the Engineer.

F. The Contractor shall be responsible for diverting flow through the manhole in order to allow bench and channel construction.

3.9 CHANGING ELEVATIONS OF EXISTING STRUCTURES

A. Lower existing frames of manholes by the removal of appropriate masonry courses, to the elevations shown on the Drawings or as directed by the Engineer.

B. Raise the existing frames of manholes by the addition appropriate grade rings to the elevations shown on the Drawings or as directed by the Engineer.

C. Where the manhole frames cannot be lowered by removal of masonry courses, such as may be the case with precast concrete manholes, the upper barrel section shall be removed and/or replaced with a section of less depth, to permit the necessary adjustment of the frame.

D. Frames and covers damaged during the Work shall be replaced at the Contractor's expense.

3.10 RESETTING CASTINGS

A. The process of resetting castings and water valve boxes, whether removing and resetting the castings, or furnishing and installing extension frames or rings or valve box riser adapters.

B. All castings and water valve boxes shall be reset to the finished grade prior to installation of the bituminous concrete pavement top course.

C. When the elevation of the top of 1-1/2 inches above the surface elevation of the adjacent pavement, a layer of bituminous concrete top course shall be furnished and installed, sloped or tapered, between the castings and/or water valve box and the adjacent pavement surface. This sloping or tapering of pavement shall be performed in a manner acceptable to the Engineer. The sloped or tapered pavement shall be furnished and installed around the entire perimeter of the casting and/or water valve box and its grade shall not exceed 2 percent.

END OF SECTION

SECTION 331112 – HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes but is not limited to high-density polyethylene (HDPE) (ductile iron pipe size) pressure pipe primarily intended for the transportation of water and sewage either buried or above grade.

1.2 REFERENCES

A. All published standards of the following associations/organizations, as mandated by specific state standards, shall be followed and applied as a minimum:
   1. AWWA C901, Polyethylene (PE) pressure Pipe & Tubing, 1/2 inch through 3 inch for water.
   2. AWWA C906, Polyethylene (PE) pressure Pipe & Fittings, 4 inch through 63 inch for water.
   3. ASTM D3035, Standard Spec for PE Pipe (DR-PR) Based on Controlled Outside Diameter.
   4. ASTM D3350, Standard Specification for PE Pipe & Fittings Materials.
   5. ASTM D1238, Melt Flow Index.
   6. ASTM D1505, Density of Plastics.
   7. ASTM D2837, Hydrostatic Design Basis.
   8. NSF Std.#14, Plastic Piping Components & Related Materials.
   9. TR-33/2005, Generic Butt Fusion Joining Procedure for Field Joining of PE Pipe.

1.3 GENERAL

A. Use:
   1. HDPE pipe/fittings shall be allowed for use as water, wastewater and reclaimed water pressure pipe where compatible with the specific conditions of the project. All material used in the production of water main piping shall be approved by the National Sanitation Foundation (NSF).

B. Documentation:
   1. Documentation from the resin's manufacturer showing results of the following tests for resin identification:
      a. Melt Flow Index ASTM D1238
   2. Density ASTM D1505

C. Manufacturer:
   1. All HDPE pipe and fittings shall be from a single manufacturer, who is fully experienced, reputable and qualified in the manufacture of the HDPE pipe to be furnished. The pipe shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these Specifications. Qualified manufacturers shall be DRISCOPIPE as manufactured by Phillips Products Co., Inc., or approved equal.

D. Finished Product Evaluation:
   1. Production staff shall check each length of pipe produced for the items listed below. The results of all measurements shall be recorded on production sheets, which become part of the manufacturer's permanent records.
      a. Pipe in process shall be checked visually, inside and out for cosmetic defects (grooves, pits, hollows, etc.).

b. Pipe outside diameter shall be measured using a suitable periphery tape to ensure conformance with ASTM F714 or ASTM D3035, whichever is applicable.

c. Pipe wall thickness shall be measured at 12 equally spaced locations around the circumference at both ends of the pipe to ensure conformance with ASTM F714 or ASTM D3035, whichever is applicable.

d. Pipe length shall be measured.

e. Pipe marking shall be examined and checked for accuracy.

f. Pipe ends shall be checked to ensure they are cut square and clean.

g. Subject inside surface to a "reverse bend test" to ensure the pipe is free of oxidation (brittleness).

E. Stress Regression Testing:

1. The polyethylene pipe manufacturer shall provide certification that stress regression testing has been performed on the specific polyethylene resin being utilized in the manufacture of this product. This stress regression testing shall have been done in accordance with ASTM D2837 and the manufacturer shall provide a product supplying a minimum Hydrostatic Design Basis (HDB) of 1,600 psi as determined in accordance with ASTM D2837.

