SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Project information.
2. Work covered by Contract Documents.
3. Future work.
4. Access to site.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and drawing conventions.

1.3 PROJECT INFORMATION

A. Project Identification: Washington School Information Processing Cooperative (WSIPC) Cooling Tower Replacement

1. Project Location: 2121 W Casino Rd, Everett, WA 98204

B. Owner: WSIPC

1. Owner's Representative: Contact: Cynthia Gefeller – 425-349-6411

C. Engineer: Glumac:

1. Vice Principal: Contact: Josh Checkis – (971) 285-6979
2. Project Manager: Contact: DeNayne Glenn - (206) 701-2580

SUMMARY

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of the Project is defined by the Contract Documents and consists of, but not limited to, the following:

1. Demolition of the existing cooling tower, control panel, disconnect, and VFD systems as indicated in project documents.

2. Installation of a new cooling tower, control panel, disconnect, and VFD systems as indicated in project documents.

3. All provisions to provide continuous cooling to the facility during construction including but not limited to; planned location for temporary tower, flex piping extensions & power connection from existing building.

4. All seismic attachment design & construction is differed to the contractor. Hire a structural engineer, permit the design& secure new equipment to existing structure as required.

B. Type of Contract

1. Project will be constructed under a single prime contract.

1.5 FUTURE WORK

A. Not used

1.6 ACCESS TO SITE

A. General: Contractor shall have limited use of Project site for construction operations as directed by Owner and as indicated by requirements of this Section.

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

1. Driveways, Walkways and Entrances: Keep driveways, parking lots, loading areas, 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 by construction operations.

b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.

C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weather tight condition throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner will occupy site and existing building during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.

2. Notify the Owner not less than 72 hours in advance of activities that will affect Owner's operations.

1.8 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.

B. On-Site Work Hours:

1. Contractor to propose work hours and schedule to complete the project subject to WSIPC approval.

2. Worksite access is available Monday – Friday 7:00 a.m. to 5:00 p.m.

3. If contractor cannot make a 3 week demolition and replacement window, WSIPC would consider Saturday work hours. Contractor to propose a schedule ahead of time.

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

SUMMARY

1. Notify Owner not less than two working days in advance of proposed utility interruptions.

2. Obtain Owner's written permission before proceeding with utility interruptions.

D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner not less than two working days in advance of proposed disruptive operations.

2. Obtain Owner's written permission before proceeding with disruptive operations.

E. Nonsmoking: Smoking is not permitted within the building, on grounds or within 25 feet of the campus.

F. Controlled Substances: Use of tobacco products and other substances on site is not permitted.

G. Employee Identification: Contractor will provide identification tags for Contractor personnel working on the Project site. Require personnel to utilize identification tags at all times.

1. Criminal Background Checks: All contractors and employees thereof must complete a Criminal Background Check form for the Oregon Department of Education and the form must be screened and approved by the Owner Representative before the employee accesses the job site. Upon approval from the Owner the Representative the form will be processed by the Oregon Department of Education. The Owner reserves the right to deny access to the job site to any employee who falsifies information or does not meet the Oregon Department of Education's requirements.

H. Employee Screening: Comply with Owner's requirements regarding drug and background screening of Contractor personnel working on the Project site.

1. Maintain list of approved screened personnel with Owner's Representative.

1.9 PREVAILING WAGE REQUIREMENT

A. Contractor must comply with local Bureau of Labor and Industries Prevailing Wage Requirements.

SUMMARY

1.10 SPECIFICATION AND DRAWING CONVENTIONS

A. 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. Imperative mood and streamlined language are generally used in the Specifications. 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.

2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.

2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.

3. Keynoting: Materials and products may be identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.11 MISCELLANEOUS PROVISIONS

A. Project Schedule:

1. Refer to Solicitation Draft documentation for schedule.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 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. Alternates described in this Section are part of the Work only if enumerated in the Agreement.

2. 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.

1.4 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.

ALTERNATES

D. Schedule: A schedule of alternates is included on Exhibit A, Bid Submission Form.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Sections:

1. Division 01 Section "Alternates" for products selected under an alternate.

2. Division 01 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

3. Divisions 02 through 49 Sections for specific requirements and limitations for substitutions.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.

2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use CSI Form 13.1A.

SUBSTITUTION PROCEDURES

2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

   a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.

   b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.

   c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable specification section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

   d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

   e. Samples, where applicable or requested.

   f. Certificates and qualification data, where applicable or requested.

   g. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers and owners.

   h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.

   i. Research reports evidencing compliance with building code in effect for Project.

   j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.

   k. Cost information, including a proposal of change, if any, in the Contract Sum.

l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.

m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Engineer will notify Contractor of acceptance or rejection of proposed substitution via addendum.

a. Use product specified if Engineer does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Modify or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately upon discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.

b. Substitution request is fully documented and properly submitted.

c. Requested substitution will not adversely affect Contractor's construction schedule.

d. Requested substitution has received necessary approvals of authorities having jurisdiction.

e. Requested substitution is compatible with other portions of the Work.

f. Requested substitution has been coordinated with other portions of the Work.

g. Requested substitution provides specified warranty.

h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Engineer will consider requests for substitution if received within 10 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Engineer.

1. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Engineer for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.

b. Requested substitution does not require extensive revisions to the Contract Documents.

c. Requested substitution is consistent with the Contract Documents and will produce indicated results.

d. Substitution request is fully documented and properly submitted.

e. Requested substitution will not adversely affect Contractor's construction schedule.

f. Requested substitution has received necessary approvals of authorities having jurisdiction.

g. Requested substitution is compatible with other portions of the Work.

h. Requested substitution has been coordinated with other portions of the Work.

i. Requested substitution provides specified warranty.

j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION (Not Used)

END OF SECTION

CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Sections:

1. Division 01 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 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, on Supplemental Instructions.

1.4 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 not instructions either to stop work in progress or to execute the proposed change.

2. Within 10 days, when not otherwise specified, 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 costs of labor and supervision directly attributable to the change.

d. 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.

e. Quotation Form: Use CSI Form 13.6B "Proposal Worksheet Summary" and 13.6C "Proposal Worksheet Detail".

B. Contractor Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim 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 costs of labor and supervision directly attributable to the change.

5. 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.

6. Comply with requirements in Division 01 Section "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

7. Proposal Request Form: Use CSI Form 13.6A "Change Order Request (Proposal)" with attachments CSI Form 13.6B "Proposal Worksheet Summary" and 13.6C "Proposal Worksheet Detail".

1.5 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: Refer to Division 01 Section "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

B. Unit Price Adjustment: Refer to Division 01 Section "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit price work.

1.6 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 AIA Document G701.

1.7 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Engineer may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction 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 Construction 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

PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Sections:

1. Division 01 Section "Unit Prices" for administrative requirements governing the use of unit prices.

2. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.

3. Division 01 Section "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

4. Division 01 Section "Submittal Procedures" for administrative requirements governing the preparation and submittal of the submittal schedule.

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Correlate line items in the schedule of values with other required administrative forms and schedules, including the following:

a. Application for Payment forms with continuation sheets.

b. Submittal schedule.

c. Items required to be indicated as separate activities in Contractor's construction schedule.

2. Submit the schedule of values to University of Oregon at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

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. Engineer's 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. Related Specification Section or Division.

b. Description of the Work.

c. Name of subcontractor.

d. Name of manufacturer or fabricator.

e. Name of supplier.

f. Change Orders (numbers) that affect value.

g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

1) Labor.

2) Materials.

3) Equipment.

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 multiple line items for principal subcontract amounts in excess of five percent of Contract Sum.

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. If required, include evidence of insurance.

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. 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 shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

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

1.5 APPLICATIONS FOR PAYMENT

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

PAYMENT PROCEDURES

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. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

D. 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 for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.

3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.

2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.

3. Provide summary documentation for stored materials indicating the following:

a. Materials previously stored and included in previous Applications for Payment.

b. Work completed for this Application utilizing previously stored materials.

c. Additional materials stored with this Application.

d. Total materials remaining stored, including materials with this Application.

F. Transmittal: Submit three 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.

G. 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 in previous application, after deduction for retainage, on each item.

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

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

4. Submit final Application for Payment with or proceeded by conditional 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.

H. 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 (preliminary if not final).

5. Schedule of unit prices.

6. Submittal 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.

I. 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.

J. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General project coordination procedures.
2. Administrative and supervisory personnel.
3. Coordination drawings.
4. Requests for Information (RFIs).
5. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Sections:

1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.
4. Division 01 Section "General Commissioning Requirements" for coordinating the Work with Owner's commissioning authority.

1.3 DEFINITIONS

A. RFI: Request from Owner, Engineer or Contractor seeking information from each other during construction.

1.4 COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.

3. Make adequate provisions to accommodate items scheduled for later installation.

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.

3. Make adequate provisions to accommodate items scheduled for later installation.

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.

2. Preparation of the schedule of values.

3. Installation and removal of temporary facilities and controls.

4. Delivery and processing of submittals.

5. Progress meetings.

6. Preinstallation conferences.

7. Project closeout activities.

8. Startup and adjustment of systems.

9. Project closeout activities.

E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

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.

1.5 KEY PERSONNEL

A. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel 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, office, and cellular telephone numbers and email addresses. 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. Keep list current at all times.

1.6 REQUESTS FOR INFORMATION (RFIS)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Engineer will return RFIs submitted to Engineer by other entities controlled by Contractor with no response.

2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.

2. Project number.

3. Date.

4. Name of Contractor.

5. Name of Engineer.

6. RFI number, numbered sequentially.

7. RFI subject.

8. Specification Section number and title and related paragraphs, as appropriate.

9. Drawing number and detail references, as appropriate.

10. Field dimensions and conditions, as appropriate.

11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.

12. Contractor's signature.

13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

14. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: AIA Document G716.

D. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow seven working days for Engineer's response for each RFI. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.

1. The following RFIs will be returned without action:

2. Requests for approval of submittals.

3. Requests for approval of substitutions.

4. Requests for coordination information already indicated in the Contract Documents.

5. Requests for adjustments in the Contract Time or the Contract Sum.

6. Requests for interpretation of Engineer's actions on submittals.

7. Incomplete RFIs or inaccurately prepared RFIs.

8. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt of additional information.

9. Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."

10. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within 10 days of receipt of the RFI response.

E. On receipt of Engineer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer within seven days if Contractor disagrees with response.

F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log bi-weekly. Use CSI Log Form 13.2B.

1.7 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: Contractor responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Engineer, within three days of the meeting.

B. Preconstruction Conference: Contractor to schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Engineer, but no later than 15 days after execution of the Agreement.

1. Conduct the conference to review responsibilities and personnel assignments.

2. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Discuss items of significance that could affect progress, including the following:

4. Tentative construction schedule.

5. Phasing.

6. Critical work sequencing and long-lead items.

7. Designation of key personnel and their duties.

8. Lines of communications.

9. Procedures for processing field decisions and Change Orders.

10. Procedures for RFIs.

11. Procedures for testing and inspecting.

12. Procedures for processing Applications for Payment.

13. Distribution of the Contract Documents.

14. Submittal procedures.

15. Preparation of record documents.

16. Use of the premises and existing building.

17. Work restrictions.

18. Working hours.

19. Owner's occupancy requirements.

20. Responsibility for temporary facilities and controls.

21. Procedures for moisture and mold control.

22. Procedures for disruptions and shutdowns.

23. Construction waste management and recycling.

24. Parking availability.

25. Office, work, and storage areas.

26. Equipment deliveries and priorities.

27. First aid.

28. Security.

29. Progress cleaning.

30. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Project Closeout Conference: Contractor to schedule and conduct a Project closeout conference, at a time convenient to Owner and Engineer, but no later than 30 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.

2. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

4. Preparation of record documents.

5. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.

6. Submittal of written warranties.

7. Requirements for preparing operations and maintenance data.

8. Requirements for demonstration and training.

9. Preparation of Contractor's punch list.

10. Procedures for processing Applications for Payment at Substantial Completion and for final payment.

11. Submittal procedures.

12. Owner's partial occupancy requirements.

13. Installation of Owner's furniture, fixtures, and equipment.

14. Responsibility for removing temporary facilities and controls.

15. Minutes: Entity conducting meeting will record and distribute meeting minutes.

D. Progress Meetings: Conduct progress meetings at biweekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.

2. Attendees: In addition to representatives of 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 meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. 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 status of Project.

4. 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.

a. Review schedule for next period.

5. Review present and future needs of each entity present, including the following:

a. Interface requirements.

1) Sequence of operations.

2) Status of submittals.

3) Deliveries.

4) Off-site fabrication.

5) Access.

6) Site utilization.

7) Temporary facilities and controls.

8) Progress cleaning.

9) Quality and work standards.

10) Status of correction of deficient items.

11) Field observations.

12) Status of RFIs.

13) Status of proposal requests.

14) Pending changes.

15) Status of Change Orders.

16) Pending claims and disputes.

17) Documentation of information for payment requests.

6. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Sections:

1. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the schedule of values.

2. Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.

3. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.

4. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

5. Division 01 Section "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as action submittals.

B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as informational submittals.

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols.

An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

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.

1.4 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the Engineer and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. 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.

B. 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

SUBMITTAL PROCEDURES

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 10 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 10 days for review of each resubmittal.

C. Identification and Information: Place a permanent label or title block on each paper copy 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 Contractor.

e. Name of subcontractor.

f. Name of supplier.

g. Name of manufacturer.

h. 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).

i. Number and title of appropriate Specification Section.

j. Drawing number and detail references, as appropriate.

k. Location(s) where product is to be installed, as appropriate.

l. Other necessary identification.

D. Options: Identify options requiring selection by the Engineer.

E. Deviations: Identify deviations from the Contract Documents on submittals.

F. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Engineer.

G. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Engineer will return submittals, without review, received from sources other than Contractor.

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: Use only final 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. Action Submittals: Submit four paper copies of each submittal, unless otherwise indicated. Engineer will return three copies.

2. Informational Submittals: Submit two paper copies of each submittal, unless otherwise indicated. Engineer will not return copies.

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

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.

5. Test and Inspection Reports Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."

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. Four paper copies of Product Data, unless otherwise indicated. Engineer will return three 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, unless submittal based upon Engineer's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Identification of products.

b. Schedules.

c. Compliance with specified standards.

d. Notation of coordination requirements.

e. Notation of dimensions established by field measurement.

f. Relationship and attachment to adjoining construction clearly indicated.

g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches.

3. Submit Shop Drawings in the following format:

a. Four opaque copies of each submittal. Engineer will return three copies.

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

E. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."

F. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."

G. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.

2. Number and title of related Specification Section(s) covered by subcontract.

3. Drawing number and detail references, as appropriate, covered by subcontract.

4. Submit subcontract list in the following format:

a. Number of Copies: Three paper copies of subcontractor list, unless otherwise indicated. Engineer will return two copies.

H. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."

SUBMITTAL PROCEDURES

I. 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.

J. 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 American Welding Society (AWS) forms. Include names of firms and personnel certified.

K. 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.

L. 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.

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

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

O. 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.

P. Product Test Reports: Submit written reports indicating 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.

Q. 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.

R. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."

S. 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.

T. 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.

U. Field Test Reports: Submit 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.

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

W. 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.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.

B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Division 01 Section "Closeout Procedures."

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

3.2 ENGINEER'S ACTION

A. 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.

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

D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.

E. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

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

END OF SECTION

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. 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 assurance and 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 other quality assurance and control procedures that facilitate compliance with the Contract Document requirements.

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

C. Related Sections:

1. Division 01 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.

2. Divisions 02 through 49 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

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

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

C. Preconstruction Testing: Tests and inspections performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

E. Source Quality Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

F. Field Quality Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

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

H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade or trades.

I. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply

with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

A. Contractor's Quality Control Plan: For quality assurance and quality control activities and responsibilities.

B. Contractor's Quality Control Manager Qualifications: For supervisory personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems.

1. Seismic force resisting system, designated seismic system, or component listed in the designated seismic system quality assurance plan prepared by the Engineer.

2. Main wind force resisting system or a wind resisting component listed in the wind force resisting system quality assurance plan prepared by the Engineer.

D. Testing Agency Qualifications: 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.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.

2. Entity responsible for performing tests and inspections.

3. Description of test and inspection.

4. Identification of applicable standards.

5. Identification of test and inspection methods.

6. Number of tests and inspections required.

7. Time schedule or time span for tests and inspections.

8. Requirements for obtaining samples.

9. Unique characteristics of each quality-control service.

1.6 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. 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. Record of temperature and weather 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.

QUALITY REQUIREMENTS

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of technical representative making report.

2. Statement on condition of substrates and their acceptability for installation of product.

3. Statement that products at Project site comply with requirements.

4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.

5. Results of operational and other tests and a statement of whether observed performance complies with requirements.

6. Statement whether conditions, products, and installation will affect warranty.

7. Other required items indicated in individual Specification Sections.

C. Factory Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of factory-authorized service representative making report.

2. Statement that equipment complies with requirements.

3. Results of operational and other tests and a statement of whether observed performance complies with requirements.

4. Statement whether conditions, products, and installation will affect warranty.

5. Other required items indicated in individual Specification Sections.

D. 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.

QUALITY REQUIREMENTS

1.7 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. 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, as well as sufficient production capacity to produce required units.

C. 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.

D. 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.

E. Specialists: Certain Specification Sections 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. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

F. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.

2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

G. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

H. 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.

1.8 QUALITY CONTROL

A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality control services specified and those required by authorities having jurisdiction. Perform quality control services required of Contractor by authorities having jurisdiction, whether specified or not.

2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality control services.

a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.

4. Where quality control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality control service.

5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.

6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. 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 as specified in Division 01 Section "Submittal Procedures."

C. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's

services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

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

E. 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. Determine the location from which test samples will be taken and in which in-situ tests are conducted.

3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.

4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.

5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.

6. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.

2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.

4. Facilities for storage and field curing of test samples.

5. 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.

G. Coordination: Coordinate sequence of activities to accommodate required quality assurance and 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.

1.9 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner.

1. Verifying that manufacturer maintains detailed fabrication and quality control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.

2. Notifying Engineer and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.

3. Submitting a certified written report of each test, inspection, and similar quality control service to Engineer with copy to Contractor and to authorities having jurisdiction.

4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.

5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.

6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.

2. Description of the Work tested or inspected.

3. Date test or inspection results were transmitted to Engineer.

4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Engineer's reference during normal working hours.

3.2 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 Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."

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

REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

REFERENCES

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

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

AA	Aluminum Association, Inc. (The) www.aluminum.org	(703) 358-2960
AABC	Associated Air Balance Council www.aabchq.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association	(847) 303-5664

REFERENCES

	www.aamanet.org	
ABAA	Air Barrier Association of America www.airbarrier.org	(866) 956-5888
ABMA	American Bearing Manufacturers Association www.abma-dc.org	(202) 367-1155
ACI	American Concrete Institute www.concrete.org	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AF&PA	American Forest & Paper Association www.afandpa.org	(800) 878-8878 (202) 463-2700
AGA	American Gas Association www.aga.org	(202) 824-7000
AGC	Associated General Contractors of America (The) www.agc.org	(703) 548-3118

REFERENCES

AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Architects (The) www.aia.org	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction www.aitc-glulam.org	(303) 792-9559
ALCA	Associated Landscape Contractors of America (Now PLANET - Professional Landcare Network)	
ALSC	American Lumber Standard Committee, Incorporated www.alsc.org	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020

REFERENCES

AOSA	Association of Official Seed Analysts, Inc. www.aosaseed.com	(405) 780-7372
APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
APA EWS	APA - The Engineered Wood Association; Engineered Wood Systems (See APA - The Engineered Wood Association)	
API	American Petroleum Institute www.api.org	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute www.ari.org	(703) 524-8800
ARMA	Asphalt Roofing Manufacturers Association www.asphaltroofing.org	(202) 207-0917
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)	

REFERENCES

ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers	(800) 527-4723
	www.ashrae.org	(404) 636-8400
ASME	ASME International	(800) 843-2763
	(American Society of Mechanical Engineers International)	(973) 882-1170
	www.asme.org	
ASSE	American Society of Sanitary Engineering	(440) 835-3040
	www.asse-plumbing.org	
ASTM	ASTM International	(610) 832-9500
	(American Society for Testing and Materials International)	
	www.astm.org	
AWCI	Association of the Wall and Ceiling Industry	(703) 534-8300
	www.awci.org	
AWI	Architectural Woodwork Institute	(571) 323-3636
	www.awinet.org	
AWPA	American Wood Protection Association	(205) 733-4077
	(Formerly: American Wood Preservers' Association)	
	www.awpa.com	

REFERENCES

AWS	American Welding Society	(800) 443-9353
	www.aws.org	(305) 443-9353
AWWA	American Water Works Association	(800) 926-7337
	www.awwa.org	(303) 794-7711
BHMA	Builders Hardware Manufacturers Association	(212) 297-2122
	www.buildershardware.com	
BICSI	BICSI, Inc.	(800) 242-7405
	www.bicsi.org	(813) 979-1991
CCC	Carpet Cushion Council	(610) 527-3880
	www.carpetcushion.org	
CDA	Copper Development Association	(800) 232-3282
	www.copper.org	(212) 251-7200
CEA	Canadian Electricity Association	(613) 230-9263
	www.canelect.ca	
CEA	Consumer Electronics Association	(866) 858-1555
	www.ce.org	(703) 907-7600
CFFA	Chemical Fabrics & Film Association, Inc.	(216) 241-7333
	www.chemicalfabricsandfilm.com	

REFERENCES

CGA	Compressed Gas Association www.cganet.com	(703) 788-2700
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	(301) 596-2583
CRRC	Cool Roof Rating Council www.coolroofs.org	(866) 465-2523 (510) 485-7175
CPA	Composite Panel Association www.pbmdf.com	(301) 670-0604
CPPA	Corrugated Polyethylene Pipe Association www.cppa-info.org	(800) 510-2772 (202) 462-9607
CRSI	Concrete Reinforcing Steel Institute	(847) 517-1200

REFERENCES

	www.crsi.org	
CSA	Canadian Standards Association	(800) 463-6727 (416) 747-4000
CSA	CSA International (Formerly: IAS - International Approval Services) www.csa-international.org	(866) 797-4272 (416) 747-4000
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute) www.cti.org	(281) 583-4087
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
EIA	Electronic Industries Alliance www.eia.org	(703) 907-7500
EIMA	EIFS Industry Members Association www.eima.com	(800) 294-3462 (770) 968-7945
EJCDC	Engineers Joint Contract Documents Committee	(703) 295-5000

REFERENCES

	www.ejdc.org	
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
ESD	ESD Association (Electrostatic Discharge Association) www.esda.org	(315) 339-6937
ETL SEMCO	Intertek ETL SEMCO (Formerly: ITS - Intertek Testing Service NA) www.intertek.com	(800) 967-5352
FM Approvals	FM Approvals LLC www.fmglobal.com	(781) 762-4300
FM Global	FM Global (Formerly: FMG - FM Global) www.fmglobal.com	(401) 275-3000
FMRC	Factory Mutual Research (Now FM Global)	
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850

REFERENCES

FSC	Forest Stewardship Council www.fsc.org	49 228 367 66 0
GA	Gypsum Association www.gypsum.org	(202) 289-5440
GANA	Glass Association of North America www.glasswebsite.com	(785) 271-0208
GRI	(Part of GSI)	
GS	Green Seal www.greenseal.org	(202) 872-6400
GSI	Geosynthetic Institute www.geosynthetic-institute.org	(610) 522-8440
HI	Hydraulic Institute www.pumps.org	(973) 267-9700
HI	Hydronics Institute www.gamanet.org	(908) 464-8200
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)	

REFERENCES

HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
HPW	H. P. White Laboratory, Inc. www.hpwhite.com	(410) 838-6550
IAS	International Approval Services (Now CSA International)	
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(770) 830-0369
ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830
IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IESNA	Illuminating Engineering Society of North America www.iesna.org	(212) 248-5000
IEST	Institute of Environmental Sciences and Technology www.iest.org	(847) 255-1561

REFERENCES

IGCC	Insulating Glass Certification Council www.igcc.org	(315) 646-2234
IGMA	Insulating Glass Manufacturers Alliance www.igmaonline.org	(613) 233-1510
ISO	International Organization for Standardization www.iso.ch	41 22 749 01 11
	Available from ANSI www.ansi.org	(202) 293-8020
ISSFA	International Solid Surface Fabricators Association www.issfa.net	(877) 464-7732 (702) 567-8150
ITS	Intertek Testing Service NA (Now ETL SEMCO)	
ITU	International Telecommunication Union www.itu.int/home	41 22 730 51 11
LMA	Laminating Materials Association (Now part of CPA)	
LPI	Lightning Protection Institute	(800) 488-6864

REFERENCES

	www.lightning.org	
MFMA	Metal Framing Manufacturers Association, Inc. www.metalframingmfg.org	(312) 644-6610
MH	Material Handling (Now MHIA)	
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937 (604) 298-7578
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. www.mss-hq.com	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(630) 942-6591
NACE	NACE International (National Association of Corrosion Engineers International) www.nace.org	(800) 797-6623 (281) 228-6200
NADCA	National Air Duct Cleaners Association	(202) 737-2926

REFERENCES

	www.nadca.com	
NAIMA	North American Insulation Manufacturers Association www.naima.org	(703) 684-0084
NCPI	National Clay Pipe Institute www.ncpi.org	(262) 248-9094
NCTA	National Cable & Telecommunications Association www.ncta.com	(202) 775-2300
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NeLMA	Northeastern Lumber Manufacturers' Association www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association www.netaworld.org	(888) 300-6382 (269) 488-6382

REFERENCES

NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
NFRC	National Fenestration Rating Council www.nfrc.org	(301) 589-1776
NGA	National Glass Association www.glass.org	(866) 342-5642 (703) 442-4890
NLGA	National Lumber Grades Authority www.nlga.org	(604) 524-2393
NOMMA	National Ornamental & Miscellaneous Metals Association www.nomma.org	(888) 516-8585
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010

REFERENCES

NSSGA	National Stone, Sand & Gravel Association	(800) 342-1415
	www.nssga.org	(703) 525-8788
NWWDA	National Wood Window and Door Association	
	(Now WDMA)	
PCI	Precast/Prestressed Concrete Institute	(312) 786-0300
	www.pci.org	
PDCA	Painting & Decorating Contractors of America	(800) 332-7322
	www.pdca.com	(314) 514-7322
PDI	Plumbing & Drainage Institute	(800) 589-8956
	www.pdionline.org	(978) 557-0720
PGI	PVC Geomembrane Institute	(217) 333-3929
	http://pgi-tp.ce.uiuc.edu	
PLANET	Professional Landcare Network	(800) 395-2522
	(Formerly: ACLA - Associated Landscape Contractors of America)	(703) 736-9666
	www.landcarenetwork.org	
RCSC	Research Council on Structural Connections	
	www.boltcouncil.org	

REFERENCES

RFCI	Resilient Floor Covering Institute www.rfci.com	(301) 340-8580
SAE	SAE International www.sae.org	(877) 606-7323 (724) 776-4841
SDI	Steel Deck Institute www.sdi.org	(847) 458-4647
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association www.sefalabs.com	(877) 294-5424 (516) 294-5424
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)	
SIA	Security Industry Association www.siaonline.org	(866) 817-8888 (703) 683-2075
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SMA	Screen Manufacturers Association	(561) 533-0991

REFERENCES

	www.smacentral.org	
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	(703) 803-2980
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division) www.sprayfoam.org	(800) 523-6154
SPRI	Single Ply Roofing Industry www.spri.org	(781) 647-7026
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings www.sspc.org	(877) 281-7772 (412) 281-2331
STI	Steel Tank Institute www.steeltank.com	(847) 438-8265
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333

REFERENCES

SWRI	Sealant, Waterproofing, & Restoration Institute www.swrionline.org	(816) 472-7974
TCNA	Tile Council of North America, Inc. www.tileusa.com	(864) 646-8453
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance www.tiaonline.org	(703) 907-7700
TPI	Truss Plate Institute, Inc. www.tpinst.org	(703) 683-1010
UL	Underwriters Laboratories Inc. www.ul.com	(877) 854-3577 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association www.uni-bell.org	(972) 243-3902
USGBC	U.S. Green Building Council www.usgbc.org	(800) 795-1747
WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700
WCLIB	West Coast Lumber Inspection Bureau	(800) 283-1486

REFERENCES

	www.wclib.org	(503) 639-0651
WDMA	Window & Door Manufacturers Association	(800) 223-2301
	(Formerly: NWWDA - National Wood Window and Door Association)	(847) 299-5200
	www.wdma.com	
WSRCA	Western States Roofing Contractors Association	(800) 725-0333
	www.wsrca.com	(650) 570-5441
WWPA	Western Wood Products Association	(503) 224-3930
	www.wwpa.org	

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

IAPMO	International Association of Plumbing and Mechanical Officials	(909) 472-4100
	www.iapmo.org	
ICC	International Code Council	(888) 422-7233
	www.iccsafe.org	
ICC-ES	ICC Evaluation Service, Inc.	(800) 423-6587
	www.icc-es.org	(562) 699-0543
UBC	Uniform Building Code	

REFERENCES

(See ICC)

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CE	Army Corps of Engineers www.usace.army.mil	(202) 761-0011
CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-7923
DOC	Department of Commerce www.commerce.gov	(202) 482-2000
DOD	Department of Defense http://.dodssp.daps.dla.mil	(215) 697-6257
DOE	Department of Energy www.energy.gov	(202) 586-9220
EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
FAA	Federal Aviation Administration www.faa.gov	(866) 835-5322

REFERENCES

FCC	Federal Communications Commission www.fcc.gov	(888) 225-5322
FDA	Food and Drug Administration www.fda.gov	(888) 463-6332
GSA	General Services Administration www.gsa.gov	(800) 488-3111
HUD	Department of Housing and Urban Development www.hud.gov	(202) 708-1112
LBL	Lawrence Berkeley National Laboratory www.lbl.gov	(510) 486-4000
NCHRP	National Cooperative Highway Research Program (See TRB)	
NIST	National Institute of Standards and Technology www.nist.gov	(301) 975-6478
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999
PBS	Public Buildings Service	

REFERENCES

(See GSA)

PHS	Office of Public Health and Science www.osophs.dhhs.gov/ophs	(202) 690-7694
RUS	Rural Utilities Service (See USDA)	(202) 720-9540
SD	State Department www.state.gov	(202) 647-4000
TRB	Transportation Research Board http://gulliver.trb.org	(202) 334-2934
USDA	Department of Agriculture www.usda.gov	(202) 720-2791
USPS	Postal Service www.usps.com	(202) 268-2000

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA)	(800) 872-2253 (202) 272-0080

REFERENCES

	Accessibility Guidelines for Buildings and Facilities Available from U.S. Access Board www.access-board.gov	
CFR	Code of Federal Regulations Available from Government Printing Office www.gpoaccess.gov/cfr/index.html	(866) 512-1800 (202) 512-1800
DOD	Department of Defense Military Specifications and Standards Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	(215) 697-2664
DSCC	Defense Supply Center Columbus (See FS)	
FED-STD	Federal Standard (See FS)	
FS	Federal Specification Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	(215) 697-2664
	Available from Defense Standardization Program www.dps.dla.mil	
	Available from General Services Administration	(202) 619-8925

REFERENCES

www.gsa.gov

Available from National Institute of Building Sciences (202) 289-7800
www.wbdg.org/ccb

FTMS Federal Test Method Standard
(See FS)

MIL (See MILSPEC)

MIL-STD (See MILSPEC)

MILSPEC Military Specification and Standards (215) 697-2664
Available from Department of Defense Single Stock Point
http://dodssp.daps.dla.mil

UFAS Uniform Federal Accessibility Standards (800) 872-2253
Available from Access Board (202) 272-0080
www.access-board.gov

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Sections:

1. Division 01 Section "Alternates" for products selected under an alternate.

2. Division 01 Section "Substitution Procedures" for requests for substitutions.

3. Division 01 Section "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.

2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.

3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis of Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis of design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.

2. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."

b. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.

B. Basis of Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.

2. If a dispute arises between contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.

2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.

2. Store materials in a manner that will not endanger Project structure.

3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.

4. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.

5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.

6. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.

2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.

3. Refer to Divisions 02 through 49. Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.

2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.

3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

4. Where products are accompanied by the term "as selected," Engineer will make selection.

5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

2. Products:

a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

3. Manufacturers:

a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered.

4. Basis of Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers.

Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.

2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

3. Evidence that proposed product provides specified warranty.

4. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers and owners, if requested.

5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION

EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.
9. Correction of the Work.

B. Related Sections:

1. Division 01 Section "Submittal Procedures" for submitting surveys.
2. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner accepted deviations from indicated lines and levels, and final cleaning.

1.3 DEFINITIONS

A. Cutting: Removal of in place construction necessary to permit installation or performance of other work.

EXECUTION

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

1.4 INFORMATIONAL SUBMITTALS

A. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.

2. Changes to In Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.

3. Products: List products to be used for patching and firms or entities that will perform patching work.

4. Dates: Indicate when cutting and patching will be performed.

5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate how long services and systems will be disrupted.

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

C. Refrigerant Disposal Forms: Obtain Owner forms, fill out and return to Owner for their records.

1.5 QUALITY ASSURANCE

A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Engineer of locations and details of cutting and await directions from the Engineer before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load carrying capacity or increase deflection

EXECUTION

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

    a. Primary operational systems and equipment.

    b. Fire separation assemblies.

    c. Air or smoke barriers.

    d. Fire suppression systems.

    e. Mechanical systems piping and ducts.

    f. Control systems.

    g. Communication systems.

    h. Conveying systems.

    i. Electrical wiring systems.

    j. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or 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.

    a. Water, moisture, or vapor barriers.

    b. Membranes and flashings.

    c. Exterior curtain wall construction.

    d. Equipment supports.

    e. Piping, ductwork, vessels, and equipment.

    f. Noise and vibration control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction 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.

B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or 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.

B. In Place Materials: Use materials for patching identical to in place materials. For exposed surfaces, use materials that visually match in place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to the Engineer for the visual and functional performance of in place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: 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, mechanical and electrical systems, 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; underground electrical services, and other utilities.

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

EXECUTION

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

a. Description of the Work.

b. List of detrimental conditions, including substrates.

c. List of unacceptable installation tolerances.

d. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.

5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. 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.

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

C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control

of the Contractor, submit a request for information to Engineer according to requirements in Division 01 Section "Project Management and Coordination."

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 professional engineer 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 rim 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.

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

EXECUTION

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.

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 96 inches in occupied spaces and 90 inches in unoccupied spaces.

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. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned

with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

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.

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

H. 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.

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

3.6 CUTTING AND PATCHING

A. Cutting and Patching, 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 in place 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. Temporary Support: Provide temporary support of work to be cut.

C. Protection: Protect in place 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.

D. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements of Division 01 Section "Summary."

E. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

EXECUTION

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

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.

3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond core drill.

4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.

5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.

6. Proceed with patching after construction operations requiring cutting are complete.

G. 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 practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical 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 minimize evidence of patching and refinishing.

a. Clean piping, conduit, and similar features before applying paint or other finishing materials.

b. Restore damaged pipe covering to its original condition.

EXECUTION

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 in place 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, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in place 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.

H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. 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 waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.

3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

   a. Utilize containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where more than one installer has worked.

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

EXECUTION

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 in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01 Section "Construction Waste Management and Disposal."

H. 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.

I. 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.

J. 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.

3.8 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Division 01 Section "General Commissioning Requirements."

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

EXECUTION

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

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

E. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section "Quality Requirements."

3.9 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.

3.10 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.

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

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.

2. Recycling nonhazardous demolition and construction waste.

3. Disposing of nonhazardous demolition and construction waste.

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE REQUIREMENTS

A. General: Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials.

1.5 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by EPA approved certification program.

B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management during the entire duration of the Contract.

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:

1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers.

3. Store items in a secure area until installation.

4. Protect items from damage during transport and storage.

5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:

1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers.

3. Store items in a secure area until delivery to Owner.

4. Transport items to Owner's storage area designated by Owner.

5. Protect items from damage during transport and storage.

D. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

E. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on site workers.

B. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.

4. Store components off the ground and protect from the weather.

5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to maximum 1-1/2-inch size.

B. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.

2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

C. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

D. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.

2. Polystyrene Packaging: Separate and bag materials.

3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on site, break down pallets into component wood pieces and comply with requirements for recycling wood.

4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.

B. Related Sections:

1. Division 01 Section "Execution" for progress cleaning of Project site.
2. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
3. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
4. Division 01 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
5. Divisions 02 through 49 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.

CLOSEOUT PROCEDURES

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. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.

6. Complete startup testing of systems.

7. Submit test/adjust/balance records.

8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.

9. Advise Owner of changeover in heat and other utilities.

10. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

11. Complete final cleaning requirements, including touchup painting.

12. 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 notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected.

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.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Division 01 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. 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.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order.

2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

3. Include the following information at the top of each page:

a. Project name.

b. Date.

c. Name of Engineer.

d. Name of Contractor.

e. Page number.

4. Submit list of incomplete items in the following format:

a. Three paper copies of product schedule or list, unless otherwise indicated. Engineer will return two copies.

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. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. 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, three-ring, vinyl covered, loose leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch 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.

4. Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide table of contents at beginning of document.

D. 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.

1. Use cleaning products that meet Green Seal GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

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

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

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.

b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.

c. Remove tools, construction equipment, machinery, and surplus material from Project site.

d. Clean exposed exterior and interior hard surfaced finishes to a dirt free condition, free of stains, films, and similar foreign substances. Avoid disturbing

natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

e. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

f. Sweep concrete floors broom clean in unoccupied spaces.

g. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.

h. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

i. Remove labels that are not permanent.

j. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

1) Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates.

k. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

l. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

n. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter upon inspection.

1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report upon completion of cleaning.

o. 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.

p. Leave Project clean and ready for occupancy.

C. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section "Construction Waste Management and Disposal."

END OF SECTION

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Operation manuals for systems, subsystems, and equipment.
3. Product maintenance manuals.
4. Systems and equipment maintenance manuals.

B. Related Sections:

1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Division 01 Section "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.
3. Divisions 02 through 49 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual specification sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Where applicable, clarify and update reviewed manual content to correspond to modifications and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

1. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Engineer will return two copies.

C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Engineer will return copy with comments.

1. Correct or modify each manual to comply with Engineer's comments. Submit copies of each corrected manual within 15 days of receipt of Engineer's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:

1. List of documents.

2. List of systems.

3. List of equipment.

4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR OPERATION AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Engineer.
8. Name and contact information for Commissioning Agent.
9. Names and contact information for major consultants to the Engineer that designed the systems contained in the manuals.

10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy duty, three-ring, vinyl covered, post type binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.

b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name,and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.

4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.

b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.

2. Performance and design criteria if Contractor is delegated design responsibility.

3. Operating standards.

4. Operating procedures.

5. Operating logs.

6. Wiring diagrams.

7. Control diagrams.

8. Piped system diagrams.

9. Precautions against improper use.

10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.

2. Manufacturer's name.

3. Equipment identification with serial number of each component.

4. Equipment function.

5. Operating characteristics.

6. Limiting conditions.

7. Performance curves.

8. Engineering data and tests.

9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.

2. Equipment or system break-in procedures.

3. Routine and normal operating instructions.

4. Regulation and control procedures.

5. Instructions on stopping.

6. Normal shutdown instructions.

7. Seasonal and weekend operating instructions.

8. Required sequences for electric or electronic systems.

9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.

3. Identification and nomenclature of parts and components.

4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.

2. Troubleshooting guide.

3. Precautions against improper maintenance.

4. Disassembly; component removal, repair, and replacement; and reassembly instructions.

5. Aligning, adjusting, and checking instructions.

6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.

2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.

2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

OPERATION AND MAINTENANCE DATA

C. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

D. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals.

2. Comply with requirements of newly prepared record Drawings in Division 01 Section "Project Record Documents."

E. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Sections:

1. Division 01 Section "Execution" for final property survey.
2. Division 01 Section "Closeout Procedures" for general closeout procedures.
3. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
4. Divisions 02 through 49 Sections for specific requirements for project record documents of the Work in those Sections.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set of marked-up record prints.

B. Record Specifications: Submit one paper copy of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one paper copy of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: Refer to other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy of each submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings.