F. Compatibility:

1. Contractor is responsible for compatibility between pipe materials, fittings and appurtenances.

G. Warranty:

1. The pipe manufacturer shall provide a warranty against manufacturing defects of material and workmanship for a period of ten years after the final acceptance of the project by the Owner. The manufacturer shall replace at no expense to the Owner any defective pipe/fitting material including labor within the warranty period.

PART 2 – PRODUCTS

2.1 PIPE SIZES 4-INCH DIAMETER AND LARGER

A. Materials used for the manufacture of polyethylene pipe and fittings shall be made from a PE 4710 high density polyethylene resin compound meeting cell classification 445574C per ASTM D3350; and meeting Type 111, Class C, Category 5, Grade P34 per ASTM D1238.

B. High Density Polyethylene (HDPE) pipe shall comply with AWWA Specifications C906.

C. If rework compounds are required, only those generated in the Manufacturer's own plant from resin compounds of the same class and type from the same raw material supplier shall be used.

D. Dimensions and workmanship shall be as specified by ASTM F714. HDPE fittings and transitions shall meet ASTM D3261. HDPE pipe shall have a minimum density of 0.955 grams per cubic centimeter. All HDPE pipe and fittings shall have a Hydrostatic Design Basis (HDB) of 1,600 psi.

E. HDPE pipe and accessories 4-inch diameter and larger, shall have a minimum pressure rating of 200 psi meeting the requirements of Standard Dimension Ration (SDR) 11.

F. The pipe manufacturer must certify compliance with the above requirements.

2.2 PIPE SIZES 2-INCH DIAMETER AND LESS

A. Materials used for the manufacture of polyethylene pipe and fittings shall be made from a PE 4710 high density polyethylene resin compound meeting cell classification 445574C per ASTM D3350; and meeting Type 111, Class C, Category 5, Grade P34 per ASTM D1238.

B. HDPE pipes shall comply with AWWA Specifications C901.

C. If rework compounds are required, only those generated in the Manufacturer's own plant from resin compounds of the same class and type from the same raw material supplier shall be used.

D. Dimensions and workmanship shall be as specified by ASTM D3035. HDPE fittings and transitions shall meet ASTM D3261. HDPE pipe shall have a minimum density of 0.955 grams per cubic centimeter. All HDPE pipe and fittings shall have a Hydrostatic Design Basis (HDB) of 1,600 psi.

E. HDPE pipe and accessories 2" and less in diameter, shall have a minimum pressure rating of 250 psi meeting the requirements of Standard Dimension Ration (SDR) 9.

F. The pipe Manufacturer must certify compliance with the above requirements.

2.3 FITTINGS

A. All molded fittings and fabricated fittings shall be fully pressure rated to match the pipe SDR pressure rating to which they are made. All fittings shall be molded or fabricated by the manufacturer. No Contractor fabricated fittings shall be used unless approved by the Engineer.

B. The manufacturer of the HDPE pipe shall supply all HDPE fittings and accessories as well as any adapters and/or specials required to perform the work as shown on the Drawings and specified herein.

C. All fittings shall be installed using butt-fused fittings, thermo-fused fittings/couplings, or flanged adapters and must be approved by the Engineer. NO size on size wet taps shall be permitted.

D. All transition from HDPE pipe to ductile iron or PVC shall be made per the HDPE pipe manufacturer's recommendations and specifications. A molded flange connector adapter within a carbon steel back-up ring assembly shall be used for pipe type transitions. Ductile iron back-up rings shall mate with cast iron flanges per ANSI B16.1. A 316 stainless steel back-up ring shall mate with a 316 stainless steel flange per ANSI B16.1.
   1. No solid sleeves shall be allowed between such material transitions.
   2. All HDPE pipe and fittings shall be from a single manufacturer, who is fully experienced, reputable and qualified in the manufacture of the HDPE pipe.

E. The following shall be continuously indent printed on the pipe or spaced at intervals not exceeding 5-feet:
   1. Name and/or trademark of the pipe manufacturer.
   2. Nominal pipe size.
   3. Dimension ratio.
   4. The letters PE followed by the polyethylene grade in accordance with ASTM.
   5. D1248 followed by the hydrostatic design basis in psi, e.g., PE 4710.
   6. Manufacturing standard reference, e.g., ASTM F714 or D3035, as required.
   7. A production code from which the date and place of manufacture can be determined.
   8. Color Identification, either stripped by co-extruding longitudinal identifiable color markings or shall be solid in color and as follows:

a. BLUE – Potable Water.
b. GREEN – Sanitary Sewer.
c. LAVENDER – IQ cover all.

F. Tracing Wire:
1. Open trench HDPE applications shall be installed with tracer wire.
2. Directional Drilled HDPE shall have wire conforming to Copperhead Industries Reinforced #1245 Extra-High Strength Tracer Wire and affixed to the drilling head/reamer per Detail M-17.

G. Marking Tape: Marking tape shall be installed above the pipe.

PART 3 – EXECUTION

3.1 JOINING METHOD

A. The pipe shall be joined with butt, heat fusion joints as outlined in ASTM D2657 and conform to the Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe, Technical Report TR-33/2005, published by the Plastic Pipe Institute (PPI). All joints shall be made in strict compliance with the manufacturer's recommendations. A factory qualified joining technician as designated by pipe manufacturer or experienced, trained technician shall perform all heat fusion joints.

B. Lengths of pipe shall be assembled into suitable installation lengths by the butt-fusion process. All pipes so joined shall be made from the same class and type of raw material made by the same raw material supplier. Pipe shall be furnished in standard laying lengths not to exceed 50 feet and no shorter than 20 feet.

C. On days butt fusions are to be made, the first fusion shall be a trial fusion in the presence of the Engineer. The following shall apply:
1. Heating plate surfaces shall be inspected for cuts and scrapes and shall be free of dirt and residue. Heater surfaces should be between 400˚F (minimum) to 450˚F (maximum). Measure the temperature @ 12:00, 3:00, 6:00 and 9:00 o'clock positions using a pyrometer of infrared thermometer at locations where the heating plate will contact the pipe/fitting ends. The maximum temperature difference between any two points on a single heating surface must not exceed 24˚F. If this temperature is exceeded, the heating plate shall be cleaned per the manufacturer's recommendations.
2. The fusion or test section shall be cut out after cooling completely for inspection.
3. The test section shall be 12" or 30 times (minimum) the wall thickness in length and 1" or 1.5 times the wall thickness in width (minimum).
4. The joint shall be visually inspected as to continuity of "beads" from the melted material, and for assurance of "cold joint" prevention (i.e. - joint shall have visible molded material between walls of pipe). Joint spacing between the walls of the two ends shall be a minimum of 1/16" to a maximum 3/16".

D. The polyethylene flange adapters at pipe material transitions shall be backed up by stainless steel flanges conforming to ANSI B16.1 and shaped as necessary to suit the outside dimensions of the pipe. The flange adapter assemblies shall be connected with corrosion resisting bolts and nuts of Type 316 Stainless Steel as specified in ASTM A726 and ASTM A307. All bolts shall be tightened to the manufacturer's specified torques. Bolts shall be tightened alternatively and evenly. After installation, apply a bitumastic coating to bolts and nuts.

3.2 INSTALLATION

A. HDPE pipe shall be installed in accordance with the instruction of the manufacturer, as shown on the Drawings and as specified herein. A factory qualified joining technician as designated by the pipe manufacturer shall perform all heat fusion joints.

B. HDPE shall be installed by [Open Trench Construction] or [Directional Bore Method] as outlined.

C. Care shall be taken in loading, transporting and unloading to prevent damage to the pipe. Pipe or fitting shall not be dropped. All pipe or fitting shall be examined before installation, and no piece shall be installed which is found to be defective. Any damage to the pipe shall be repaired as directed by the Engineer. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner by the contractor, at his own expense.

D. Under no circumstances shall the pipe or accessories be dropped into the trench or forced through a directional bore upon "pull-back".

E. Care shall be taken during transportation of the pipe such that it will not be cut, kinked or otherwise damaged.

F. Ropes, fabric or rubber protected slings and straps shall be used when handling pipes. Chains, cables or hooks inserted into the pipe ends shall not be used. Two slings spread apart shall be used for lifting each length of pipe.

G. Pipes shall be stored on level ground, preferably turf or sand, free of sharp objects, which could damage the pipe. Stacking of the polyethylene pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions. Where necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.

H. Pipe shall be stored on clean level ground to prevent undue scratching or gouging. The handling of the pipe shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. The maximum allowable depth of cuts, scratches or gouges on the exterior of the pipe is 5 percent of wall thickness. The interior pipe surface shall be free of cuts, gouges or scratches.

I. Pipe shall be laid to lines and grade shown on the Drawings with bedding and backfill as shown on the Drawings.

J. When laying is not in progress, open ends of the pipe shall be closed by fabricated plugs, or by other approved means.

K. Sections of pipe with cuts, scratches or gouges exceeding 5 percent of the pipe wall thickness shall be removed completely and the ends of the pipeline rejoined.

L. The pipe shall be joined by the method of thermal butt fusion, as outlined in Part 3 — Execution, Section 3.1 Joining Method. All joints shall be made in strict compliance with the manufacturer's recommendations.