1. Preparation: 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 provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.

b. Accurately record information in an acceptable drawing technique.

c. Record data as soon as possible after obtaining it.

d. Record and check the markup before enclosing concealed installations.

e. Cross-reference record prints to corresponding archive photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.

b. Revisions to details shown on Drawings.

c. Locations and depths of underground utilities.

d. Revisions to routing of piping and conduits.

e. Revisions to electrical circuitry.

f. Actual equipment locations.

g. Pipe size and routing.

h. Locations of concealed internal utilities.

i. Changes made by Change Order or Construction Work Change Directive.

j. Changes made following Engineer's written orders.

k. Details not on the original Contract Drawings.

l. Field records for variable and concealed conditions.

m. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up record prints.

4. Mark record sets with erasable, red colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

5. Mark important additional information that was either shown schematically or omitted from original Drawings.

6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Engineer. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.

2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.

3. Refer instances of uncertainty to Engineer for resolution.

4. Engineer will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.

a. Refer to Division 01 Section "Submittal Procedures" for requirements related to use of Engineer's digital data files.

b. Engineer will provide data file layer information. Record markups in separate layers.

C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

2. Format: Annotated PDF electronic file with comment function enabled.

3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.

4. Identification: As follows:

a. Project name.

b. Date.

c. Designation "PROJECT RECORD DRAWINGS."

d. Name of Engineer.

e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications 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. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.

4. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as paper copy and scanned PDF electronic file(s) of marked up paper copy of Specifications.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.

3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as paper copy scanned PDF electronic file(s) of marked up paper copy of Product Data.

1. Include record Product Data directory organized by specification section number and title, electronically linked to each item of record Product Data.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. 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.

B. Format: Submit miscellaneous record submittals as paper copy and scanned PDF electronic file(s) of marked up miscellaneous record submittals.

1. Include miscellaneous record submittals directory organized by specification section number and title, electronically linked to each item of miscellaneous record submittals.

PROJECT RECORD DOCUMENTS

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and modifications to project record documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Engineer's reference during normal working hours.

END OF SECTION

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.

2. Training in operation and maintenance of systems, subsystems, and equipment.

3. Demonstration and training video recordings.

B. Related Sections:

1. Divisions 23 & 26 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules utilizing manufacturer produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Qualification Data: For facilitator, instructor and videographer.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

a. Name of Project.

b. Name and address of videographer.

c. Name of Engineer.

d. Name of Construction Manager.

e. Name of Contractor.

f. Date of video recording.

2. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy-duty, three-ring, vinyl-covered binders. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.

3. At completion of training, submit complete training manual(s) for Owner's use.

1.5 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.

2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.

3. Review required content of instruction.

4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved operation and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Engineer.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

a. System, subsystem, and equipment descriptions.

b. Performance and design criteria if Contractor is delegated design responsibility.

c. Operating standards.

d. Regulatory requirements.

e. Equipment function.

f. Operating characteristics.

g. Limiting conditions.

h. Performance curves.

2. Documentation: Review the following items in detail:

a. Operations manuals.

b. Maintenance manuals.

c. Project record documents.

d. Identification systems.

e. Warranties and bonds.

f. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

a. Instructions on meaning of warnings, trouble indications, and error messages.

b. Instructions on stopping.

c. Shutdown instructions for each type of emergency.

d. Operating instructions for conditions outside of normal operating limits.

e. Sequences for electric or electronic systems.

f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

a. Startup procedures.

b. Equipment or system break-in procedures.

c. Routine and normal operating instructions.

d. Regulation and control procedures.

e. Control sequences.

f. Safety procedures.

g. Instructions on stopping.

h. Normal shutdown instructions.

i. Operating procedures for emergencies.

j. Operating procedures for system, subsystem, or equipment failure.

k. Seasonal and weekend operating instructions.

l. Required sequences for electric or electronic systems.

m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.

b. Checking adjustments.

c. Noise and vibration adjustments.

d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.

b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.

b. Types of cleaning agents to be used and methods of cleaning.

c. List of cleaning agents and methods of cleaning detrimental to product.

d. Procedures for routine cleaning

e. Procedures for preventive maintenance.

f. Procedures for routine maintenance.

g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.

b. Repair instructions.

c. Disassembly; component removal, repair, and replacement; and reassembly instructions.

d. Instructions for identifying parts and components.

e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner with at least seven days' advance notice.

D. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video Recording Format: Provide high quality color video recordings with menu navigation in format acceptable to Engineer.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

D. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

E. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

F. Pre-Produced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION

SECTION 230500 - BASIC HVAC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work under this Section shall comply with the requirements of General Conditions, Supplemental Conditions, Special Conditions and Division 01 - General Requirements, and shall include all Mechanical Sections specified herein.

1.2 SCOPE OF THIS SECTION

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to, the following:

1. Compliance with all codes and standards applicable to this jurisdiction
2. Shop Drawings for Equipment
3. Coordination Documents
4. Record Drawings
5. Start-up Service and Building Commissioning
6. Instruction, Maintenance, and O & M Manuals
7. Work associated with Delivery, Storage, and Handling of products
8. Work associated with provision of Temporary Facilities
9. Preparation of Posted Operating Instructions
10. Meeting Project Safety and Indemnity requirements
11. Proper Cleaning and Closing
12. Supplying proper Warranty information
13. Supply specified Guarantee documentation
14. Design and provision of Supports and Anchors
15. Pipe Supports
16. Identification Markers
17. Coordination of Electrical requirements for equipment provided

1.3 DESCRIPTION OF WORK

A. The Contract Documents, including Specifications, Construction Drawings, Owner Design Requirements and referenced Codes and Standards, require the Contractor to provide all material and labor to install complete and operable heating, ventilating, air conditioning systems for the project, whether or not specifically shown in the documents, and where applicable, shall appropriately interface with all existing building systems affected by new construction.

B. The Contractor shall refer to the architectural interior details, floor plans, elevations, and the structural and other Contract Drawings and shall coordinate this work with that of the other trades to avoid interference.

C. The drawings are diagrammatic and show generally the locations of the fixtures, equipment, duct routing and pipe routing and are not to be scaled. All dimensions and existing conditions shall be inspected and verified by contractors at the building prior to start of any work.

D. The Contractor shall comply with the project closeout requirements as detailed in General Requirements of Division 01.

E. Where project involves interface with existing building and site systems, every effort has been made to note existing utilities and services. However, the Contractor should thoroughly familiarize themselves with existing conditions and be aware that in some cases information is not available as to concealed conditions, which exist in portions of the existing building affected by this work.

F. The contractor shall design and supply all miscellaneous metals and system support components that are necessary to support all mechanical system, whether indicated or not on the drawings. Such metals and support components and related connections shall be provided as necessary to directly and concentrically impost loads on the primary structure. Refer to structural design requirements for specific attachment requirements. The mechanical system supports shall accommodate lateral movements between floors as defined in the story drift requirements.

G. The contractor shall design and supply mechanical devices and system components that are necessary to accommodate structural movement as defined by structural design criteria associated with ductwork and piping transitions through building expansion joints. Design of expansion joints to allow for dimensional changes in portions of a structure separated by such joints should take both reversible and irreversible movements into account.

1.4 DESCRIPTION OF BID DOCUMENTS

A. Specifications:

1. Specifications, in general, describe quality and character of materials and equipment.
2. Specifications are of simplified form and include incomplete sentences.

B. Drawings:

1. Drawings in general are diagrammatic and indicate sizes, locations, connections to equipment and methods of installation. Coordinate with other trades before commencing any work.
2. Before proceeding with work check and verify all existing and new dimensions. Verify exact location and elevation of existing work prior to any construction.
3. Contractor shall assume all responsibility for fitting of materials and equipment to other parts of equipment and structure, and to avoid other pipes, conduits and ducts. Contractor shall be responsible to relocate other work or modify new work as necessary.
4. Contractor shall make adjustments that may be necessary or requested, in order to resolve space problems, preserve headroom, and avoid architectural openings, structural members and work of other trades.

5. If any part of Specifications or Drawings appears unclear or contradictory, apply to Owner's Representative interpretation and decision as early as possible, including during bidding period.

1.5 DEFINITIONS

A. Above Grade: Not buried in the ground and not embedded in concrete slab on ground.

B. Accessible: Ability to perform recommended maintenance without removal of services or equipment and requiring no special platforms.

C. Actuating or Control Devices: Automatic sensing and switching devices such as thermostats, pressure, float, electro-pneumatic switches and electrodes controlling operation of equipment.

D. Below Grade: Buried in the ground or embedded in concrete slab on ground.

E. Concealed: Embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces, or in enclosures. In general, any item not visible or directly accessible.

F. Connect: Complete hook-up of item with required service.

G. Drift: The horizontal deflection at the top of the story relative to the bottom of the story. Refer to structural design for drift dimensional movements.

H. Expansion Joint: A mid-structure separation designed to relieve stress on building materials caused by building movement induced by any of the following: thermal expansion and contraction; wind sway; seismic events; static load deflection; or live load deflection. Expansion joint systems are used to bridge the gap and maintain building assembly functions while accommodating expected movements. Expansion joints also include transitions from an existing building to a new building addition. Refer to structural design for expansion joint dimensional movements.

I. Explosion Proof Equipment (per National Electrical Code-Article 501): Equipment enclosed in a case that is capable of withstanding an explosion of a specified gas or vapor that may occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within, and that operates at such an external temperature that a surrounding flammable atmosphere will not be ignited thereby. Explosion proof motors are required for Class I, II or II applications regardless of Division or Group as defined in National Electrical Code – Article 501 and ANSI/ISA-12.20.01.

1. Class I: Hazardous due to flammable gases or vapors are present or may be present in quantities sufficient to produce explosive or ignitable mixtures.
2. Class II: Hazardous due to combustible or conductive dusts are present or may be present in quantities sufficient to produce explosive or ignitable mixture.
3. Class III: Hazardous dues to ignitable fibers are present or may be present in quantities sufficient to produce explosive or ignitable mixtures.

4. Division: The substance referred to by Class has a high probability (Division 1) or low probability (Division 2) of producing an explosive or ignitable mixture due to it being present continuously, intermittently, or periodically or from the equipment itself under normal operating conditions.
5. Group: Type of hazardous material in surrounding environment ranging from Group A flammable liquids to Group G combustible dusts.

J. Exposed: Not installed underground or concealed.

K. FRT: Fire retardant treated wood is any wood product that, when impregnated with chemicals by a pressure process or other means during manufacture, shall have, when tested in accordance with ASTM E84 or UL 723, a listed flame spread index of 25 or less.

L. Furnish: To supply equipment and products as specified.

M. Indicated, Shown or Noted: As indicated, shown or noted on Drawings or Specifications.

N. Install: To erect, mount and connect complete with related accessories.

O. Motor Controllers: Manual or magnetic starters (with or without switches), individual push buttons or hand-off-automatic (HOA) switches controlling the operation of motors.

P. Must: A desire to complete the specified task. Allows some flexibility in application as opposed to Shall.

Q. Noncombustible Material: A noncombustible material is a substance that will not ignite, burn, support combustion, or release flammable vapors when subject to fire or heat in compliance with ASTM E136 Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C. Examples of noncombustible materials include the following, but confirm compliance in manufacturer literature:

1. Portland cement concrete, concrete, gypsum concrete (normally used in drywall or poured gypsum floor toppings), Portland cement stucco, Portland cement plaster, and gypsum plaster, gypsum wall board (sheetrock), and Type X gypsum wall board.
2. Brick masonry, concrete block masonry, and ceramic tiles.
3. Steel, stainless steel, galvanized steel, and other metals, except aluminum (aluminum is classified as limited-combustible), magnesium and magnesium alloys.
4. Sheet glass, block glass, and uncoated glass fibers.
5. Mineral wool and rock wool.

R. NRTL: Nationally Recognized Testing Laboratory, including UL and/or ETL.

S. Piping: Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and related items.

T. Provide: To supply, install and connect as specified for a complete, safe and operationally ready system.

U. Reviewed, Satisfactory or Directed: As reviewed, satisfactory, or directed by or to Architect/Engineer/Owner's Representative.

V. Rough-In: Provide all indicated services in the necessary arrangement suitable for making final connections to fixture or equipment.

W. Shall: An exhortation or command to complete the specified task including providing and installing work associated with task.

X. Similar or Equal: Of base bid manufacture, equal in materials, weight, size, design, and efficiency of specified products.

Y. Supply: To purchase, procure, acquire and deliver complete with related accessories.

Z. Typical or Typ: Exhibiting the qualities, traits, or characteristics that identify a kind, class, number, group or category. Of or relating to a representative specimen. Application shall apply to all other similarly identified on plan or detail.

AA. Will: A desire to complete the specified task. Allows some flexibility in application as opposed to Shall".

BB. Wiring: Raceway, fittings, wire, boxes and related items.

CC. Work: Labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation.

1.6 RELATED WORK SPECIFIED ELSEWHERE

A. All Division 23 Mechanical sections included herein.

B. Division 26: Electrical.

1. Power connections to all mechanical equipment and controls interface of electrical equipment.

1.7 CODES AND STANDARDS

A. The Contractor is cautioned that code requirements not explicitly detailed in these specifications or drawings, but which may be reasonably inferred or implied from the nature of the project, must be provided as part of the contract.

B. Perform all tests required by governing authorities and required under all Division 23 Sections. Provide written reports on all tests.

C. Electrical devices and wiring shall conform to the latest standards of NEC; all devices shall be UL listed and labeled.

D. All accessible mechanical work shall comply with the minimum requirements of the Americans with Disabilities Act (ADA) and local amendments. Also, refer to ICC/ANSI A117.1 Accessible and Usable Buildings and Facilities. Refer to Architectural drawings and specifications for additional ADA requirements. The following requirements are provided as consolidated list of minimum ADA requirements. Compliance requirements applicable to HVAC work includes, but is not limited to, the following:

1. Section 309: Operable parts shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate operable parts shall be 5 pounds maximum.
2. Section 308.3: Temperature control devices mounted on walls with operable buttons or switches shall be placed where clear floor or ground space allows a parallel approach and the side reach is unobstructed. Operable parts shall be located 48" maximum above finished floor, and no lower than 42" above finished floor. Do not mount above light switches to avoid inaccurate temperature readings due to light switch heat output.
3. Section 308.3.2: Where a clear floor or ground space allows a parallel approach to an element and high reach is over an obstruction, the height of the obstruction shall be 34" maximum and depth of obstruction shall be 24" maximum.
4. Section 404.2.9: Fire doors shall have a minimum opening force allowable by the applicable Building Code. The force for pushing or pulling open a door other than fire doors shall be 5 pounds maximum.

E. All excavation work must comply with all provisions of state laws including notification to all owners of underground utilities at least 48 business day hours, but not more than 10 business days, before commencing an excavation.

F. Provide in accordance with rules and regulations of the following:
1. Washington Building Codes enforced by the Authority Having Jurisdiction (AHJ):
    a. 2018 Washington State Building Code (2018 International Building Code (IBC) with State and Local Amendments)..
    b. 2018 Washington State Mechanical Code (2018 International Mechanical Code (IMC), including 2018 International Fuel Gas Code, 2018 NFPA 58, and 2017 NFPA 54 with State and Local Amendments.
    c. 2018 Washington State Plumbing Code (2018 Uniform Plumbing Code (UPC) with State and Local Amendments).
    d. 2018 Washington State Fire Code (2018 International Fire Code (IFC) with State and Local Amendments).
    e. Fuel Gas Code 2018 of Washington. (International Fuel Gas Code 2018 (IFGC 2018)
    f. 2020 Washington State Electrical Code (2020 National Electrical Code (NEC)).).
    g. 2018 Washington State Energy Code (2018 International Energy Conservation Code).).
    h. Washington State Ventilation and Indoor Air Quality Code, WA 51-13 (VIAQ).
2. Local, city, county and state codes and ordinances.
3. Local Bureau of Buildings.
4. Local Health Department.
5. Local and State Fire Prevention Districts.
6. State Administrative Codes.

G. Provide in accordance with appropriate referenced standards of the following and as referenced in other specification sections:

1. AABC - Associated Air Balance Council
2. ADA - Americans with Disabilities Act
3. ADC - Air Diffuser Council
4. AHRI - Air Conditioning, Heating and Refrigeration Institute
5. AMCA - Air Moving and Conditioning Association
6. ANSI - American National Standards Institute
7. ASCE 7-10 – American Society of Civil Engineers – Minimum Design Loads for Buildings and Other Structures
8. ASHRAE - American Society of Heating, Refrigerating & Air Conditioning Engineers
9. ASME - American Society of Mechanical Engineers
10. ASTM - American Society for Testing Materials
11. AWS - American Welding Society
12. CSA - Canadian Standards Association
13. ETL - Electrical Testing Laboratories
14. FM - Factory Mutual
15. IBC - International Building Code
16. ICC AC156 Seismic Certification by Shake-Table Testing of Nonstructural Components.
17. MSS - Manufacturer's Standardization Society
18. NEMA - National Electrical Manufacturer's Association
19. NFPA - National Fire Protection Association
20. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
21. UL - Underwriter's Laboratories

H. Provide compliance in accordance with the following referenced standard which applies to general system compliance in contrast to specific equipment standards referenced elsewhere:

1. UL-2043: Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces. This is applicable to spaces above suspended ceilings and below raised floors.

1.8 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to the Owner’s Representative for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to the Owner’s Representative for a decision before proceeding.

1.9 QUALITY ASSURANCE

A. Manufacturer's Nameplates: Nameplates on manufactured items shall be metallic riveted or bolted to the manufactured item, with nameplate data engraved or punched to form a non-erasable record of equipment data suitable for the ambient exposure.

B. All work shall include the following:

1. Manufactured items and equipment shall be a current, cataloged product of the manufacturer.
2. Replacement parts shall be readily available and stocked in the USA.

C. Experience: Unless more stringent requirements are specified in other sections of Division 23, manufactured items shall have been installed and used, without modification, renovation or repair, on other projects for not less than one year prior to the date of bidding for this project.

D. Each product and/or equipment type shall be provided by one manufacturer. Mixtures of manufacturers for each product and/or equipment type are not acceptable. Example – all fire dampers shall be supplied by one manufacturer.

E. Special Inspections: Provide structural design and Special Inspections as required in Chapter 17 of the local building code and the Authority Having Jurisdiction, and as defined in the manufacturer installation instructions for each anchorage system. All anchors post-installed in hardened concrete members shall have periodic Special Inspections. Special inspection agencies shall be independent of the design and construction companies and shall act as agents for the AHJ, but contracted directly with the Owner or Owner’s Representative.

F. Welding Standards:

1. Welding Qualifications:
   a. Certification: Each welder shall have a current AWS QC7 welding certification with successful completion of written test and welding samples in compliance with AWS D1.1. The welder must maintain their certification to show qualified welding experience every six months. The Owner’s Representative reserves the right to request sample coupon test welds of each welder to validate quality of welding work.

2. Welding Procedures:
   a. Steel Support Welding: All work shall be performed in compliance with American Welding Society AWS D1.1/D1.1M-Structural Welding Code-Steel.
   b. Pipe Welding: All work shall be performed to meet or exceed the requirements of the American Welding Society AWS B2.1 Specification for Welding Procedure and Performance Qualification and ASME Boiler & Pressure Vessel Code: Section IX “Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.”

G. Pressure Piping Standards

1. Comply with ASME B31.1 Power Piping, ASME B31.3-Process Piping and ASME B31.9-Building Services Piping standards for materials, products, and installation per pressure and temperature operating class.
2. Comply with ASME B31.9 Building Services Piping standard for the following services:
   a. Conveying fluid between 0°F (-18°C) to 250°F (121°C).
   b. Fluid pressure less than 350 psig.

3. Comply with ASME B31.1 Power Piping standard for the following services:
   a. Steam.

4. Comply with ASME B31.3 Process Piping standard for the following services:
   a. Conveying fluid above 250°F (121°C).
   b. Toxic or flammable fluids.

1.10 GENERAL REQUIREMENTS

A. Examine all existing conditions at building site.

B. Review contract documents and technical specifications for extent of new work to be provided.

C. Provide and pay for all permit, licenses, fees and inspections, including, but not limited to, building permits, planning permits, air quality management district permits, operating licenses, utility district fees, special district fees, environmental impact reports, and additional local permits and fees.

D. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing. This work shall include furnishing and installing all access doors required for mechanical access. Joints and fittings shall not be located in inaccessible locations such wall, floor and roof penetrations.

E. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected. Refer to Equipment Specifications for rough-in requirements.