M. Mechanical connections of the polyethylene pipe to auxiliary equipment such as valves, pumps and tanks shall be through flanged connections which shall consists of the following:
   1. A polyethylene flange shall be thermally butt-fused to the stub end of the pipe.
   2. A 316 stainless steel back up ring shall mate with a 316 stainless steel flange.

3. 316 stainless steel bolts and nuts shall be used.

N. Flange connections shall be provided with a full-face neoprene gasket.

O. All HDPE pipe must be at the temperature of the surrounding soil at the time of backfilling and compaction.

P. If a defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to the Owner. All pipe and fittings shall be thoroughly cleaned before installation, shall be kept clean until they are used in the work and when laid, shall conform to the lines and grades required.

Q. Open Trench Installation:

1. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16-in per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site. Laying instructions of the manufacturer shall be explicitly followed.
2. Good alignment shall be preserved during installation. Deflection of the pipe shall occur only at those places on design drawings and as approved by the Engineer. Fittings, in addition to those shown on the Drawings, shall be used only if necessary or required by the Engineer.
3. Each length of the pipe shall have the assembly mark aligned with the pipe previously laid and held securely until enough backfill has been placed to hold the pipe in place. Joints shall not be "pulled" or "cramped".
4. Precautions shall be taken to prevent flotation of the pipe in the trench.
5. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the backfill. Trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below top of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, pipe bedding shall be placed to fill any voids created and the backfill shall be recompacted to provide uniform side support for the pipe.
6. Restrained joints shall be installed where shown on the Drawings or as directed by the Engineer.

R. Directional Bore Installation:

1. Refer to Specification “Horizontal Directional Drilling”.

3.3 CLEANING

A. At the conclusion of the work, thoroughly clean all of the new pipe lines to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period by forcing a cleaning swab through all mains 4" or greater. Flushing velocities shall be a minimum of 2.5 feet per second. All flushing shall be coordinated with the Owner. Debris cleaned from the lines shall be removed from the job site.

3.4 TESTING

A. Conform to Section “Common Work Results for Utilities” for testing and disinfection of pipe.

END OF SECTION

SECTION 331120 – WATER SERVICES

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes provisions for the installation of water services.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's catalog cuts, specifications and installation instructions.

1.3 REFERENCES

A. All published standards of the following associations/organizations, as mandated by specific state standards, shall be followed and applied as a minimum:
   1. American Society of Testing and Materials (ASTM).
   2. American Waterworks Association (AWWA).
   3. American National Standards Institute (ANSI).

PART 2 – PRODUCTS.

2.1 EQUIPMENT

A. Materials in contact with potable water shall be made from copper alloy no. C83600 in accordance with ASTM B62 and ASTM B584.

B. Pipe and Fittings:
   1. Pipe: Type K copper tubing, ASTM B88.
   2. Fittings: Wrought copper, compression end, ANSI B16.22.

C. Valves and Valve Boxes:
   1. Corporation Valve/Stop:

3/4" and 1"	Mueller Co.	H-15008/Ground Key
	Ford Meter Box Co.	F 1000/Ground Key
1-1/2" and 2"	Mueller Co.	B-25008/Ball Corp.
	Ford Meter Box Co.	FB 1000/Ball Corp.

   2. Curb Valve/Stop: Quarter turn plug, bronze with compression ends.

3/4" and 2"	Mueller Co.	H-15209
3/4" and 1"	Ford Meter Box Co.	Z-44

   3. Curb Box: Extension type with stationary rod and arch pattern base:
   4. Lid: Cast iron removable brass pentagon head plug. "Water" shall be cast into lid.
   5. Valve Keys: Two (2) keys, designed to fit curb stop.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Trenching, backfilling and compaction conforming to Section "Trenching, Backfilling, and Compaction."

B. Pipe installation conforming to Section "Buried Pipe Installation."

3.2 INSPECTION

A. Inspect all pipe and fittings prior to laying in the trench. Remove all defective pipe and fittings from the site.

B. Do not backfill until inspection by the Engineer, unless otherwise approved by the Engineer.

END OF SECTION

SECTION 333216.13 – PACKAGED SEWAGE GRINDER PUMP UNITS

PART 1 – GENERAL

1.1 SUMMARY

A. Provide all labor, materials, equipment, tools and incidentals required to provide a packaged grinder pumping station system with pumps, controls, piping, fittings, valves, supports, control panel, wet well, and miscellaneous appurtenances required for a complete installation as shown on the Drawings and specified herein.

B. The Drawings are for the purpose of guidance and to show functional features and required external connections. They do not necessarily show all components necessary to accomplish the desired results nor do they necessarily show all components required to interface with the equipment. The Contractor shall provide all parts, equipment, wiring, piping and devices necessary to meet the functional requirements of the system.

C. The Drawings are intended to show the general arrangement of the equipment including, but not limited to, pumps, motors, piping, fittings, valves, supports, and wet well. They are not intended to show exact dimensions. Connection piping may have to be modified in order to accommodate the actual equipment furnished. The costs of such modifications are considered as being in the bid price and, therefore, no payment will be made for such modifications.

D. Equipment and appurtenances vary by manufacturer. If modifications to the Drawings are required to change equipment configuration, piping, equipment supports or, appurtenances, the Contractor shall submit drawings stamped by a Professional Engineer who is licensed in the state of New York to the Engineer for approval. All related design and construction costs associated with any modifications will be the responsibility of the Contractor.

1.2 REFERENCES

A. Reference Standards: Comply with applicable provisions and recommendations of the following except otherwise shown or specified.
   1. American Society of Testing Materials (ASTM)
   2. National Electric Manufacturing Association (NEMA)
   3. American National Standards Institute (ANSI)
   4. Underwriter's Laboratory, Inc. (UL)
   5. American Institute of Steel Construction (AISC)
   6. American Iron and Steel Institution (AISI).

1.3 SYSTEM DESCRIPTION

A. Summary:
   1. The grinder pump station and required accessories furnished as a package shall include, but not limited to the following:
      a. Wetwell, access way, gaskets, and piping penetrations where required and as detailed on the Drawings.
      b. Submersible grinder pump and pump removal system.
      c. Pump controls mounted in a control panel, level indicator, alarms, dry control contacts, and electrical wiring.

d. Internal piping, fittings, check valves, level control, and pipe supports.

B. Submersible Pump Performance: The pumps shall have the following minimum performance requirements:

ITEM	FLOW RATE (GPM)	TDH (FT)
Design Point	11	92
Secondary Point	9	138

C. Design Requirements:

1. The submersible pump shall comply with the following minimum design requirements:
   a. Liquid Pumped: Raw Sewage.
   b. Location: Wetwell.
   c. Number Required: 1.
   d. Discharge Size: 1-1/4 inch.
   e. Inlet Diameter: 4 inches.
2. The submersible pump motors shall comply with the following minimum design requirements:
   a. Maximum horsepower: 1.
   b. Maximum speed: 1725 rpm.
   c. Power Requirements: Single Phase, 208 volts, 60 Hz.

1.4 SUBMITTALS

A. General:

1. Refer to Division 1 Submittal Procedures for quantity, included information and administrative procedures of each type of submittal.
2. Submit all equipment supplied under this Section at the same time.

B. For approval: Submit product data and shop drawings as follows:

1. Manufacturer's information, specifications, and data showing dimensions, materials of construction, and weight of all major items of equipment specified in this Section.
2. Installation diagrams showing location, arrangement, and size of all anchor bolts required for the equipment, if applicable.
3. Pump Performance curves showing total dynamic head (TDH) and flow rate.
4. Motor information including manufacturer, model, frame number, type of enclosure, volts, cycle (i.e., hertz), phase, NEMA design designation, NEMA insulation class, nameplate horsepower, locked rotor torque, locked rotor amps, percent slip, rpm at full nameplate load, service factor, and maximum ambient temperature.
5. Control panel wiring schematic and layout drawings.

C. For information: Submit an Operation and Maintenance Manual as follows:

1. Refer to Division 1 Section "Closeout Procedures" and Section "Operation and Maintenance Data."
2. Operation and maintenance manuals shall include all approved shop drawings associated with this Section, complete instructions for installation, parts list for all components, and wiring schematics and diagrams.
3. Include a list and frequency of specific maintenance activities. Include lubrication frequency, application points, lubricant type, and method of application.

1.5 QUALITY ASSURANCE

A. All equipment provided under this Section shall be a standard product in regular production by manufacturers having a minimum of five (5) years and twenty (20) installations of proven and reliable experience in providing the equipment and services intended for this project. Supplier shall provide a list of names and dates, if requested, of installations for verification by the Engineer.

B. A factory-authorized maintenance and parts facility shall be located within a five-hundred (500) mile radius from equipment installation. The manufacturers shall show evidence of a parts inventory for all routine maintenance items associated with the supplied equipment.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products on site under the provisions of Division 1.