F. Coordinate mechanical equipment and materials installation with other building components.

G. Ductwork and piping dimensions, as identified on drawings and in specifications, refer to the interior free dimensions. Adjust work as necessary to account for larger outside dimensions to account for material wall thickness. Upsize plastic pipe diameters as necessary to maintain minimum interior dimensions.

H. Verify all dimensions by field measurements.

I. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.

J. 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.

K. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

L. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Contractor shall provide for all cutting and patching required for installation of this work unless otherwise noted.

M. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.

N. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. Connect equipment for ease of disconnecting, without interference with other installations.

O. Coordinate the installation of mechanical materials and equipment above ceilings with ductwork, piping, conduits, suspension system, light fixtures, cable trays, sprinkler piping and heads, and other installations.

P. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

Q. Coordinate with Owner's Representative in advance to schedule shutdown of existing systems to make new connections. Provide valves in new piping to allow existing system to be put back in service with minimum down time.

R. All materials (such as supports, gaskets, sealants, insulation, ductwork, piping, wiring, controls, etc.) located within air plenum spaces, air shafts, and occupied spaces shall be noncombustible or have a flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) Method. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing, or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified. Coordinate with all disciplines to assure that all discrete electrical, plumbing and mechanical products located in plenums are non-combustible and compliant with UL 2043.

S. Products made of or containing lead, asbestos, mercury or other known toxic or hazardous materials are not acceptable for installation under this Division. Any such products installed as part of the work of the Division shall be removed and replaced and all costs for removal and replacement shall be borne solely by the installing Contractor.

1.11 CYBERSECURITY PROTECTION

A. For all installed systems that have internet connectivity, including but not limited to controls, monitoring, metering, sensors, or other remote access capabilities, the General Contractor is responsible to request from its subcontractors a cybersecurity risk mitigation plan. All cybersecurity risk mitigation plans shall be coordinated with the owner to verify functionality and compatibility with the owner's network architecture and topology. Cybersecurity risks to be mitigated include intrusion, remote access, viruses, spy-ware, and malware. Put in-place and in-use effective protection and homogenous policies for infrastructure, servers, workstations, controllers, network connected equipment, internet connected systems/devices, WiFi devices, IOT devices and mobile devices. Where relevant and applicable, apply the requirements of ISO/IEC 27000 Series of Standards relating to "Information Technology - Security Techniques".

B. For any "highly secure environments" identified by the owner, implement relevant jurisdiction-specific standards to be performed by an accredited Information Security advisor.

C. Coordinate with Division 27 and 28 work as applicable.

1.12 MINOR DEVIATIONS

A. The Drawings are diagrammatic and show the general arrangements of all mechanical work and requirements to be performed. It is not intended to show or indicate all offsets, fittings, and accessories which will be required as a part of the work of this Section.

B. The Contractor shall review the structural and architectural conditions affecting their work. It is the specific intention of this section that the contractor's scope of work shall include:

1. Proper code complying support systems for all equipment whether or not scheduled or detailed on drawings or in these specifications
2. Minor deviations from the mechanical plans required by architectural and structural coordination.

C. The Contractor shall study the operational requirements of each system, and shall arrange work accordingly, and shall furnish such fittings, offsets, supports, accessories, as are required for the complete, proper and efficient installation of all systems from the physical space available for use by this section. This requirement extends to the Contractor's coordination of this section's work with the "Electrical Work", "Plumbing Work" and all work associated with deferred and delegated design and construction scopes. Should conflicts occur due to lack of coordination, the time delay, cost of rectification, demolition, labor and materials, shall be borne by the Contractor and shall not be at a cost to the Owner.

D. Minor deviations to avoid conflict shall be permitted where neither the design intent nor system performance is altered.

E. Advise the Owner's Representative, in writing, in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Owner's Representative of conflict.

1.13 MAJOR DEVIATIONS

A. Major deviation is a deviation from the project design that is not a minor deviation. This includes but is not limited to changes to the design intent, system or equipment capacities and/or energy performance, system or equipment performance, utility routing, equipment room layouts, equipment orientations that may affect other trades, and weights that differ from the scheduled values.

B. In addition to all Division 01 and Division 23 requirements associated with Substitution requests, Contractor shall give Engineer specific written notice of any major deviations that the Submittal may have from the requirements of the Contract Documents with each Submittal or Shop Drawing. This notice must be set forth in a written communication prepared on the contractor's letterhead separate from the Submittal; and, in addition, in the case of a Shop Drawing or Product Submittal, by a specific notation made on the Shop Drawing or Product Submittal itself. The Contractor shall clearly indicate proposed deviations from requirements in the Contract Documents, including variations, limitations, cost impacts and additional engineering design that may be required. Include relevant additional information and revisions, other than those requested by Engineer on previous submittals. Include the same identification information as related to the associated submittal.

1.14 SPECIFIED EQUIPMENT

A. Where specific manufacturers and/or model numbers are provided in the contract documents, it shall be understood that they constitute the design basis for the project. Where approved optional manufacturers are identified, the Contractor may submit based on these manufacturers, however, the submittals must be inclusive of all additional costs (or credits) and coordination requirements necessary to successfully and fully implement said manufacturer's product. See section on Substitutions below for procedures to use non-specified equipment.

B. **Where required by law**, specified equipment listed on the contract documents shall be interpreted to include the phrase "or equal" to allow products that are equal to those specified. The Engineer of Record has the sole authority to accept a product as equal to the specified product. For an "or equal" product to be accepted for use on the project, the following conditions must be met:

1. The proposed "or equal" substitution shall be submitted within seven days (7) of contract award.
2. Contractor shall notify the Engineer as to how the substituted product will impact the project completion.
3. Contractor shall notify Engineer as to the costs of both the substituted product and the listed product.
4. Contractor shall provide a detailed analysis of the difference between the listed product and proposed product.
5. Contractor shall provide:
    a. Product identification, manufacturer literature, samples, names and addresses of similar projects where the substituted product has been used along with facility contact information, and

b. The name and address of the manufacturer's representative

6. Contractor shall pay the cost of the design team to review the proposed substitution and any redesign fees.

C. Engineer's approval of an "or equal" product does not relieve Contractor of the responsibility to submit required shop drawings and to comply with all other requirements of the Contract Documents.

1.15 SHOP DRAWINGS AND EQUIPMENT SUBMITTALS

A. Prior to construction submit for review all materials and equipment in accordance with this section and Division 01 requirements.

B. The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Engineer's review of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Engineer of such deviation at the time of submittal and (1) the Engineer has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation.

C. After approval of preliminary list of materials, the Contractor shall submit Shop Drawings and manufacturer's Certified Drawings to the Owner's Representative for approval.

D. The Contractor shall submit approved Shop Drawings and manufacturer's equipment cuts, of all equipment requiring connection by Division 26, to the Electrical Contractor for final coordination of electrical requirements. Contractor shall bear all additional costs for failure to coordinate with Division 26.

E. Delegated-Design Submittal: For structural pipe and equipment supports, vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic, and where required wind forces required to select vibration isolators, seismic and wind restraints, support framing members, and for designing vibration isolation bases.
2. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment and cantilever loads. Provide base with level top surfaces with integral sloping on bottom to match support structure.

F. Submittals and Shop Drawings:

1. Submit electronic copies of manufacturer's submittal sheets in one (1) coordinated package per specification section. Multiple submissions will not be accepted without

prior approval of the Engineer or the Owner's Representative. Organize submittal sheets in sequential order aligned with matching specification section numbers.

2. Provide electronic copies of shop drawings prepared to show details of the proposed installation. Copies of contract design drawings submitted to demonstrate shop drawing compliance will not be accepted.
3. Paper submittals will only be acceptable if specifically required by Division 01.
4. The approved submittals shall be converted into Operations & Maintenance Manuals at the completion of the project. Refer to Division 01 for additional requirements.
5. Mark each copy of each submittal to show which specific products, options, accessories, appurtenances, etc. are applicable to this specific project.
6. 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.
7. For equipment, include the following in addition to the above, as applicable:
    a. Wiring diagrams that show factory-installed wiring.
    b. All required electrical operational and connection requirements.
    c. Connection requirements for all required systems, utilities and services to make equipment/product fully operational.
    d. Printed performance data and curves.
    e. Operational range diagrams.
    f. Equipment/product dimensions and weights, point loads, center-or-gravity, etc.
    g. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

1.16 COORDINATION DOCUMENTS/SHOP DRAWINGS

A. The Contractor shall prepare coordinated Shop Drawings using the same electronic format as the contract documents.

1. The shop drawings shall serve to record the coordination of the installation and location of all HVAC equipment, ductwork, grilles, diffusers, piping, fire sprinklers, lights, audio/video systems, electrical services and all system appurtenances.
2. The Drawings shall include all mechanical rooms and floor plans.
3. The Drawings shall be keyed to the structural column identification system, and shall be progressively numbered. Prior to completion of the Drawings, the Contractor shall coordinate the proposed installation with the Owner's Representative and the structural requirements, and all other trades (including HVAC, Plumbing, Fire Protection, Electrical, Ceiling Suspension, and Tile Systems), and provide maintenance access clearance as required by manufacturer installation instructions and as required to meet minimum code clearances. When conflicts are identified, modify system layout as

necessary to resolve. Do not fabricate, order or install any equipment or materials until coordination documents are approved by the General Contractor and Owner's Representative.

4. Within thirty (30) days after award of Contract, submit proposed coordination document Shop Drawing schedule, allowing adequate time for review and approval by parties mentioned above. Drawings or electronic coordination should be prepared and submitted for approval on a floor-by-floor basis to phase with building construction.

B. The coordination work shall be prepared as follows:

1. Two dimensional AutoCAD / Revit based documents (if required for project):
   a. Contractor shall prepare AutoCAD/Revit coordination drawings to an accurate scale of 1/4" = 1'-0" or larger. Drawings are to be same size as Contract Drawings and shall indicate locations, sizes and elevations above finished floor, of all systems. Lettering shall be minimum 1/8" high.
   b. Contractor shall obtain AutoCAD/Revit drawings from all other trades as required to fully coordinate the installation with architectural, structural, HVAC, plumbing, electrical, fire alarm devices, low voltage devices, and other systems that interface with and/or impact the HVAC work.
   c. Provide maintenance access clearance as required by manufacturer installation instructions and as required to meet minimum code clearances.
   d. Drawings shall incorporate all addenda items and change orders.
   e. Distribute drawings to all other trades and provide additional coordination as needed to assure adequate space for piping, equipment and routing to avoid conflicts. When conflicts are identified, modify system layout as necessary to resolve.

2. Three dimensional Revit / BIM based documents (required for all projects):
   a. Provide three dimensional Revit model and BIM input information locating all equipment and piping, including valves and fittings, dimensions from column lines, and bottom of pipe elevations above finished floor.
   b. Contractor shall obtain Revit model and BIM input from all other trades as required to fully coordinate the installation with architectural, structural, HVAC, plumbing, electrical, fire alarm devices, low voltage devices, and other systems that interface with and/or impact the fire protection work.
   c. Model shall indicate locations of all equipment and piping, including valves and fittings, dimensions from column lines, and bottom of pipe elevations above finished floor.
   d. Provide maintenance access clearance as required by manufacturer installation instructions and as required to meet minimum code clearances.
   e. Model shall incorporate all addenda items and change orders.
   f. Distribute Revit model and BIM input information to all other trades and provide additional coordination as needed to assure adequate space for equipment and piping and routing to avoid conflicts. When conflicts are identified, modify system layout as necessary to resolve.

C. Advise the Owner's Representative in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Owner's Representative of conflict.

D. Verify in field exact size, location, invert, and clearances regarding all existing material, equipment and apparatus, and advise the Owner's Representative of any discrepancies between those indicated on the Drawings and those existing in the field prior to any installation related thereto.

E. Final Coordination Drawings with all appropriate information added are to be submitted as Record Drawings at completion of project.

F. Provide copy of Record Drawings to Testing and Balancing Contractor for their use when doing their work.

1.17 SUBSTITUTIONS

A. General: In addition to all other requirements included in Division 01, by submitting a bid, the Contractor represents that its bid is based on materials, equipment and performance described in the Contract Documents, including Addenda. Contractors shall request approval for use of proposed substitute materials and equipment when the Contract Documents list materials and equipment by product or manufacturer name and/or model number.

B. Definitions

1. Substitutions: Changes in products, materials, equipment, and methods of construction from those specified in the Contract Documents.

C. Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by the Engineer; otherwise, requests will be returned without action:

1. Revisions to the Contract Documents are not required.
2. Revisions to the Contract Documents are required and Contractor's substitution request includes provisions for both schedule affects, and all costs associated with required additional Design and Engineering fees to incorporate Contractor's proposed substitution.
3. Proposed substitution is in keeping with the general intent and performance requirements of the Contract Documents, including the level of quality of the Work represented by the requirements therein.
4. The substitution request is fully documented and properly submitted in a timely fashion.
5. Substitution requests submitted for retroactive approval of already installed products and materials will be rejected.

D. Substitution Requests shall be made in writing by Contractor in accordance with the following requirements:

1. While requests for Substitution shall be submitted no later than 30 days after contract award, Contractor is encouraged to submit such requests for Substitution during the bid

period. All bids that are based on unapproved Substitutions shall be at the Contractor's sole risk.

2. Substitution Format: Unless otherwise specified in Division 01 requirements, submit written Substitution requests using CSI Substitution Request Form 1.5C.
    a. Identify the proposed Substitution product, fabrication or installation to be replaced in each Substitution request. Include within each request the related contract document reference to include specification Section(s) and/or drawing sheet number(s).
    b. Provide complete documentation on both the specified product and the proposed Substitution, including the following information as may be appropriate:
        1) Statement indicating why specified product or fabrication or installation method cannot be provided or why substitution is being proposed.
        2) Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution. Coordination information shall identify cost savings or increases associated with the proposed Substitution and shall include all additional design and engineering fees as well as additional construction costs necessary to incorporate.
        3) Point-by-point comparison of specified and proposed substitute product data, fabrication drawings, and installation procedures. This shall include detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, utility consumption, energy efficiency, weight, size, durability, visual effect, sustainable design characteristics, maintenance and maintainability, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
        4) Samples, where applicable or when requested by Owner or Engineer.
        5) Certificates and qualification data, where applicable or requested.
        6) List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
        7) Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
        8) Research reports evidencing compliance with building code in effect for Project as may be required.
        9) Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.
        10) Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.

11) Cost information, including a proposal of change, if any, in the Contract Sum.
12) Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
13) Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

E. Contractor’s proposed Substitutions shall fully include the costs of the design team to review and to incorporate the proposed substitution into the Contract Documents including all redesign and re-engineering fees. Contractor shall also, as a part of the substitution request, identify the funding mechanism to compensate the design and engineering team for approved Substitutions that require additional design and engineering to successfully incorporate into the project. Substitutions that do not account for redesign and re-engineering costs will not be reviewed.

F. Engineer's approval of a substitute does not relieve Contractor of the responsibility to submit required shop drawings and coordination drawings and to comply with all other requirements of the Contract Documents.

1.18 REQUESTS FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified (refer to Division 01).

1. Coordinate and submit each RFI in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
2. Each RFI shall address single questions and related issues only.
3. Each RFI shall be thoroughly reviewed and approved by the General Contractor and/or Construction Manager for accuracy and need for information required before submittal to the Owner’s Design Representative.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Architect and/or Construction Manager.
6. RFI number, numbered sequentially and unique.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.

11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.
13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow a minimum three business days for Engineer's response to each RFI, plus additional time for Architect and General Contractor to review and forward. Each RFI received by Engineer after 1:00 p.m. will be considered as received the following business day.

1. The following Contractor-generated RFIs will be returned without action:
    a. Incomplete RFIs or inaccurately prepared RFIs.
    b. RFIs submitted without indication of review and approval for submission by General Contractor or Construction Manager.
    c. RFIs addressing multiple unrelated issues.
    d. Requests for approval of submittals.
    e. Requests for approval of substitutions.
    f. Requests for approval of Contractor's means and methods.
    g. Requests for information already indicated in the Contract Documents.
    h. Requests for adjustments in the Contract Time or the Contract Sum.
    i. Requests for interpretation of Engineer's actions on submittals.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt of additional information.

1.19 RECORD DOCUMENTS

A. Maintain set of Coordination Documents (drawings and specifications) marked "Record Set" at the job site at all times and use it for no other purpose but to record on it all the changes and revisions during construction.

B. Record Drawings shall indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers and other control devices, filters, boxes and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e. – valves, traps, strainers, expansion compensators, tanks, etc.).

C. Record Specifications shall indicate approved substitutions; Change Orders; and actual equipment and materials provided.

D. Provide copy of Record Documents to Testing and Balancing Contractor and Commissioning Agent for use when performing their work.

E. At the completion of the construction transfer all “Record Set” notations to a clean set of drawings and specifications in a neat and orderly fashion that incorporates all site markups to clearly show all changes and revisions to the Contract Documents. Submit copies of Record Documents and CD/DVD disks labeled with all drawings and specifications and other supporting documentation.

F. Refer also to Division 01 for full scope of requirements.

1.20 START-UP SERVICE AND BUILDING COMMISSIONING

A. Prior to start-up, be assured that systems are ready, including checking the following: Proper equipment rotation, proper wiring, auxiliary connections, lubrication, venting, controls, and installed and properly set relief and safety valves.

B. Provide services of factory-trained technicians for start-up of air conditioning units, temperature controls, chillers, boilers, pumps, and other major pieces of equipment. Certify in writing compliance with this Paragraph, stating names of personnel involved and the date work was performed.

C. Provide certificates of calibration for all sensors required for control and monitoring including temperature and pressure.

D. Refer to other Division 23 Sections for additional requirements.

1.21 INSTRUCTION, MAINTENANCE, AND O&M MANUALS

A. Operations and Maintenance (O&M) Manuals: Upon completion of the work, and prior to training of Owner's personnel, the Contractor shall submit to the Owner’s Representative complete set of operating instructions, maintenance instructions, part lists, and all other bulletins and brochures pertinent to the operation and maintenance for equipment furnished and installed as specified in this section, bound in a durable binder. Refer to Division 01.

B. Contractor shall be responsible for providing proper instruction of the of Owner's personnel for operation and maintenance of equipment, and apparatus installed as specified in Division 23. Training is to be appropriate to the complexity of the equipment. The Contractor shall develop and submit training materials prior to this training. These materials shall include qualifications of the trainer, training agenda, learning objectives, and a written test to be administered at the end of the training session. Operation and Maintenance manuals must present, incorporated and referenced in the training sessions.

1.22 DELIVERY, STORAGE AND HANDLING

A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

B. Store equipment and materials in an environmentally controlled area at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage. Piping and equipment showing signs of rust shall be removed from site and replaced with new.
1. .

1.23 POSTED OPERATING INSTRUCTIONS

A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. Attach or post operating instructions adjacent to each principal system and equipment including start-up, operating, shutdown, safety precautions and procedure in the event of equipment failure. Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal.

1.24 SAFETY AND INDEMNITY

A. The Contractor shall be solely and completely responsible for conditions of the job site including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal hours of work.

B. No act, service, Drawing, review, or Construction Review by the Owner’s Representative, Architect, the Engineers or their consultants, is intended to include the review of the adequacy of the Contractor's safety measures, in, on, or near the construction site.

C. The Contractor performing work under this Division of the Specifications shall hold harmless, indemnify and defend the Owner, the Architect, the Engineers and their consultants, and each of their officers, employees and agents from any and all liability claim, losses or damage arising, or alleged to arise from bodily injury, sickness, or death of a person or persons, and for all damages arising out of injury to or destruction of property arising directly or indirectly out of, or in connection with, the performance of the work under the Division of the Specifications, and from the Contractor's negligence in the performance of the work described in the Construction Contract Documents; but not including the sole negligence of the Owner’s Representative, the Architect, the Engineers, and their consultants or their officers, employees and agents.

1.25 CLEANING AND CLOSING

A. All work shall be inspected, tested, and approved before being concealed or placed in operation.

B. Upon completion of the work, all equipment installed as specified in this section, and all areas where work was performed, shall be cleaned to provide operating conditions satisfactory to the Owner’s Representative.

1.26 WARRANTIES

A. Refer to general terms and conditions, as well as warranties and obligations defined in Division 1 of the specifications that provide basic warranty requirements for the entire project.