B. Accept products on the site in factory packing.

C. Protect components from physical damage including effects of weather, water, dust, and construction debris.

1.7 PROJECT SITE CONDITIONS

A. Verify that all dimension shown on Drawings and shop drawings match field conditions.

B. Verify actual dimensions of equipment specified in this Section prior to installation.

1.8 WARRANTY

A. Comply with warranty requirements under the provisions of Division 1.

B. Provide written warranty to the Owner for all materials and workmanship of equipment provided under this Section for a period of one (1) year from the date of Substantial Completion. Any defects due to the use of improper materials or workmanship occurring within that time shall be promptly rectified, as approved by the Engineer, without cost to the Owner.

C. The equipment furnished under this Section shall be guaranteed to be free of defects in workmanship, design, and material. The Contractor shall replace, without cost to the Owner, any equipment or part that is defective or shows undue wear, within one (1) year after Substantial Completion.

D. The Contractor shall include the services of a factory-trained representative to provide repair service for the equipment under this Section for a period of one (1) year from Substantial Completion. The cost of all replacement parts required during this one (1) year period shall be included.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Provide semi-positive displacement submersible grinder pump station complete with wetwell, valves, level controls, and control panel as manufactured by Environment One Corporation Model DH 071-93 or approved equal.

2.2 PUMPS

A. The pump shall be a custom designed, integral, vertical rotor, motor driven, solids handling pump of the progressing cavity type with a single mechanical seal. The rotor shall be through-hardened, highly polished, precipitation hardened stainless steel. The stator shall be of a specifically compounded ethylene propylene synthetic elastomer.

2.3 Grinder

A. The grinder shall be placed immediately below the pumping elements and shall be direct-driven by a single, one-piece motor shaft. The grinder impeller assembly shall be securely fastened to the pump motor shaft by means of a threaded connection attaching the grinder impeller to the motor shaft. The grinder will be of the rotating type with a stationary hardened and ground stainless steel shredding ring spaced in close annular alignment with the driven impeller assembly, which shall carry two hardened type 400 series stainless steel cutter bars.

B. The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of "foreign objects," such as paper, wood, plastic, glass, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1-1/4" diameter stainless steel discharge piping.

2.4 MOTOR

A. The motor shall be a 1 HP, 1725 RPM, 240 Volt 60 Hertz, 1 Phase, capacitor start, ball bearing, air-cooled induction type with a low starting current not to exceed 30 amperes and high starting torque of 8.4 foot pounds. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor.

B. The pump/core shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump. The seal shall have a stationary ceramic seat and carbon rotating surface with faces precision lapped and held in position by a stainless steel spring.

2.5 WETWELL AND ACCESS WAY

A. The tank shall be made of rotationally molded high density polyethylene, with a melt index of 2.0 grams/10 minutes or lower to assure high environmental stress cracking resistance. The tank shall have a nominal thickness of 1/2". All seams created during tank construction are to be thermally welded and factory tested for leak tightness. Tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth. All station components must function normally when exposed to 150 percent of the maximum external soil and hydrostatic pressure.

B. The tank shall be furnished with one EPDM grommet fitting to accept an 8 inch and 4 inch SDR 35 PVC pipe.

C. The access way shall be an integral extension of the wet well assembly and include a lockable cover assembly providing low profile mounting and watertight capability. Access way design and construction shall facilitate field adjustment of station height in increments of 3" without the use of any adhesives or sealants requiring cure time before installation can be completed.

D. The station shall have all necessary penetrations molded in and factory sealed. To ensure a leak-free installation, no field penetrations shall be acceptable.

2.6 INTERNAL PIPING

A. All discharge piping shall be constructed of 304 Series Stainless Steel and terminate outside the access way bulkhead with a stainless steel, 1 1/4 inch female NPT fitting. The discharge piping shall include a stainless steel ball valve rated for 200 psi WOG. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.

2.7 ELECTRICAL CONNECTION

A. The access way shall include a single NEMA 6P electrical quick disconnect for all power and control functions, factory installed with access way penetrations warranted by the manufacturer to be watertight. The access way shall also include a 2 inch PVC vent to prevent sewage gases from accumulating in the tank.

2.8 VALVES

A. The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the stainless steel discharge piping. The check valve will provide a full-ported passageway when open, and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. Moving parts will be made of a 300 series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low back-pressure. The valve body shall be an injection molded part made of glass filled PVC.

B. The pump discharge shall be equipped with a factory-installed, gravity-operated, flapper-type integral anti-siphon valve built into the stainless steel discharge piping. Moving parts will be made of 300 series stainless steel and fabric-reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly, providing a maximum degree of freedom to ensure proper operation even at a very low pressure. The valve body shall be injection-molded from a glass-filled thermoplastic resin.

2.9 CORE UNIT

A. The pump station shall have cartridge type, easily removable core assembly consisting of pump, motor, grinder, all motor controls, check valve, anti-siphon valve, level control, electrical quick disconnect and wiring. The watertight integrity of each core unit, shall be established by 100 percent factory test at a minimum of 5 PSIG.

2.10 CONTROLS

A. All necessary controls, including motor and level controls, shall be located in the top housing of the core unit. The top housing will be attached with stainless steel fasteners.

B. Non-fouling wastewater level controls for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air column connected to a pressure switch. The level detection device shall have no moving parts in direct contact with the wastewater. High-level sensing will be accomplished in the manner detailed above by a separate air-bell sensor and pressure switch of the same type. Closure of the high-level sensing device will energize an alarm circuit as well as a redundant pump-on circuit. For increased reliability, pump ON/OFF and High-level alarm functions shall not be controlled by the same switch.

C. To assure reliable operation of the pressure switches, each core shall be equipped with a breather assembly, complete with a suitable means to prevent accidental entry of water into the motor compartment. The grinder pump will be furnished with a 6 conductor 14 gauge, type SJOW cable, pre-wired and watertight to meet UL requirements with a factory installed NEMA 6P electrical quick disconnect half attached to it.

2.11 ALARM PANEL

A. The grinder pump station shall include a NEMA 4X, UL-listed alarm panel suitable for wall or pole mounting. The NEMA 4X enclosure shall be manufactured of thermoplastic polyester to ensure corrosion resistance. The enclosure shall include a hinged, lockable cover with padlock, preventing access to electrical components, and creating a secured safety front to allow access only to authorized personnel. The enclosure shall not exceed 10.5" W x 14" H x 7" D, or 12.5" W x 16" H x 7.5" D if certain options are included.

B. The alarm panel shall contain one (1) 15-amp, double-pole circuit breaker for each pump core power circuit and one (1) 15-amp single-pole circuit breaker for each pump core alarm circuit. The panel shall contain a push-to-run feature, an internal run indicator, and a complete alarm circuit. All circuit boards in the alarm panel are to be protected with a conformal coating and the AC power circuit shall include an auto resetting fuse.

C. The alarm panel shall include the following features: external audible and visual alarm; push-to-run switch; and redundant pump start with high level alarm capability. The alarm sequence is to be as follows:

1. When liquid level in the sewage wet-well rises above the alarm level, audible and visual alarms are activated, the contacts on the alarm pressure switch close, and the redundant pump starting system is energized.
2. The audible alarm may be silenced by means of the externally mounted, push-to-silence button.
3. Visual alarm remains illuminated until the sewage level in the wet-well drops below the “off” setting of the alarm pressure switch.
4. The visual alarm lamp shall be inside a red, oblong lens at least 3.75" L x 2.38" W x 1.5" H. Visual alarm shall be mounted to the top of the enclosure in such a manner as to maintain NEMA 4X rating. The audible alarm shall be externally mounted on the bottom of the enclosure, capable of 93 dB @ 2 feet. The audible alarm shall be capable of being deactivated by depressing a push-type switch that is encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure (push-to-silence button).
5. The entire alarm panel, as manufactured and including any of the following options, shall be listed by Underwriters Laboratories, Inc.

2.12 LATERAL ASSEMBLY

A. Brass Components:

1. All brass valve and fitting components are to meet ASTM specification B62-63-B505Q and the AWWA Standard C800 and conform to ANSI B16.26. Components shall be made from brass alloy CDA 89520. All brass components shall be individually tested with internal air pressure of 150 min. psi. Manufacturer shall provide a Certificate of Conformance upon request.
2. All pipe connections shall be made using pack joint connections including a Buna-N beveled gasket for sealing to the outside diameter of the pipe. A split clamp locking device with stainless steel hardware shall be integrated into all connection fittings to securely restrain the pipe from hydraulic pressure and external loading caused by shifting and settling. Stainless steel insert stiffeners shall be provided for all pack joint connection fittings to be used with HDPE pipe.

3. Brass valves shall be pressure tight in both directions with integral stops at the fully-closed and fully-open positions. The tee-head and stem shall be constructed of a single, solid piece to assure reliable operation. The stem shall be secured into the valve body using either a bronze or plastic ring. Buna-N O-rings shall be used to provide a redundant, watertight seal on the stem. A spherical, fluorocarbon-coated brass ball shall be supported in molded, Buna-N rubber seats to provide watertight seals in either direction, as well as maximum flow capacity and ease of operation. Valves shall be designed to withstand a working pressure of 150 psi minimum.

B. Check Valves:

1. Check Valves shall be injection molded from noncorroding, glass fiber reinforced PVC for durability. The check valve flapper shall include a non-fouling, integral hinge made from fabric reinforced synthetic elastomer to assure corrosion resistance, dimensional stability, fatigue strength and trouble free operation. The check valve will provide a full-ported passageway and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. A nonmetallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating at low back pressure.