B. The warranties and corrective obligations provided under this section (i) are in addition to, and not in lieu of, any other warranty, representation, covenant, duty or other obligation (including any corrective obligation) of the Contractor or Manufacturer, (ii) have no relationship to the time when any warranty, representation, duty, covenant or other obligation of Contractor or Manufacturer may be enforced or any dispute resolution proceeding commenced and (iii) are made by the Manufacturer to both the Contractor and the Owner and by the Contractor to Owner.

C. All equipment and systems shall be provided with a minimum one-year warranty, or longer, as defined in each subsequent specification section. Warranty shall include all parts, material, labor and travel.

D. Warranty Start Date: The start date for all warranty periods shall be defined as starting from the date of Substantial Completion which shall include the Certificate of Occupancy from the Authority Having Jurisdiction.

E. Refer to individual Specification sections for additional extended warranty requirements.

F. Provide complete warranty information for each item, to include product or equipment, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.

G. Nothing in any separate warranty or other document provided by Contractor or Manufacturer, or both, will apply to limit their liability or responsibility for damages arising out of or related to a breach of any warranty or corrective obligation.

H. Service during warranty period: Contractor shall provide maintenance as specified elsewhere during the 12-month warranty period.

1.27 GUARANTEE

A. The Contractor shall guarantee and service all workmanship and materials to be as represented by him and shall repair or replace, at no additional cost to the Owner, any part thereof which may become defective within the period of one (1) year, minimum, after Substantial Completion, ordinary wear and tear excepted.

B. Contractor shall be responsible for and pay for any damages caused by or resulting from defects in this work.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish and install all new material, equipment, and apparatus hereinafter specified unless specifically noted otherwise. All material, equipment, and apparatus shall be identified by the manufacturer's name, nameplate, and pertinent data.

B. All materials, equipment, and apparatus are mentioned as standards unless noted otherwise. The words “or approved equal” shall be considered to be subsequent to all manufacturers’ names used herein, unless specifically noted that substitutes are not allowed.

2.2 SUPPORTS AND ANCHORS

A. General: Comply with applicable codes pertaining to product materials and installation of supports and anchors, including, but not limited to, the following:

1. UL and FM Compliance: Provide products, which are UL listed and FM approved.
2. ASCE 7 (Latest Edition): American Society of Civil Engineers-Minimum Design Loads for Buildings and Other Structures.
3. MSS Standard Compliance: Manufacturer's Standardization Society (MSS).
4. SMACNA: Seismic Restraint Manual: Guidelines for Mechanical Systems.
5. NFPA: Pamphlet number 13 and 14 for fire protection systems.
6. Provide copper plated or plastic coated supports and attachment for copper piping systems. Field applied coatings or tape is unacceptable.
7. Manufacturer: Mason Industries, Hilti Inc., B-Line/Tolco (Eaton), Anvil, Erico, Kin-Line, Simpson Strong-Tie Co. Inc., Superstrut, Empire, PHD Manufacturing, Carpenter & Paterson, Powers Fasteners or equal.

B. Horizontal Piping Hangers and Supports: Except as otherwise indicated, provide factory-fabricated hangers and supports of one of the following MSS SP-58 types listed.

1. Adjustable Steel Clevis Hangers: MSS Type 1.
2. Adjustable Steel Swivel Band Hangers: MSS Type 10.
3. U-Bolts: MSS Type 24.
4. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:
    a. Plate: Unguided type.
    b. Plate: Guided type.
    c. Plate: Hold-down clamp type.

5. Pipe Saddle Supports: MSS Type 36, including steel pipe base support and cast iron floor flange.
6. Pipe Saddle Supports with U-Bolt: MSS Type 37, including steel pipe base support and cast iron floor flange.
7. Adjustable Pipe Saddle Supports: MSS Type 38, including steel pipe base support and cast iron floor flange.
8. Single Pipe Roller with Malleable Sockets: MSS Type 41. Rollers are not required for hydronic piping where spring hangers are utilized.

9. Adjustable Roller Hangers: MSS Type 43. Rollers are not required for hydronic piping where spring hangers are utilized.
10. Pipe Roll Stands: MSS Type 44.
11. Pipe Guides: Provide factory-fabricated guides of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base with a two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

C. Horizontal Cushioned Pipe Clamp: Where pipe hangers are called out to absorb vibration or shock install a piping clamp with thermoplastic elastomer insert. Cush-A-Clamp type by many manufacturers.

D. Vertical Piping Clamps: Provide factory-fabricated two-bolt vertical piping riser clamps, MSS Type 8 and or four-bolt riser clamps for heavy loads, MSS Type 42. Provide with 1” thick (minimum) neoprene pad on floor with 1/4" thick steel plate to distribute riser clamp weight to pad.

E. Hanger-Rod Attachments: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments of one of the following MSS types listed.

1. Steel Turnbuckles: MSS Type 13.
2. Steel Clevises: MSS Type 14.
3. Swivel Turnbuckles: MSS Type 15.
4. Malleable Iron Eye Sockets: MSS Type 16.
5. Steel Weldless Eye Nuts: MSS Type 17.

F. Building Attachments: Except as otherwise indicated by the Structural Engineering design, provide factory-fabricated building attachments of one of the following types listed.

1. Concrete Inserts:
   a. MSS Type 18.
   b. Manufacturers: Hilti #KCS-MD (for metal deck) or HCI-WF (for wood forms), Simpson Strong Tie #Blue Banger Hanger, Powers Fasteners #Bang-It (for metal deck) or #Wood-Knocker (for wood forms), or equal.

2. Steel Brackets: One of the following for indicated loading:
   a. Light Duty: MSS Type 31.
   b. Medium Duty: MSS Type 32.
   c. Heavy Duty: MSS Type 33.

3. Horizontal Travelers: MSS Type 58.
4. Concrete Screw Anchors: For floor mounted attachments with maximum allowable pullout and shear force of 250 lbs. (1.1 kN) per anchor regardless of size.
   a. Manufacturers: Hilti #Kwik Hus EZ-I, Simpson Strong-Tie #Titen HD (or Rod Hanger version), Powers Fasteners #Wedge-Bolt+ (Screw Anchor), Powers

Fasteners #Vertigo+ (Rod Hanger), Powers Fasteners #Snake+ (Internally Threaded Screw Anchor), or equal.

5. Torque-Controlled Expansion Anchor:
   a. Manufacturers: Hilti #Kwik Bolt TZ2, Simpson Strong Tie #Strong-Bolt 2, Powers Fasteners #Power-Stud+ SD1 or Power-Stud+ SD2, or equal.

6. Screws and Bolts:
   a. Manufacturers: Bolt Depot, Fastenal, National Bolt & Nut, or equal.

7. Eye Bolts:
   a. Manufacturers: Lawson Products, Sierra Pacific, US Cargo Control, or equal.

8. Powder-Driven Concrete Anchors:
   a. Only for existing concrete structures with minimum 4000 psi concrete compressive strength.
   b. Minimum embedment of 1” (25 mm).
   c. Maximum allowable load of 50 lbs. (0.2 kN) per anchor.
   d. Manufacturer: Hilti #X or D Series, Powers Fasteners #CSI Series, or equal.

G. Saddles and Shields: Except as otherwise indicated, provide saddles or shields under piping at hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with adjacent pipe insulation. Insulation shall be continuous through each support with no direct contact between pipes and support elements wherever pipes are required to be insulated.

1. Pipe Covering Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.
2. Insulation Protection Shields: MSS Type 40, 18" minimum, or of the length recommended by manufacturer to prevent crushing of insulation. High-density insulation insert lengths shall match or exceed shield length.
3. Thermal Hanger Shields: Constructed of 360° insert of waterproofed calcium silicate (60 psi flexural strength minimum) encased in 360° sheet metal shield. Provide assembly of same thickness as adjoining insulation. Shield length shall match or exceed length of calcium silicate insert.
   a. Pre-manufactured insulated pipe shields are an acceptable alternate when installed per manufacturer’s instructions for pipe sizes to 6” diameter. Manufacturers: SnappItz, Armacell #ArmaFix Ecolight or equal.

4. Thermal Hanger Couplings: Constructed of high strength plastic coupling to retain un-insulated tubing at clevis hangers and strut-mounted clamps. Allowed for pipe diameter up to 4”.
   a. Manufacturers: Hydra-Zorb #Klo-Shure Insulation Couplings, Mason Industries #MW-SCCI or equal.

5. Welded Pipe Hanger Lug: For use on each insulated chilled and heating water pipe at lateral and longitudinal seismic restraint locations to allow for support attachment outside of the insulation jacket. Heavy gauge steel U shaped lug with support hole. Gauge and

dimensions as required for supported system and insulation thickness. Lug shall be welded to pipe at required seismic restraint locations for lateral and/or longitudinal control.

a. Manufacturers: Mason Industries #MW-WPL or equal. Where welding is explicitly not allowed, based on project criteria, the use of pipe clamps with pre-welded lugs may be allowed through the submittal process using Mason Industries #MW-SPC or equal.

H. Miscellaneous Materials:

1. Metal Framing: Provide products complying with NEMA STD ML1.
2. Steel Plates, Shapes, and Bars: Provide products complying with ASTM A36.
3. Cement Grout: Portland Cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C404, Size No. 2). Mix at a ratio of one-part cement to three-parts sand by volume, with minimum amount of water required for placement and hydration.
4. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required. Weld steel in accordance with AWS standards.
5. Pipe Brackets: Copper plated brackets and supports for various mounting options. Insulate brackets attached to metal studs with felt.
   a. Manufacturers: Holdrite or equal.

2.3 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping. Coordinate all pipe stands with structural design. Select stands for rated support weight and spacing. Refer to details on drawings for permanent fixed roof support and curbs.

B. Compact Pipe Stand:

1. Adjustable strut-based support stands shall only be used as intermediate support points between permanent fixed stands/supports as required to prevent pipe from sagging.
2. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
3. Base: Single piece, vulcanized rubber, molded polypropylene or polycarbonate.
4. Hardware: Galvanized or stainless steel.
5. Pipe Stand Manufacturers: Dura-Blok, Roof Top Blox, Roof Products Systems, nVent CADDY Pyramid, Portable Pipe Hangers, or equal.
6. Accessories: Mount on protective roof pad with a minimum of 6” material extending beyond all edges to allow for future pipe movement. Nonwoven pad shall be constructed spaghetti-like strands of flexible plastic with UV inhibitor and rated for -40°F to 180°F (-40°C to +82°C). Manufacturer: Yellow Spaghetti or equal.

C. Single-Pipe Stand:

1. Adjustable strut-based support stands shall only be used as intermediate support points between permanent fixed stands/supports as required to prevent pipe from sagging.

2. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
3. Base: Single piece, vulcanized rubber, molded polypropylene, or polycarbonate.
4. Vertical Members: Two, galvanized or stainless steel, continuous-thread 1/2-inch (12-mm) rods.
5. Horizontal Member: Adjustable horizontal, galvanized or stainless-steel pipe support channels.
6. Pipe Supports: Roller, strut clamps, clevis hanger or swivel hanger.
7. Hardware: Galvanized or stainless steel.
8. Pipe Stand Manufacturers: Dura-Blok, Roof Products Systems, nVent CADDY Pyramid, Portable Pipe Hangers, or equal.
9. Accessories: Mount on protective roof pad with a minimum of 6" material extending beyond all edges to allow for future pipe movement. Nonwoven pad shall be constructed of spaghetti-like strands of flexible plastic with UV inhibitor and rated for -40°F to 180°F (-40°C to +82°C). Manufacturer: Yellow Spaghetti or equal.

D. Multiple-Pipe Stand:

1. Adjustable strut-based support stands shall only be used as intermediate support points between permanent fixed stands/supports as required to prevent pipe from sagging.
2. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
3. Base: Two or more, vulcanized rubber, molded polypropylene, or polycarbonate.
4. Vertical Members: Two or more, galvanized or stainless steel, channels.
5. Horizontal Member: Two or more, adjustable height, galvanized or stainless-steel pipe support slotted channels or plates.
6. Pipe Supports: Roller, strut clamps, clevis hanger or swivel hanger.
7. Hardware: Galvanized or stainless steel.
8. Pipe Stand Manufacturers: Dura-Blok, Roof Products Systems, nVent CADDY Pyramid, Portable Pipe Hangers, or equal.
9. Accessories: Mount on protective roof pad with a minimum of 6" material extending beyond all edges to allow for future pipe movement. Nonwoven pad shall be constructed of spaghetti-like strands of flexible plastic with UV inhibitor and rated for -40°F to 180°F (-40°C to +82°C). Manufacturer: Yellow Spaghetti or equal.

2.4 IDENTIFICATION MARKERS

A. Mechanical Identification Materials: Provide products of categories and types required for each application as referenced in other Division 23 Sections. Where more than single type is specified for application, selection is installer's option, but provide single selection for each product category. Stencils, hand printed, painted, and felt pen markers are not acceptable.

1. Labels shall be printed to match the abbreviations or spelled out names used in the construction drawings. Custom printed labels are acceptable for specialty services and equipment.

B. Plastic Pipe Markers:

1. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially or fully cover the circumference of pipe, or insulated pipe, and to attach to pipe without fasteners or adhesive complying with ANSI A13.1. Minimum letter size shall be 1/2” high.
2. Pressure Sensitive Type: Provide pre-printed, permanent adhesive, color coded, pressure sensitive vinyl pipe markers, complying with ANSI A13.1. Secure both ends of markers with color coded adhesive vinyl tape.
3. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125°F (52°C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.
4. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.
5. Nomenclature shall include service type and directional arrow as follows:
    a. Chilled Water Supply and Return: green background with white lettering.
    b. Heating Water Supply and Return: yellow background with black lettering.
    c. Condenser Water Supply and Return: green background with white lettering.
    d. Heat Pump Loop Supply and Return: green background with white lettering.
    e. Refrigerant: yellow background with black lettering.
    f. Exhaust air: blue background with white lettering.
    g. Other piping services: Comply with ANSI and ASME A13.1standards.
    h. Direction of water flow.

C. Valve Tags:

1. Brass Valve Tags: Provide 1-1/2" diameter 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener. Fill tag engraving with black enamel.
2. Plastic Laminate Valve Tags (indoors only): Provide 3/32” thick engraved plastic laminate valve tags, with piping system abbreviations in 1/4" high letters and sequenced valve number 1/2" high, and with 5/32” hole for fasteners.
3. Valve Tag Fasteners: Provide solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves and manufactured specifically for that purpose.

D. Plastic Equipment Signs:

1. Provide 4-1/2” x 6” (minimum) plastic laminate sign, ANSI A13.1 color coded with engraved white core lettering. Minimum letter size shall be 1/2” high.
2. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
3. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
    a. Tag number
    b. Equipment service.
    c. Design capacity.
    d. Other design parameters, such as pressure drop, entering and leaving conditions, rpm, etc.

4. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2”x11” bond paper, tabulate each equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.5 ELECTRICAL

A. General:

1. Mechanical Contractor shall be responsible for coordinating all electrical requirements of mechanical equipment with Electrical Contractor prior to procurement or installation.
2. All electrical material, equipment, and apparatus specified herein shall conform to the requirements of Division 26.
3. Provide all motors for equipment specified herein. Provide motor starters, controllers, and other electrical apparatus and wiring which are required for the operation of the equipment specified herein.
4. Set and align all motors and drives in equipment specified herein.
5. Provide expanded metal or solid sheet metal guards on all V-belt drives to totally enclose the drive on all sides. Provide holes for tachometer readings. Support guards separately from rotating equipment.
6. Provide for all rotating shafts, couplings, etc., a solid sheet metal, inverted “U” cover over the entire length of the exposed shaft and support separately from rotating equipment. Cover shall extend to below the bottom of the shaft and coupling, and shall meet the requirements of the State Industrial Safety Regulations.
7. Specific electrical requirements (i.e., horsepower and electrical characteristics) for mechanical equipment are scheduled on the Drawings.

B. Quality Assurance:

1. Electrical components and materials shall be UL or ETL listed/labeled as suitable for location and use - no exceptions.

C. Motors:

1. The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment Specifications.
2. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
3. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range. Unless otherwise noted on plans, all motors 3/4 HP and larger shall be rated for 3-phase operation above 200 volts. Unless otherwise noted on plans, all motors up to 1/2 HP shall be rated for 120-volt, single phase operation.
4. Temperature Rating: Motor meets class B rise with class F insulation.
5. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.
6. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design “B”, except “C” where required for high starting torque.

a. Frames: NEMA Standard No. 48 or 56; use driven equipment manufacturer's standards to suit specific application.
b. VFD driven motors to be provided as inverter ready and equipped with a shaft grounding device.
c. Bearings:
    1) Ball or roller bearings with inner and outer shaft seals.
    2) Regreasable, except permanently sealed where motor is normally inaccessible for regular maintenance.
    3) Designed to resist thrust loading where belt drives or other drives product lateral or axial thrust in motor.
    4) For fractional horsepower, light duty motors, sleeve type bearings are permitted.
    5) Enclosure type for various applications:
        a) Open drip-proof (ODP) motors for indoor use in clean air environments.
        b) Totally enclosed fan cooled (TEFC) motors for outdoor use and indoor application in dirty environments and in mechanical rooms.
        c) Totally enclosed air over (TEAO) motors for motors in the airstream of cooling towers and fluid coolers.
        d) Explosion proof motors where motor is located in environments with hazardous or flammable quantities of vapors, gases, mists or dusts or where motor is located inside ductwork or cabinets with hazardous vapors, gases, mists or dusts that exceed 25 percent of the lower flammability limit.
        e) Guarded drip-proof motors where exposed to contact by employees or building occupants.
        f) Weather protected Type I for outdoor use, Type II where not housed.
        g) Electronically commutated motor (ECM) for indoor use in clean air environments.
d. Overload Protection: Built-in thermal overload protection where external overload protection is not provided and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.
e. Noise Rating: “Quiet.”
f. Efficiency:
    1) Motors shall have a minimum efficiency per governing State or Federal codes, whichever is higher.
    2) And, motors shall meet the NEMA premium efficiency standard.
g. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

D. Starters and Electrical Devices:

1. Motor Starter Characteristics:
    a. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R with conduit hubs.
    b. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition.

2. Manual switches shall have pilot lights and all required switch positions for multi-speed motors. Overload Protection: Melting alloy or bi-metallic type thermal overload relays, sized according to actual operating current (field measured).
3. Magnetic Starters:
   a. Heavy duty, oil resistant, hand-off-auto (HOA), or as indicated, and pilot lights, properly arranged for single speed or multi-speed operation as indicated.
   b. Trip-free thermal overload relays, each phase, sized according to actual operating current (field measured).
   c. Interlocks, pneumatic switches and similar devices as required for coordination with control requirements of Division 23 Controls sections.
   d. Built-in primary and secondary fused control circuit transformer, supplied from load side of equipment disconnect.
   e. Externally operated manual reset.
   f. Under-voltage release or protection for all motors over 20 hp.

4. Motor Connections: Liquid tight, flexible conduit, except where plug-in electrical cords are specifically indicated.

E. Low Voltage Control Wiring:

1. General: 14-gauge, Type THHN, color coded, installed in conduit.
2. Manufacturer: General Cable Corp., Alcan Cable, American Insulated Wire Corp., Senator Wire and Cable Co., or Southwire Co.

F. Disconnect Switches:

1. Fusible Switches: For equipment 1/2 HP or larger, provide fused, each phase; heavy duty; horsepower rated; spring loaded 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 indicated.
2. Non-Fusible Switches: For equipment less than 1/2 horsepower, switch shall be horsepower rated; toggle switch type with thermal overload quantity of poles and voltage rating as required.

PART 3 - EXECUTION

3.1 GENERAL

A. Workmanship shall be performed by licensed journeymen or master mechanics and shall result in an installation consistent with the best practices of trades.

B. Install work uniform, level and plumb, in relationship to lines of building. Do not install any diagonal, or otherwise irregular work unless so indicated on Drawings or as approved by Owner’s Representative.

3.2 MANUFACTURER'S DIRECTIONS

A. Follow manufacturers' directions and recommendations in all cases where the manufacturers of articles used on this Contract furnish directions covering points not shown on the Drawings or covered in these Specifications.

1. If the contractor must deviate from the manufacturer’s recommendations provide a letter from the manufacturer indicating the clearance to be provided is acceptable for scheduled performance and maintenance.

3.3 INSTALLATION

A. Coordinate the work between the various Mechanical Sections and with the work specified under other Divisions. If any cooperative work must be altered due to lack of proper supervision or failure to make proper and timely provisions, the alternations shall be made to the satisfaction of the Engineer and at the Contractor’s cost. Coordinate wall and ceiling work with the General Contractor, and other trades in locating ceiling air outlets, wall registers, etc.