C. Curb Boxes:

1. Curb boxes shall be constructed of cast iron and steel pipe. All components shall be heavily coated with asphalt paint to assure durability in the ground. Curb boxes shall provide 12" of height adjustment downward (shorter) from their extended height.

D. High Density Polyethylene Pipe:

1. Pipe shall be high performance, high molecular weight, high density polyethylene pipe equal to Driscopipe* 1000 as manufactured by Phillips Driscopipe, Inc., Dallas, Texas. The pipe material shall be a Type III, Class C, Category 5, P34 material as described in ASTM D 1248. Minimum cell classification values of the pipe material shall be 345434C as referenced in ASTM D 3350 - 84. The density shall be 0.941 - 0.957 gms/cm3 when tested in accordance with ASTM D 1505. Melt Flow shall be no greater than 0.15 gms/10 min. when tested in accordance with ASTM D 1238 - Condition E. (Melt Flow shall be no greater than 4.0 gms/10 min. when tested in accordance with ASTM D 1238 - Condition F.) Flexural Modulus shall be 110,000 psi to less than 160,000 psi when tested in accordance with ASTM D 790. Tensile strength at yield shall be 3,200 psi to less than 3,500 psi when tested in accordance with ASTM D 638. Environmental Stress Resistance shall be in excess of 5,000 hours with zero failures when tested in accordance with ASTM D 1693 - Condition C.

E. Existing Forcemain Connection:

1. 1-1/2” corporation valve, model E-25029, as manufactured by Mueller or approved equal.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that all dimensions shown on the Drawings and shop drawings match field conditions.

B. Verify actual dimensions of equipment before starting installation.

C. The Contractor shall inspect all material or equipment as it is received to determine damage and/or missing parts. It shall be his responsibility to repair or replace damaged items in accordance with the manufacturer’s instructions.

3.2 FIELD PREPARTION AND PAINTING

A. Finish field preparation and painting shall be performed as recommended by the manufacturer.

B. The Contractor shall touch-up all shipping damage to the paint and stainless steel as soon as the equipment arrives on the job site.

C. The Contractor shall supply paint for field touch-up and field painting.

D. Prior to assembly the Contractor shall coat all stainless steel bolts and nut threads with a non-seizing compound.

3.3 INSTALLATION

A. Equipment installation shall be in complete conformance to the manufacturer's instructions.

B. Provide all necessary lubrication for initial operation.

C. All connected piping shall be supported separately of the equipment.

D. All material shall be new, undamaged and conform to the latest standards listed.

E. Cooperate with other trades to avoid interferences with the installation of this work. Install all equipment and systems so as not to delay progress of construction and correlate with other trades to avoid delay. Should differences of opinion develop, the Engineer's decision shall be final.

F. Backfill grinder pump unit and meter pit in accordance with Section "Earthwork."

3.4 FIELD QUALITY CONTROL

A. The Contractor shall provide the services of equipment suppliers to inspect and insure that the equipment provided under this Contract has been installed correctly and without damage.

B. Operating testing shall include as a minimum a demonstration to the Engineer of the proper operation of alarms and controls, pump performance tests, and motor current and system pressure readings at the operating points.

C. A qualified and factory trained manufacturer's representative shall check and approve the installation before operation. The representative shall test operate the system in the presence of the Engineer and verify that all the equipment is in conformance with the specified requirements. Provide necessary equipment and labor to support the manufacturer's representative. Provide a minimum of one (1) 8-hour day on site by a qualified manufacturer's representative.

1. Field testing shall be performed after installation of the equipment. The field testing shall demonstrate the following:
    a. Certify that the equipment has been properly installed in accordance with the manufacturer's instructions and recommendations.
    b. The equipment has been installed in the specified location and orientation or as shown on the drawings.
    c. The equipment operates without cavitation, overheating or overloading, or objectionable vibration of any part.
    d. There are no mechanical defects in any of the parts.
    e. The pumps can deliver the required TDH and flow rate.

f. Supervise the equipment start-up and initial operation.

g. Operate the system in the presence of the Engineer and demonstrate the proper operation of all interlocks, alarms, controls, and sequencing.

h. Field test under operating point.

i. Instruct Owner personnel on the operation, care and maintenance of the equipment.

j. Prepare a written report summarizing the start-up and initial operation activities.

k. Revisit the project site as often as necessary until all problems are resolved and the installation and operation are entirely satisfactory in the judgment of the Owner.

3.5 CLEANING

A. Clean work under the provisions of Division 1.

B. Remove all debris from site.

3.6 PROTECTION OF FINSHED WORK

A. Protect finished installation under the provisions of Division 1.

END OF SECTION