B. Inspect all material, equipment, and apparatus upon delivery and do not install any damaged or defected materials.

C. Coordinate all condensate piping from cooling coils with Division 22 work. Provide equipment bases and curbs with enough height to provide a minimum of 8” clearance between bottom on equipment condensate outlet and adjoining surface to allow for adequate installation space for the water filled condensate traps. Water trap depth shall not be less than 3” and increased where system static pressure exceeds 2” external static plus 1” additional safety factor.

1. Install manufacturer provided condensate “air-traps” where provided with cooling equipment and condensing boilers. Install traps per manufacturer’s instructions and install condensate piping as required by local code.

3.4 SUPPORTS AND HANGERS

A. Prior to installation of hangers, supports, anchors, and associated work, installer shall meet at project site with the General Contractor, installer of each component of associated work, inspection and testing agency representatives, (if any), installers of other work with requirements specified.

B. Installation of Building Attachments: Install building attachments at required locations within concrete or on structural steel for proper piping support. Install additional building attachments where support is required for additional 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 securely to forms. Where Gypcrete is indicated, install reinforcing bars through opening at top of inserts. Inserts and anchors shall be located no closer than 6” to any edge and no closer than 1” from any pre-tension cables or embedded steel and as required per manufacturer’s instructions and Structural Engineer.

C. Proceed with installation of hangers, supports, and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including, but not limited to, proper placement of inserts, anchors, and other building structural attachments.

D. Install hangers, supports, rails, clamps, and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers and rails where possible. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

E. Install pipe supports (hangers, rails, etc.) within 12 inches of every change in piping direction (only one support required at each change in direction), end of pipe run or concentrated load, and within 36 inches of every major piece of equipment. Supports (hangers, rails, etc.) shall be installed on both sides of flexible connections. Where flexible connection connects directly to a piece of equipment only one support is required.

F. Install hangers, rails, and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

G. Support sprinkler piping and gas independently of other piping.

H. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

I. Hanger Spacing in accordance with following minimum spans for support of individual pipes. Install a minimum of one hanger within 12” of each change of direction (only one required on either side of elbow), at the end of deadend pipe runs and within 36” of every piece of equipment. For straight runs of horizontal piping with no concentrated loads such as valves, flanges, expansion joints, or other components. Sections of piping with concentrated loads will have to be considered carefully and a determination made as to appropriate spacing and rod size for the given situation. Other spacing and rod sizes may be considered in compliance with Table 121.5 of ASME B31.1, ANSI/MSS SP-58 Table 4, and local mechanical code, but shall not exceed 12 feet for any pipe size. Comply with more restrictive requirements of local codes where those exceed the following minimum criteria.

1. Steel Pipe:

Steel Pipe Size	Hanger/Support Spacing (Maximum)	Rod Size (Minimum)
1/2" to 1”	7 feet	3/8”
1-1/4” to 2-1/2”	10 feet	3/8”
3” to 4”	12 feet	3/8”
5” to 8”	12 feet	1/2"
10” to 12”	12 feet	5/8”
14” to 16”	12 feet	3/4"

2. Copper Pipe:

Copper Pipe Size	Hanger/Support Spacing (Maximum)	Rod Size (Minimum)
1/2"	4 feet	3/8”
3/4” to 2”	6 feet	3/8”
2-1/2” to 4”	8 feet	3/8”
5” to 8”	8 feet	1/2"

3. Plastic/Fiberglass Pipe:

Plastic/Fiberglass Pipe Size	Hanger/Support Spacing (Maximum)	Rod Size (Minimum)
Up to 1”	3 feet	3/8”
1-1/4” to 2-1/2”	4 feet	3/8”
3” to 8”	4 feet	1/2"

4. Trapeze support: Provide details stamped by a Registered Structural Engineer for the project state indicating trapeze channels, support rod sizes, and spacing.
5. Maximum threaded rod loading: Below are maximum loads for hanger rods based on ASHRAE Fundamentals Handbook (Pipe Design Chapter) and ASTM A36, with a safety factor.

Maximum Allowable Loading Capacity for Hanger Rod in Tension	
Nominal Rod Diameter	Load (Maximum Weight)
3/8”	610 pounds
1/2"	1,130 pounds
5/8”	1,810 pounds
3/4"	2,710 pounds
7/8”	3,770 pounds
1”	4,960 pounds

J. Provisions for Movement:

1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connecting equipment.
3. Insulated Piping: Comply with the following installation requirements:
   a. Clamps: Attach clamps, including spacers, (if any), to piping with clamps projecting through insulation.
   b. Shields: Where low compressive strength insulation or vapor barriers are indicated on cold or chilled water piping, install shields or inserts.
   c. Saddles: Where insulation without vapor barrier is indicated install protection saddles.

K. Installation of Anchors:

1. Install anchors at proper locations to prevent excessive stresses and to prevent transfer of loading and stresses to connected equipment.
2. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure.
3. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.
4. Anchor Spacing: Where not otherwise indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops and bends.

L. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

M. Equipment Supports:

1. Provide all concrete bases, unless otherwise furnished as work of Division 03. Furnish to Division 03 Contractor scaled layouts of all required bases, with dimensions of bases, and location to column centerlines. Furnish templates, anchor bolts, and accessories necessary for base construction. Coordinate size of concrete pads and placement of anchors bolts with structural design. Anchor bolts shall be placed to maintain 6”, minimum, or greater distance from concrete pad edges.
2. Provide structural steel stands to support equipment above floor mounted or suspended from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks.

N. Adjusting:

1. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments.
2. Support Adjustment: Provide grout under supports to align piping and equipment to proper level and elevations.

3. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.5 ELECTRICAL COORDINATION

A. Division 23 installers shall coordinate with Division 26 work to provide complete systems as required to operate all mechanical devices installed under this Division of work.

B. Installation of Electrical Connections: Furnish, install, and wire (except as may be otherwise indicated) all heating, ventilating, air conditioning, etc., motors and controls in accordance with the drawings and in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC, and NECA's "Standard of Installation" to ensure that products fulfill requirements.

C. Division 23 has responsibilities for electrically powered mechanical equipment which is specified in Division 23 Specifications or scheduled on Division 23 Drawings as follows:

1. Motors: Furnish and install all motors necessary for mechanical equipment.
2. Magnetic Starters: Furnish all magnetic starters whether manually or automatically controlled which are necessary for mechanical equipment. Furnish these starters with all control relays or transformers necessary to interface with mechanical controls. If the starter is factory installed on a piece of Division 23 equipment, also furnish and install the power wiring between starter and motor.
3. Variable Frequency Drives: Provide all VFD's associated with mechanical equipment. If the drive is installed on a piece of factory assembled equipment the wiring between motor and drive is to be provided as part of the factory equipment.
4. Disconnects: Provide the disconnects which are part of factory wired Division 23 equipment. Factory wiring to include wiring between motor and disconnect or combination starter/disconnect.
5. Controls: Division 23 Contractor (including the Building Automation System (BAS) Controls subcontractor) is responsible for furnishing the following equipment in its entirety. This equipment includes but is not limited to the following:
    a. Additional control panels beyond what is identified on drawings shall be provided by BAS contractor in order to provide a complete control system at no additional cost to Owner. 120v wiring to these control panels shall be provided by the Contractor as coordinated by the BAS contractor from nearest source panel.
    b. Control relays necessary for controlling Division 23 equipment.
    c. Control transformers necessary for providing power to controls for Division 23 equipment.
    d. Line voltage thermostats.
    e. Low or non-load voltage control components.
    f. Remote bulb thermostats.
    g. Non-life safety related valve or damper actuators.
    h. Float switches.
    i. Solenoid valves.
    j. Switches.
    k. Refrigeration controls.

l. Communications wiring and conduit between control devices and mechanical equipment. Control wiring gauge in stranded or solid wire configuration shall be the responsibility of the contractor to coordinate with manufacturers for allowable lengths and load requirements to assure complete and operational systems.
m. Raceway to support control cabling.

6. Fire/Smoke Dampers: Division 23 is responsible for providing and physically installing the damper and for installing any required control interface wiring to Division 23 controls.
   a. Where fire/smoke dampers are part of an integrated smoke control system, Division 23 is responsible for providing dampers with specified end switches for use by Division 28 in providing proof of closure.
   b. Where fire/smoke dampers are part of an integrated smoke control system, Division 23 is responsible for installing duct detectors, provided by Division 28, in duct.
   c. Where these dampers are not part of an integrated area wide smoke detection system, Division 23 is responsible for providing each fire/smoke damper with a dedicated duct detector installed per the requirements of the building code. If not integral with the damper assembly, the detector is to be installed in ductwork by Division 23 but wired to the damper controller by Division 26.

D. Division 26 Electrical Responsibilities:

1. BAS Controls Contractor shall initiate and coordinate a meeting with the Electrical Contractor and General Contractor to coordinate all BAS component locations and wiring requirements prior to start of construction. All additional costs associated with lack a coordinated shall be the responsibility of the BAS Contractor at no additional cost to the Owner.
2. Additional power requirements, including conduit and wiring, for additional or relocated control panels and devices shall be coordinated and the responsibility of the BAS Controls Contractor at no additional cost to Owner.
3. Motors: Provide the power wiring for the motors from servicing panel to motor controller.
4. Magnetic Starters: Except where magnetic starters are factory installed on Division 23 factory assembled equipment, Division 26 is to install magnetic starters furnished by Division 23 and install the necessary power wiring to the starter and from the starter to the motor. In the case of factory installed starters, Division 26 is to install the necessary power wiring from source panel/disconnect to the starter.
5. Variable Frequency Drives: Provide the necessary power wiring to the VFD and from the VFD to the motor except in the case of factory installed VFD's where wiring between the motor and VFD is to be by Division 23.
6. Disconnects: Provide all disconnects necessary for Division 23 mechanical equipment which are not provided as part of factory wired Division 23 equipment. Provide power wiring to all disconnects. In addition, provide power wiring between motor and disconnect when the disconnect is not factory installed.
7. Controls: Division 26 is responsible for providing power to mechanical control panels and provide final power connection to Division 23 provided control transformers.

E. Motors and Motor Control Equipment: Conform to the standards of the NEMA. Equip motors with magnetic or manual line starters with overload protection. Motor starters and line voltage controls shall be installed under Electrical Section but located and coordinated as required under this Section of the work. Starters shall be combination type with non-fusible disconnect switches. All single phase fractional horsepower motors shall have built-in overload protection.

3.6 FIELD PAINTING

A. All painting shall be provided under this Division work, unless otherwise specified under Section 099100: Painting. Painting schemes shall comply with ANSI A13.1.

B. Paint all exposed materials such as piping, framing, supports, black steel, ductwork, equipment, insulation, galvanized steel, etc. The inside surface of visible ductwork above diffusers/grilles/registers shall be painted flat black.

C. All exposed work under Division 23 shall receive either a factory finish or a field prime coat finish, except:

1. Exposed copper piping.
2. Exposed stainless steel.
3. Exposed aluminum.
4. Aluminum jackets installed over outdoor insulation.

3.7 FACTORY PAINTING

A. Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors must withstand 500 hours in a salt-spray fog test. Salt-spray fog test must be in accordance with ASTM B117, and for that test the acceptance criteria must be as follows: immediately after completion of the test, the paint must show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen must show no signs of rust creepage beyond 3 mm 0.125 inch on either side of the scratch mark. The film thickness of the factory painting system applied on the equipment must not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120°F (50°C), the factory painting system must be designed for the temperature service.

3.8 COASTAL OR MARINE ENVIRONMENTS

A. Coastal and marine environments are characterized by the abundance of sodium chloride (salt) which is carried by sea spray, mist or fog. Salt spray can be carried several miles by ocean breezes and tidal currents, often up to five (5) miles from the coast. As a result, protection of HVAC equipment from ocean-borne electrolytes is necessary to assure long equipment life. Line-of-sight distance from the ocean, prevailing wind direction, relative humidity, wet/dry time, and coil temperature will determine the severity of corrosion potential in the coastal environment. If the condenser coils or evaporator coils face the ocean or faces into the prevailing winds from the coast, there is a higher probability of seawater contamination.

B. Coils shall have a flexible epoxy polymer electrostatic coating uniformly applied to coil and fin surface areas with no materiel bridging between fins. Coating shall be applied in factory, not field applied. The coating process will ensure complete coil encapsulation and a uniform dry film thickness from 0.6 to 1.2 mils on all surface areas including fin edges and meet 4B to 5B rating cross-hatch adhesion per ASTM B3359. Corrosion durability will be confirmed through testing to no less than 5,000 hours salt spray resistance per ASTM B117 using scribed aluminum test coupons. Coating shall be applied to all coils rated for air flows greater than 3,000 cfm.

C. Equipment cabinets shall be coated with painted on all sides of metal skin and framing elements. No exposed metal is allowed. Coating shall be applied in factory, not field applied. The paint shall be applied using powder coating or spray epoxy as required to meet a 5,000 hour salt spray resistance per ASTM B117.

3.9 IDENTIFICATION MARKERS

A. General: Where identification is to be applied to surfaces which require insulation, painting, or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

B. Piping System Identification:

1. Install pipe markers on each system indicated to receive identification, and include arrows to show normal direction of flow.
2. Locate pipe markers as follows:
    a. Near each valve and control device.
    b. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
    c. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
    d. At access doors, manholes, and similar access points which permit view of concealed piping.
    e. Near major equipment items and other points of origination and termination.
    f. Spaced horizontally at maximum spacing of 20' along each piping run, with minimum of one in each room.
    g. Vertically spaced at each story traversed.

3. The termination of concealed condensate piping shall be marked to indicate whether the piping is connected to the primary or secondary drain.

C. Ductwork Identification: A minimum of every 50' for all ductwork, 12" or more in diameter or width, where ducts are concealed above accessible ceilings.

D. Mechanical Equipment Identification: Locate engraved plastic laminate signs on or near each major item of mechanical equipment and each operational device. Provide signs for the following:

1. Main control and operating valves, including safety devices.
2. Meters, gauges, thermometers, and similar units.
3. Cooling Tower
4. Strainers, filters, treatment systems and similar equipment.

E. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations. Equipment signs shall include an identification of the area or other equipment served by the equipment being labeled.

F. Underground Piping Identification: During backfilling/topsoiling of each exterior underground piping system, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker.

3.10 VIBRATION AND DYNAMIC BALANCING

A. All equipment submitted and installed by Division 23 shall not exceed maximum tolerances as specified by the “International Research and Development Corporation”, Worthington, Ohio, measured by the displacement, peak to peak, as follows:

1. All Fans: Below severity chart labeled “FAIR”, maximum velocity of 0.0786 in/sec, peak.

B. Where installed equipment noise or vibration is objectionable to the Owner’s Representative, it shall be responsibility of the contractor to conduct testing to confirm that the equipment does not exceed the standard.

C. Correction shall be made to all equipment, which exceeds vibration tolerances specified above. Final vibration levels shall be reported as described above.

3.11 TESTING

A. Provide all tests specified hereinafter and as otherwise required. Provide all test equipment, including test pumps, gauges, instruments, and other equipment required. Test all rotational equipment for proper direction of rotation. Upon completion of testing, certify to the Owner’s Representative, in writing, that the specified tests have been performed and that the installation complies with the specified requirements and provide a report of the test observations signed by qualified inspector.

B. Temperature Control: Test all control functions to assure that all systems are controlling as specified or as otherwise necessary and that all controls are adjusted to maintain proper room temperatures. The manufacturer's representative shall perform all tests.

END OF SECTION 230500

SECTION 230593 - TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 230500 - Basic HVAC Materials and Methods, and other Sections in Division 23 specified herein.

1.2 WORK RELATED IN OTHER SECTIONS

A. Section 230500: Basic HVAC Materials and Methods.

B. Division 26: Electrical.

1.3 SUMMARY

A. Scope: Extent of testing, adjusting and balancing work required by this Section is indicated on the drawings, in schedules, and by the requirements of this Section, and Section 230500 -Basic Mechanical Requirements.

B. Systems: Testing, adjusting and balancing specified in this Section shall include, but not be limited to, the following systems:

1. Building automation system controls.
2. Hydronic system including condenser water.
3. Instruction of Owner's personnel for future balancing of systems.

1.4 CODES AND STANDARDS

A. The Contractor is cautioned that code requirements not explicitly detailed in these specifications or drawings, but which may be reasonably inferred or implied from the nature of the project, must be provided as part of the contract.

B. Reference Standards

1. ANSI/ASHRAE Standard 111 - Measurement, Testing, Adjusting and Balancing of Building HVAC Systems (current edition).
2. ASHRAE - HVAC Applications Handbook: Chapter 38 - Testing, Adjusting and Balancing (current edition).
3. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings, Chapter 6 (current edition).
4. AABC - National Standards for Total System Balance.
5. NEBB - Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

6. SMACNA - HVAC Systems-Testing, Adjusting and Balancing.
7. SMACNA - HVAC Air Duct Leakage Test Manual.
8. ANSI - American National Standards Institute. Comply with the following:
   a. S1.4: Specifications for Sound Level Meters.
   b. S1.11: Specifications for Electroacoustics - Octave-Band and Fractional-Octave-Band Filters

9. Building Code, with State Amendments, Chapter 9 Fire Protection Systems.
10. Mechanical Code, with State Amendments, Chapter 4 Ventilation Air Supply.
11. Local Nonresidential Energy Code.

1.5 QUALITY ASSURANCE

A. Contractor's Qualifications: A specialist certified by the National Environmental Balancing Bureau (NEBB) or Associated Air Balance Council (AABC) with at least 5 years of experience in those testing, adjusting and balancing requirements similar to those required for this project, is not the installer of the system to be tested and is otherwise independent of the project. Testing, adjusting, and balancing shall be performed by a certified NEBB technician or a certified AABC technician under direct field supervision of a Certified NEBB Supervisor or a Certified AABC Supervisor. Testing and balancing agency must submit qualifications for review and approval prior to acceptance for work.

B. Penalty: The Contractor shall submit the name of the organization he proposes to employ for approval within 30 days after contract award. If the Contractor fails to submit the name of an acceptable agency within the specified time, a firm may be selected to accomplish the work, and this selection shall be binding upon the Contractor at no additional cost.

C. Retainages: In addition to any other sums retained or withheld pursuant to the provisions of this Contract, the amount of dollars will be withheld from payments to the contractor until such time as the work has been completed and accepted. In no event will this amount be paid to the Contractor prior to 60 days following acceptance of the project; during such time, the Contractor shall investigate and correct any reported deficiencies unless such deficiencies are a result of unauthorized tampering by building occupants.

D. Calibration of Testing Instruments: All measurement instruments used for testing, adjusting, balancing, and commissioning shall be calibrated. The time between the most recent calibration data and the final test report date shall not be over 6 months.

E. Testing and balancing agency, as part of its contract, shall act as authorized inspection agency responsible to Consulting Engineer and Owner, and shall list all items that are installed incorrectly, require correction, or have not been installed in accordance with contract Drawings and Specifications, pertaining to air distribution, cooling and heating systems. The testing and balancing agency is required to provide written reports of all deficiencies and proposed recommendations to the Owner' Representative, Contractor, Architect and Engineer.

F. The testing and balancing agency shall provide with their bid a performance guarantee covering all phases of the work as herein specified.

G. The General and Mechanical Contractors shall cooperate with the selected testing and balancing agency in the following manner:

1. Provide sufficient time before final completion dates so that tests and balancing can be accomplished.
2. The various system installers, suppliers and contractors shall provide all required materials, labor and tools to make corrections when required without undue delay. Install balancing dampers and valves as required by testing and balancing agency.
3. The contractor shall put all heating, ventilating and air conditioning systems and equipment into full operation and shall continue the operation of the same during each working day of testing and balancing.
4. Testing and balancing agency shall be kept informed of any major changes made to the system during construction, and shall be provided with a complete set of Record Drawings.
5. The General Contractor shall make space and other facilities available to the testing and balancing agency to enable their work to progress. The General Contractor shall schedule the work of other trades to avoid conflicts with this work.

H. All balancing work shall be coordinated with other disciplines to comply with the meet or exceed the minimum requirements of the Americans with Disabilities Act (ADA), Building Code, local amendments and State Energy Code.

1.6 SUBMITTALS

A. Conform to the Submittals requirements of Division 01.

B. Forms: The Contractor shall deliver a complete copy of either NEBB or AABC standard forms for testing and balancing work associated with the project. These forms shall serve as specific guidelines for producing final test report. Hybrid or non-standards forms are not acceptable.

C. Test Reports: Provide final certified test report, six (6) certified hard copies or one electronic PDF formatted copy, with signature of the test and balance supervisor responsible for the work. The final reports shall include key plans identifying all inlets and outlets. Final test reports shall be typed. Reports with handwritten data entry are not acceptable.

D. Maintenance Data: Include, in maintenance manuals, copies of certified and approved test and balance reports and identification of instruments.

E. Qualifications: The Test and Balance Agency shall submit qualifications of all persons responsible for supervising and performing the on-site testing and balancing work and the name of the certifying agency, NEBB or AABC. Provide a reference list of five (5) similar size projects with contact person and telephone number.

1.7 AGENDA

A. Agenda: A preliminary report and agenda shall be submitted and approved prior to the start of testing and balancing work.

1. Review plans and specifications prior to installation of any of the affected systems, and submit a report indicating any deficiencies in the systems that would preclude the proper adjusting, balancing, and testing of the systems.
2. The agenda shall include a general description of each air and water system with its associated equipment and operation cycles for heating and cooling.
3. The agenda shall include a list of all air and water flows to be performed at all mechanical equipment.
4. The agenda shall incorporate the proposed selection points for sound measurements, including typical spaces as well as sound sensitive areas such as conference rooms.
5. The agenda shall also include specific test procedures and parameters for determining specified quantities (e.g. flow, drafts, sound levels) from the actual field measurements to establish compliance with contract requirements. Samples of forms showing application of procedures and calculations to typical systems shall be submitted.
6. Specific test procedures for measuring air quantities at terminals shall specify type of instrument to be used, method of instrument application (by sketch) and factors for:
    a. Air terminal configuration.
    b. Flow direction (supply or exhaust).
    c. Velocity corrections.
    d. Effective area applicable to each size and type of air terminal.
    e. Density corrections.

7. The agenda shall include identification and types of measurement instruments to be used, and their most recent calibration date.

1.8 JOB CONDITIONS

A. General: Do not proceed with testing, adjusting and balancing work until the following conditions have been met.

1. Installation and start-up work on equipment or systems to be tested has been completed and documented.
2. Work area scheduled for testing, adjusting and balancing is clean and free from debris, dirt and discarded building materials.
3. All architectural openings (doors, windows, and other openings) which may affect the operation of the system to be tested shall be in their completed normal positions and operation.
4. All related mechanical systems which may affect the operation of the system to be tested shall be at their normal operating conditions.

PART 2 - PRODUCTS

2.1 TEST HOLES

A. Test holes and ports shall be provided in ducts, housings and pipes as directed by the Balancing Agency. At each location where ducts or plenums are insulated, test holes shall be provided with an approved extension with plug fitting.

2.2 PATCHING MATERIALS

A. Material: Seal, patch and repair ductwork, piping and equipment drilled or cut for testing purposes.

1. Plastic plugs with retainers may be used to patch drilled holes in ductwork and housings.
2. Insulation shall be neatly hemmed with metal or plastic edging, leaving test points visible for future testing.

2.3 TEST INSTRUMENTS

A. Test Instruments: All instruments used for measurements shall be accurate and calibration histories for each instrument shall be available for examination. Each test instrument shall be calibrated by an approved laboratory or by the manufacturer. The Owner's Representative has the right to request instrument recalibration, or the use of other instruments and test methodology, where accuracy of readings is questionable.

B. Additional Instruments: Permanently installed measuring instruments, such as temperature and pressure gauges, shall be checked against Certified Calibrated instruments. Any instrument which does not meet specification requirement shall be replaced or recalibrated.

C. Cone Instruments: The Contractor shall employ manufactured enclosure type cones, capable of air volume direct readings, for all diffuser/grille/register air flow measurements. The readout meters shall meet calibration requirements.

PART 3 - EXECUTION

3.1 PROCEDURES AND INSTRUMENTS, GENERAL

A. Requirements: All systems and components thereof shall be adjusted to perform as required by approved project drawings and specifications.

B. Test Duration: Operating tests of heating and cooling coils, fans, and other equipment shall be of not less than four-hours duration after stabilized operating conditions have been established. Capacities shall be based on temperatures and air and water quantities measured during such tests.

C. Instrumentation: Method of application of instrumentation shall be in accordance with the approved agenda.

1. All instruments shall be applied in accordance with the manufacturer's certified instructions.
2. All labor, instruments, and appliances required shall be furnished by the Contractor. Permanently installed instruments used for the tests (e.g., flow meters and Btu meters) shall not be installed until the entire system has been cleaned and ready for operation.

3.2 WATER SYSTEM PROCEDURES

A. Preparation:

1. Open all valves to fully open position. Close coil bypass stop valves. Set mixing valve to full coil flow.
2. Remove all strainers and clean same. Reinstall.
3. Examine water system and determine if water has been treated and cleaned.
4. Check pump rotation.
5. Check expansion tank to determine they are not air bound and the system is completely full of water.
6. Check all air vents at high points of water systems and determine that all are installed and operating freely.
7. Check operation of automatic bypass valve.
8. Operate each variable frequency drive (VFD) and verify controls installation is complete.
9. Check and set operating temperatures of all equipment at design requirements.
10. Complete air balance must have been accomplished before actual water balance begins.

B. Adjustment: All heating, cooling and condensing water systems shall be adjusted to provide required quantity to or through each component.

C. Metering: Water quantities and pressures shall be measured with calibrated meters.

1. Venturi tubes, orifices, or other metering fittings and pressure gauges shall be used to measure water flow rates and balance systems. Systems shall be adjusted to provide the approved pressure drops through the heat transfer equipment (coils except room units, converters, etc.) prior to the capacity testing.
2. Where flow metering fittings are not installed, in air/water type heat transfer equipment, flow balance shall be determined by measuring the air side energy differential across the heat transfer equipment. Measurement of water temperature differential shall be performed with the air system, adjusted as described herein, in operation.

D. Automatic Controls: Automatic control valves shall be positioned for full flow through the heat transfer equipment of the system during tests.

E. Flow: Flow through bypass circuits at three-way valves shall be adjusted to equal that through the supply circuit, when the valve is in the bypass position.

F. Distribution: Adjustment of distribution shall be affected by means of balancing devices (cocks, valves, and fittings) and automatic flow control valves as provided. Manual service valves shall not be used for balancing.

1. Where automatic flow control valves are utilized in lieu of Venturi tubes, only pressure differential need be recorded, provided that the pressure is at least the minimum applicable to the tag rating.

G. Special Procedures: Where available pump capacity (as designed) is less than total flow requirements of individual heat transfer units of system served, full flow may be simulated by the temporary restriction of flow to portions of the system; specific procedures shall be delineated in the agenda.

H. Water System Test and Balance Procedure: Perform the following tests, and balance each system in accordance with the following requirements:

1. Set chilled, heating and condenser water pumps to proper gallons per minute delivery.
2. Adjust chilled water flow though chiller(s).
3. Adjust heating water flow through boiler(s).
4. Adjust condenser water flow through cooling tower(s).
5. Test and record entering and leaving water temperatures through chillers, boilers, heat exchangers and cooling towers/fluid coolers.
6. Test and record water temperatures at inlet and outlet side of each terminal unit. Note rise or drop of temperatures from source.
7. Proceed to balance each terminal unit.
8. Upon completion of flow readings and adjustments at coils, mark all settings and record data.
9. After adjustments to coils are made, recheck settings at the pumps, chiller, boilers, and cooling towers and readjust if required.
10. Record and check the following items at each coil.
    a. Inlet water temperatures.
    b. Leaving water temperatures.
    c. Water pressure drop of each coil.
11. Pump operating suction and discharge pressures and final total dynamic head.
12. List all mechanical specifications of pumps.
13. Rated and actual running amperage of pump motor.
14. Water metering device readings.

3.3 WATER SYSTEM DATA

A. Report: The certified report for reach water system shall include the data listed below.

1. Pumps:
    a. Installation data
        1) Manufacturer and model
        2) Size
        3) Type drive
        4) Motor hp, voltage, phase, and full load amps
    b. Design data
        1) GPM
        2) Head
        3) RPM and amps
    c. Recorded data
        1) Discharge pressures (full-flow and no-flow)

2) Suction pressures (full-flow and no-flow) operating head
3) Operating gpm (from pump curves if metering is not provided) no-load
4) Amps
5) Full-flow amps
6) No-flow amps

2. Cooling Towers and Fluid Coolers:
   a. Installation data
      1) Manufacturer and model
      2) Motor hp, voltage, cycles, phase, and full load amps
      3) Part load amperes
      4) GPM
      5) Water pressure drop
      6) Entering and leaving water temperature
   b. Recorded data
      1) GPM
      2) Water pressure drop
      3) Entering and leaving water temperature
      4) Amperes

B. Air coil capacities shall be verified from air side measurement data. Capacities of coils shall be the difference of the energy carried by the air between the upstream and downstream of the coils.

C. The measured air flow rate for the fan may be used for air coil capacity calculations providing no ducted bypassing of coil is occurring.

D. Water/water heat exchanger equipment capacity shall be verified by measuring the flow rate and temperature differential of the water.

E. Capacity verification shall be performed after air and water systems have been balanced.

F. False load shall be applied if the upstream air or water does not meet the specified conditions at the time of test.

3.4 BALANCING MEASUREMENT TOLERANCES

A. Comply with codes and standards applicable for this project and local AHJ.

B. Comply with maximum tolerance air balance limitations listed in the ASHRAE Handbook – HVAC Applications (latest edition) and as listed in the following guidelines:

1. Condenser water flow rate: 0% to +10% of design water flows.

3.5 CERTIFIED REPORTS

A. Submittals: Six (6) copies of the reports described herein, covering air and water system performance, air motion (fpm), and sound pressure levels, shall be submitted prior to final tests and inspection.

B. Instrument Records: Types, serial numbers, and dates of calibration of all instruments shall be included.

C. Reports: Reports shall conspicuously identify items not conforming to contract requirements, or obvious malfunction and design deficiencies.

D. Certification: Certification shall include checking of adherence to agenda, of calculations, of procedures, and evaluation of final summaries.

3.6 FINAL COMMISSIONING TESTS, INSPECTIONS AND ACCEPTANCE

A. Scope: Test shall be made to demonstrate that capacities and performance of air and water systems comply with contract requirements.

1. At the time of final inspection, the Contractor shall recheck, random selection of data (water and air quantities, air motion, and sound levels) recorded in the certified report. In addition, all courtrooms, auditoriums, and conference rooms shall be rechecked.
2. Points and areas for recheck shall be selected by the commissioning team.
3. Measurement and test procedures shall be the same as approved for work forming basis of certified report.
4. Selections for recheck (specific plus random), in general, will not exceed 25 percent of the total number tabulated in the report, except that special air systems may require a complete recheck for safety reasons.

B. Retests: If random tests elicit a measured flow deviation of 10 percent or more from design, or a sound level greater than 2 db or more than recorded in the certified report listings, as 10 percent or more of the rechecked selections, the report shall be automatically rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, new certified reports submitted, and new inspection tests made, all at no additional cost. Retainage time shall be based on the date of the final acceptance of the certified report.

C. Marking of Settings: Following final acceptance of certified reports, the settings of all valves, splitters, dampers, and other adjustment devices shall be permanently marked by the Contractor so that adjustment can be restored if disturbed at any time. Devices shall not be marked until after final acceptance.

END OF SECTION 230593

SECTION 232500 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 230500 - Basic HVAC Materials and Methods, and other Sections in Division 23 specified herein.

1.2 DESCRIPTION OF SCOPE

A. Provide complete water treatment work required by this section as indicated on drawings and schedules and by requirements of this section, and includes necessary equipment, chemicals, and service for the following systems:

1. Cleaning solution for HVAC Piping Systems.
2. Treatment of cooling tower condenser water systems-startup only.
3. Treatment of cooling tower condenser water systems.

B. Provide chemicals and service program for a period of one year from start-up date of equipment, including the following:

1. Initial water analysis and recommendations.
2. Systems start-up assistance and supporting documentation.
3. Training of operating personnel.
4. Periodic field service and consultation for first year of operation.
5. Customer report charts and log sheets.
6. Laboratory technical assistance.

1.3 GENERAL PERFORMANCE REQUIREMENTS

A. Water treatment systems for open loop piping systems, including condenser water shall inhibit corrosion and scale to maximize efficiency and operating life of HVAC equipment.

B. Water treatment systems for cooling towers shall also inhibit microbiological fouling.

C. Water treatment shall be based on existing water quality, HVAC system materials and performance, and any local jurisdictional requirements.

D. Water treatment services shall include water analysis; water quality goal definition; solid or liquid chemical products designed to treat specific water conditions; effective dosage calculations; equipment adjustment and maintenance. Services shall be provided by qualified water treatment professionals trained in solid chemical application.

E. Water treatment equipment for delivery of solid or liquid chemicals shall deliver accurate dosages per professional water treatment service recommendations, and use equivalent or less energy than liquid chemical systems.

1.4 QUALITY ASSURANCE

A. Manufacturers and Representative Qualifications. Firms regularly engaged in manufacture of water treatment equipment, chemical and service shall have been active in the field of industrial water treatment and whose products have been in satisfactory use in similar service for not less than 5 years, and shall have full-time service personnel located within 150 miles of the project site.

B. Codes and Standards:

1. ASME Compliance: Construct pressure service tanks in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, provide stamp and certification.
2. UL Labels: Provide water conditioners ancillary electrical components that have been listed and labeled by UL.
3. NEMA Standards: Provide electrical controls and enclosures conforming to applicable standards of NEMA for environment where water conditioners are indicated.
4. Chemical Standards: Provide only chemical products that are acceptable under state and local public health and pollution control regulations. All products shall have the necessary registrations and approvals. All biocides shall be registered with the company performing the service in the State where the project is located and the company shall have all necessary licenses.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical product including rated capacities of selected equipment clearly indicating water pressure drops, weights, installation and start-up instructions, and furnished specialties and accessories.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to water treatment equipment. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Record Drawings: At project closeout, submit record drawings of installed systems and products.

E. Maintenance Data: Submit maintenance data and parts list for each item of equipment, control, and accessory; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual.

1.6 DELIVERY, STORAGE AND HANDLING

A. Handle water treatment materials and components carefully to prevent damage, breaking, denting and scoring to materials and equipment. Deliver packaged units in original crates. Do not install damaged water treatment materials and components; remove from site and replace with new.

B. Store water treatment materials and components in an environment satisfactory to prevent their damage by the elements.

1.7 EXTENDED MAINTENANCE SERVICES

A. Agreement to Maintain: Prior to time of final acceptance, submit four copies of "Agreement for Continued Service and Maintenance" for water treatment system, for Owner's possible acceptance. Offer terms and conditions for furnishing chemicals and providing continued testing and servicing, and including replacement of materials and equipment, for one-year period with option for renewal of Agreement by Owner. For the purposes of this section, the date of substantial completion shall begin on the date regular chemical treatment has commenced for the water systems.

1.8 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 230500 for additional warranty and Substantial Completion requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or to the environment.

B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

C. Open hydronic systems, including cooling tower and fluid-cooler systems, shall have the following water qualities:

1. pH: Maintain a value within 8.0 to 9.1, or as required by equipment manufacturer.
2. "P" Alkalinity: Maintain a maximum value of 100 ppm, , or as required by equipment manufacturer.
3. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm, , or as required by equipment manufacturer.
4. Soluble Copper: Maintain a maximum value of 0.20 ppm, , or as required by equipment manufacturer.
5. TSS: Maintain a maximum value of 10 ppm, or as required by equipment manufacturer.
6. Ammonia: Maintain a maximum value of 20 ppm, or as required by equipment manufacturer.
7. Free "OH" Alkalinity: Maintain a maximum value of 0 ppm, or as required by equipment manufacturer.
8. Microbiological Limits:

    a. Total Aerobic Plate Count: Maintain a maximum value of 10,000 organisms/mL, or as required by equipment manufacturer.

b. Total Anaerobic Plate Count: Maintain a maximum value of 1000 organisms/mL, or as required by equipment manufacturer.
c. Nitrate Reducers: Maintain a maximum value of 100 organisms/mL, or as required by equipment manufacturer.
d. Sulfate Reducers: Maintain a maximum value of 0 organisms/mL, or as required by equipment manufacturer.
e. Iron Bacteria: Maintain a maximum value of 0 organisms/mL, or as required by equipment manufacturer.

D. Passivation for Galvanized Steel Cooling Towers or Fluid Coolers: For the first 60 days of operation.

1. pH: Maintain a value within 7 to 8, or as required by equipment manufacturer.
2. Calcium Carbonate Hardness: Maintain a value within 100 to 300 ppm, or as required by equipment manufacturer.
3. Calcium Carbonate Alkalinity: Maintain a value within 100 to 300 ppm, or as required by equipment manufacturer.

2.2 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment and that can attain water quality specified in "Performance Requirements" Article.

B. Chemicals to be FDA approved and safe for use with direct steam injection humidification and for steam used in direct contact with food.

2.3 NON-CHEMICAL TREATMENT FOR COOLING TOWER AND FLUID COOLER SYSTEMS:

A. Non-chemical device technology shall be considered where the make-up water supply contains less than 25 ppm SiO2 and Ca levels are less than 25 ppm. The non-chemical system shall include all necessary components to provide a fully functional system to control scale, corrosion, and biological contamination.

B. Refer to Section 232501 Non-Chemical HVAC Water Treatment for options.

2.4 CHEMICAL TREATMENT FOR OPEN CONDENSING WATER/COOLING TOWER SYSTEM

A. Subject to compliance with requirements, provide products by US Water Services, Chem Pro Lab, San Joaquin Chemicals, Garratt-Callahan, Chemcoa Nalco, ITOH2 Industrial Treatment of Water.

B. General: Provide a prefabricated automatic control system to monitor and control cooling bleed by conductivity and feed of inhibitor based on impulse water meter signals. If pH and alkalinity of the makeup water source requires adjustment, a pH control system will be supplied.

C. Controller: The controller shall include all necessary control features in a single easily removable panel housed in a NEMA 12 enclosure. The system shall include all chemical injection fittings, chemical feed pumps, solution line injector or corporation stops, solenoid

bleed assembly of appropriate size and alternating biocide with bleed lock out feature. Controller to be UL approved. Manufacturers: Pulsafeeder, LMI, Lakewood Instruments, Hydro Systems Company, Accepta, Advantage Control.

1. Biocide Program Timers and Pumps: An internal program within the controller shall provide "day, hour and minute trip" to periodically feed biocide. During the feeding of the biocide, the bleed cycle shall be automatically locked out to permit retention of the biocide. A suitable chemical pump constructed of materials resistant to the biocides to be used shall be provided to inject the biocide into the third chemical injection tee. Pump must have sufficient capacity to inject the necessary dosage of biocide for 24 hours operation within a one-hour time span. All oxidizing biocide feed pumps shall be of the peristaltic type. All oxidizing biocide injection feed locations shall be either directly into the cooling tower basin with a bulk-head fitting extending into and below the water line, or into the condenser water header with a corporation stop injection assembly to insure dissemination of material without causing damage to the pipe injection site. If Halogen chemistry is used, an ORP or Chlorine controller shall be supplied with all necessary sensors, pumps, and fittings.
2. Sensor shall be constructed of "O" ring sealed PVC with carbon electrodes. Temperature compensation over 32ºF to 140ºF shall be automatic to compensate for condenser water temperature changes. Sensor shall be easily removed from the flow cell via pin fasteners to facilitate cleaning.
3. Pressure rating shall be 150 psig. Conductivity calibration range shall cover 0.0 to 3,000 mmhos full scale. Front panel adjustable. Accuracy and repeatability 1%. Deadband 0.5% of full scale.
4. Auto-Off-Manual switch to be provided on front panel.
5. An alarm timer shall be provided to limit the time an inhibitor pump may be activated per bleed cycle when chemical inhibitor is fed proportional to bleed-off. The alarm timer range shall be 5 to 90 minutes and be front panel adjustable. The alarm timer shall:
6. Disconnect the inhibitor feed pump.
7. Activate an alarm light.
8. Have no effect on the bleed cycle solenoid valve.
9. Automatically reset after the conductivity is satisfied.
10. pH Control: Sensors shall be constructed of or enclosed in "O" ring sealed PVC housings and shall be easily removable from the flow cell for cleaning

    a. Pressure rating shall be 150 psig.
    b. The pH sensor shall be of the glass type in order to provide a linear display of pH.
    c. The reference electrode shall be refillable and feature a visible KCL reservoir to permit easy viewing of the excess KCL level. A ceramic junction shall be used to ensure long electrode life.
    d. pH calibration shall be front panel adjustable and have a fixed span of 4-9 pH for control and display.
        1) Control Accuracy: 0.0 pH units
        2) Deadband: 0.05 pH units
        3) Drift less than: 0.1 pH/month

e. An alarm timer shall be provided to limit the time an acid pump may pump continuously whether activated manually or automatically. The alarm timer range shall be 5 to 90 minutes and be front panel adjustable. In the alarm condition:
   1) The acid pump shall be disconnected.
   2) Activate the alarm light.
   3) Switch 115 VAC to a terminal for an external alarm.
   4) Automatically reset after the pH is satisfied or the output switched off.

f. "Low pH alarm timer override" shall function if the pH should drop to 6.5 (adjustable) or below within the system. In the alarm condition:
   1) The acid pump shall be disconnected.
   2) Activate the alarm light.
   3) Switch 115 VAC to a terminal for an external alarm.
   4) A combination flow switch, flow sight and back check valve shall be provided which will:
      a) Disconnect all outputs during a "no flow" condition.
      b) Be magnetically operated and not utilize "through the pipe wall" levers or paddles that could be subject to fouling or sticking.
      c) Operate at 1.5 GPM minimum flow rate.

g. Display Lamps: All display lamps shall be solid state LEDs for longest life.
h. Display of pH and/or conductivity shall be as follows:
   1) Single meter readout of pH.
   2) Meter for pH and meter for conductivity.
   3) Chart recorder for pH, 60 day capacity, inkless recording type.
   4) Dual channel chart recorder for display of pH and conductivity, 60 day capacity, inkless recording type.

D. Chemical Feed Pumps: Each pump shall be electronically controlled, positive displacement diaphragm type with variable stroke and speed, with the exception of the oxidizing biocide chemical feed pump. The only moving part in the drive mechanism shall be an electromagnet driven by an electronic pulsing circuit. No lubrication shall be required. The pump shall be fully adjustable with a maximum delivery of 24 GPD and a maximum working discharge pressure of 75 psig. For acid service, the pump head and fittings must be of PVC, the check balls ceramic, and the diaphragm and "O" rings of Viton. For non-acid service, the head may be Lucite and diaphragm of hypalon construction. All pumps to operate on 115 VAC. Biocide pump fittings, and head shall be polymoreslene. Diaphragm to be Teflon. A pre-plumbed chemical solution line assembly shall be PVC schedule 80 and be so constructed as to prevent excessive heat buildup due to chemical reaction with circulation water. Manufacturer: Liquid Metronics. The assembly shall include:

1. Acid injection tee.
2. Inhibitor injection tee.
3. 1/4" PVC ballcock valve installed in a tee to facilitate safe chemical pump priming and pressure relief.
4. PVC double union shut-off valve 3/4".
5. External chemical injection assembly with double union ball valve and brass gate valve shut-off.

E. Solenoid Bleedoff Valve: Shall be pilot operated, cast-iron body with a brass top and rubber diaphragm to provide a slow closing action and have built in provisions for manual flow rate adjustment. Must be completely serviceable without removing it from the system line. Valve to be sized at minimum of one-half the diameter of tower makeup valve. Maximum working pressure 200 psig. Manufacturer: ASCO.

F. Water Meters: Contact pulse water meter with sealed pulse contact, sized for water makeup line and system requirements.

G. Chemical Feed Piping: Schedule 80 PVC with solvent welded joints or polyethylene tubing with compression fittings.

H. Chemical Tracking and Web-Based Monitoring Systems:

1. Web-based monitoring interface and application for remote monitoring, documentation and optional remote control of chemical dosing. Manufacturers: Lakewood Instruments, Advantage Controls.
2. Used with solid chemicals containing a UV tracer dye. Manufacturers: APTech Group EnduroSolv brand solid chemicals with duroTrace UV additive.
3. UV probe and chemical analyzer with manual or automatic chemical feed adjustment capability.

I. Filtration

1. In applications where high cycles of concentration are being maintained, 7 to 10 cycles or more, provide a bag type, cartridge-type, or a sand filter system to remove suspended solids.
2. Refer to Section 232613 Water Filtration for Open-Loop Hydronic Systems for requirements.

2.5 CHEMICAL TREATMENT TEST EQUIPMENT

A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TSS, inhibitor, chloride, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers, and oxidizing biocide test for open cooling systems.

2.6 CORROSION TEST COUPON RACK

A. Corrosion Test Coupon Assembly: Constructed of corrosive-resistant material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.

1. Two-station rack for closed-loop systems.
2. Four-station rack for open-loop systems.

2.7 STAINLESS-STEEL PIPES AND FITTINGS

A. Stainless-Steel Tubing: Comply with ASTM A269, Type 316.

B. Stainless-Steel Fittings: Comply with ASTM A815/A815M, Type 316, Grade WP-S.

C. Two-Piece, Full-Port, Stainless-Steel Ball Valves: ASTM A351/A351M, Type 316 stainless-steel body; ASTM A276, Type 316 stainless-steel stem and vented ball, carbon-filled TFE seats, threaded body design with adjustable stem packing, threaded ends, and 250-psig (1725-kPa) steam working-pressure rating and 600-psig (4140-kPa) cold working-pressure rating.

PART 3 - EXECUTION

3.1 CHEMICAL COMPATIBILITY

A. The Water Treatment Contractor is responsible for determining the system material content and submitting chemicals compatible with each system's content. In the case of systems equipped with aluminum heat exchangers, non-Borate Nitrite inhibitors must be submitted. For closed chilled water systems in excess of 10,000 gallons, non-Nitrate inhibitors must be submitted if aluminum heat exchangers are in use.

3.2 FLUSHING AND CLEANING

A. The Water Treatment Contractor shall be responsible for furnishing the cleaning material and supervising the chemical cleaning of the chilled water piping, process cooling water system, condenser water piping, heating piping, and heat recovery loop piping. See 232113 for flushing and cleaning method for HVAC piping.

B. The system to be cleaned shall be filled with a solution of 10% by weight of a heavy duty alkaline liquid cleaner. The cleaner shall be capable of wetting and penetrating heavy soil deposits of oil or grease, and keeping these products in suspension, for removal through flushing the system to drain. Alkaline cleaners shall not be used for systems with galvanized components to assure no stripping of zinc coating.

C. The cleaning solution shall be circulated for a minimum of 8 to 24 hours depending on the system water volume. At the end of the circulation period the system shall be flushed to sanitary sewer drain for an additional 8 to 24 hours and then refilled with fresh water, taking care to remove any entrapped air from the system.

D. At the end of the cleaning period, the system shall be chemically treated as specified. In no case shall the system being cleaned be left in an untreated condition for more than 8 hours.

E. At the conclusion of the cleaning operation, the Water Treatment Contractor shall certify in writing that the system was cleaned as specified.

3.3 TESTING

A. Closed Systems:

1. Provide a Nitrite "Drop Test" kit or other inhibitor test kit for determining the level of Nitrite or other approved inhibitor in the closed system.

B. Open Systems:

1. Provide the following test equipment and test kits:

a. One conductivity meter and three ranges covering 0 to 10,000 PPM/TDS and with automatic temperature compensation.
b. Provide one reagent-free, fluorescent-reading meter for determining the level of inhibitor being used in the cooling tower water. Provide a Phosphonate/Molybdate test kit with systems treated without the use of fluorescent.
c. One “Drop Test” for determining the chlorine level of the water in the cooling tower water.

3.4 COUPON RACKS

A. Coupon Rack for Open Systems:

1. Install a minimum two station coupon rack, built to ASME specifications and as shown on the drawing, made from 3/4" PVC Schedule 80 pipe. The coupon holders shall consist of nylon screw and nut for holding the coupon, PVC water inlet ball shut off valves, 3/4" PVC pipe, and the coupon rack shall be pre-mounted on a galvanized steel channel support frame. When the system is ready for startup, the Water Treatment Contractor shall install three pre-weighted copper coupons in the above coupon holders, noting time and date. Coupon will be removed at the end of each 90-day period, noting time and date, reweighed, and inspected, with a report being sent to the General Contractor/Mechanical Contractor, for distribution to the Owner’s Representative showing the condition of the system being treated.

3.5 INSTALLATION

A. Coordination where installation of Water Treatment equipment in piping systems is required with the other work (plumbing and heating piping) as necessary to interface components of water treatment equipment. Provide installation instructions to those firms providing installation.

B. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer’s wiring diagram submittal to Electrical installer.

1. Verify that electrical wiring installation is in accordance with manufacturer’s submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.
2. Install pressure gauges, valves, and controls furnished by manufacturer, in accordance with manufacturer’s instructions.

C. Coordination of chemical system with service access:

1. In the event a cooling tower mechanical room is located in an area that is inaccessible for delivery of wet chemical drums, the water treatment contractor shall base their bid on a control, feed, and bleed system that uses solid chemical technology for both scale, corrosion control, and bacterial control.

D. Provide full size shut-off ball valves and piping between tower sump filter and inlet/discharge side of pump. Tower filtration system filters shall be of the multi-media sand filter type for all open systems and closed loop systems in excess of 10,000 gallons. The multi-media sand filters

shall be capable of filtering down to a minimum of 0.5 micron and shall automatically perform unit backwashes based on a programmed pressure differential set-point. Filters for closed loop systems less than 10,000 gallons in capacity shall be of the cartridge filter type and shall be capable of filtering down to a minimum of 1 micron. Cyclone or other separator type filtration systems shall not be accepted

3.6 INSPECTION

A. Examine areas and conditions under which water treatment systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.7 FIELD QUALITY CONTROL

A. Following start-up sample water at one-week intervals for period of three (3) weeks and provide a test report on the conditions of the water. Subsequent visits shall be at a monthly frequency.

3.8 SYSTEM START-UP

A. The Water Treatment Supplier shall put the system into operation and adjust as necessary for proper operation.

B. The Water Treatment Supplier shall provide a written report to the Division 23 Contractor indicating that the start-up has been completed and that all Water Treatment Equipment is operating properly.

3.9 TESTING AND CLEANING

A. Following start-up sample all treated water systems at one-week intervals for period of three (3) weeks and prepare certified test report for each system being treated. Subsequent visits shall be at a monthly frequency.

B. Start-up test, and adjust water conditioners in presence of manufacturer’s authorized representative. Operate units including regeneration, back washing, rinsing and flushing. Adjust unit to maintain required steady state effluent water quality.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer’s touch-up paint.

3.10 CLOSEOUT PROCEDURES

A. Provide services of manufacturer’s technical representative to instruct Owner’s personnel in operation and maintenance of water treatment systems.

1. Schedule training with Owner, provide at least 7-day notice to Contractor and Engineer of training date.

a. The water treatment vendor shall provide scheduled owner training on all equipment supplied including but not limited to theory, function, safety, testing equipment and recommended tests and logging protocol.

b. The water treatment vendor must have the ability to provide a central online data base that the vendor and owners rep have access to all data from control equipment and water use.

2. Submit certified test reports to Engineer.
3. Provide a water treatment service program for the installation and warranty period.

   a. The supplier shall provide from qualified service representatives, 12 service visits, complete with reports at the following times:
      1) Visit one: Aid on installation, identification of installation points for equipment, and outline of program with contractor as needed
      2) Visit two: Inspection and testing of cleaned and drained piping, scheduling tentative date for start-up.
      3) Visit three: Start-up of system.
      4) Visit 4-12: Training of operators, and beginning monthly service visits to total 12 visits over one year of operation. Each call shall include testing all systems, checking chemicals and equipment and completing field test reports. Troubleshooting and training of new operators is always included.

4. Provide sufficient supply of biocide and inhibitor for the cooling tower system during the warranty period.

END OF SECTION 232500

SECTION 236500 - COOLING TOWERS

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 230500 - Basic HVAC Materials and Methods, and other Sections in Division 23 specified herein.

1.2 SCOPE

A. All work to be furnished and installed under this Section shall comply with all the requirements of Division 01, and shall include, but not necessarily be limited to, the following:

1. Cooling towers.
2. Controls and control connections.
3. Condenser water connections.
4. Makeup water and drainage connections.
5. Automatic chemical control system.
6. Starters and variable frequency drives
7. Electrical power connections.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 230500: Basic HVAC Materials and Methods.

B. Section 230593: Testing, Adjusting and Balancing.

C. Division 26: Electrical.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Provide systems that are the standard product of an equipment manufacturer regularly engaged in the production of such units who issues complete catalog information on such products. Units shall not be fabricated by the Contractor.

B. Structural Performance: Tower and tower support structure shall withstand the effects of locally defined gravity loads, seismic loads, dead loads, live loads, winds loads and stresses within limits and under conditions indicated according to the Building Code and ASCE 7. Coordinate support structure requirements with Structural Engineer.

C. Codes and Standards-Provide components conforming to the requirements of the latest addition of the following:

1. Factory Mutual Approval (where required by Owner or AHJ): The tower shall be listed in the current FM Approval Guide and conform to the FM Approval Standard for Cooling Towers, Class Number 4930 that is approved for use without sprinkler systems. The tower shall have successfully passed full scale fire testing, static and cyclic wind pressure testing, large missile impact testing and structural design evaluation as administered by FM Approvals.
2. American National Standards Institute (ANSI):
   a. A58.1: Minimum Design Loads for Buildings and Other Structures.
3. Cooling Tower Institute (CTI):
   a. ATC-105: Standard Specifications for Thermal Testing of Wet/Dry Cooling Towers.
   b. ATC-128: Code for Measurement of Sound from Water Cooling Towers.
   c. ATC-140: Isokinetic Drift Measurement Test Code for Water Cooling Towers.
   d. STD-111: Standard Specifications Gear Speed Reducers for Application on Water-Cooling Towers.
   e. STD-131: Fiberglass-Reinforced Plastic Panels.
   f. STD-201: Standard for Thermal Performance Certification of Evaporative Heat Rejection Equipment.
   g. STD-201RS: Standard for Certification of Water Cooling Tower Thermal Performance.
   h. WTG-142: Treatment of Galvanized Cooling Tower to Prevent White Rust.
   i. ESG-151: Variable Frequency Drive Application Guidelines for Cooling Towers.
4. National Electrical Manufacturers Association (NEMA): Provide electrical components which comply with NEMA Standards.
5. National Fire Protection Association (NFPA):
   a. 70: National electrical Code.
6. Occupational Safety and health Administration (OSHA): Construct stairways and ladders in conformance with OSHA requirements.
7. Underwriters Laboratories (UL): Provide electrical components which comply with UL Standards.
8. Energy Compliance: Equipment shall meet and/or exceed the minimum requirements of ASHRAE 90.1 Energy Standards for Buildings or local State Energy Code, as applicable.

D. Certification: Submit certification of tower conformance to CTI design and testing standards, CTI Certification Standard STD-201.

E. Design and certify towers for a wind load of 30 pounds per square foot.

F. Drift Eliminators: Achieve drift reduction to 0.002 percent (maximum) of the recirculated water volume for counter-flow towers and to 0.005 percent (maximum) for cross-flow towers.

1.5 PRODUCT SUBSTITUTIONS

A. The Contractor shall certify the following items are correct when using substituted products other than those scheduled or shown on the drawings as a basis of design:

1. The proposed substitution does not affect dimensions shown on drawings.
2. The Contractor shall pay for changes to building design, including engineering design, detailing, structural supports, and construction costs caused by proposed substitution.
3. The proposed substitution has no adverse effect on other trades, construction schedule, or specified warranty requirements.
4. Maintenance and service parts available locally are readily obtainable for the proposed substitute.

B. The Contractor further certifies function, appearance, and quality of proposed substitution are equivalent or superior to specified item.

C. The Contractor agrees that the terms and conditions for the substituted product that are found in the contract documents apply to this proposed substitution.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for units showing dimensions, weights (shipping, installed, and operating), capacities, ratings, performance with operating point clearly indicated, motor electrical characteristics, finishes of materials, and installation instructions. Include the following:

1. Maximum flow rate.
2. Minimum flow rate.
3. Drift loss as percent of design flow rate.
4. Sound power levels in eight octave bands for operation with fans off, fans at minimum, and design speed.
5. Performance curves for the following:
    a. Varying entering-water temperatures from design to minimum.
    b. Varying ambient wet-bulb temperatures from design to minimum.
    c. Varying water flow rates from design to minimum.
    d. Varying fan operation (off, minimum, and design speed).
6. Fan airflow, brake horsepower, and drive losses
7. Motor amperage, efficiency, and power factor at 100, 75, 50, and 25 percent of nameplate horsepower.
8. Electrical power requirements for each cooling tower component requiring power.

B. Shop Drawings: Submit manufacturer's shop drawings of assemblies, control panels, sections and elevations, unit isolation, valves, alarms, methods of assembly of components, and location and size of each field connection. Include the following:

a Assembled unit dimensions.

b Weight (shipping and operating) and load distribution

c Required clearances for maintenance and operation.

d Sizes and locations of piping and wiring connections.

e Wiring Diagrams: For power, signal, and control wiring.

C. Maintenance Data: Submit maintenance instructions, including instructions for lubrication, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in operating and maintenance manuals; in accordance with requirements of Division 01.

D. Wiring Diagrams: Submit manufacturer's ladder-type wiring diagrams for power and control wiring required. Differentiate between factory-installed and field-installed wiring.

E. Seismic Qualification Certificates: For cooling towers, accessories, and components, from manufacturers.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01. Deliver units to the site in containers with manufacturer's stamp or label affixed.

B. Store/protect products under provisions of Division 01. Protect units against dirt, water, chemical, and mechanical damage. Do not install damaged units - remove from project site.

C. Rigging: Comply with the manufacturer's rigging and installation instructions.

1.8 WARRANTY

A. Provide minimum one-year warranty from date of Substantial Completion, including all parts, material, labor and travel.

B. Refer to Section 230500 for additional warranty and Substantial Completion requirements.

C. Motor/Drive System: Provide five (5) year comprehensive warranty against basin leaks, materials and workmanship including motor, fan, bearings, mechanical support, sheaves, bushing and belts.

PART 2 - PRODUCTS

2.1 FORCED-DRAFT, COUNTERFLOW COOLING TOWERS

A. Description: Forced-draft, counterflow cooling tower that is factory fabricated and assembled.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Baltimore Aircoil Co. #VF1 Series or Evapco or Marley equal

C. Casing: Structural steel frame constructed of heavy-gage steel angles and channels. Casing panels shall be constructed of the following:

1. Galvanized steel complying with ASTM A653/A653M, G235 (Z600) coating designation, or,
2. 304 or 316 Stainless Steel, or,
3. Fiberglass-reinforced polyester with UV inhibitors, or,
4. Galvanized steel panels protected with a thermosetting hybrid polymer or epoxy.

D. Casing features:

1. Panels: Shall totally encase the fill media to protect the fill from damage due to direct atmospheric contact.
2. Fasteners: Corrosion resistance equal to or better than the materials being fastened.
3. Joints: Sealed watertight.
4. Welded Connections: Continuous and watertight.
5. Rigging Supports: For handling cooling towers at construction site.
6. Access Doors: Access doors shall be provided and located throughout the tower, to allow easy access and maintenance to the bottom pan section, motor, and media. Access doors shall provide a watertight seal.

E. Basin:

1. Makeup water connection.
2. Overflow connection.
3. Sloped basin to low drain connection in sump. Outlet connection shall be beveled for welding, grooved for mechanical coupling or bolt hole circle for flat face flange.
4. Removable strainer with openings smaller than nozzle orifices.
5. Removable anti-vortexing device to prevent air entrainment
6. Collection Basin: 304 or 316 Stainless steel panels and structural members.

F. Fan:

1. Belt-driven, hot-dip galvanized steel, forward-curved centrifugal fan; statically and dynamically balanced.

G. Water Distribution System: Main header and lateral branch piping designed for even distribution over fill throughout the flow range without the need for balancing valves and for connecting individual, non-clogging spray nozzles.

1. Pipe Material: Schedule 40 PVC or stainless steel.
2. Nozzles: Removable plastic, brass, or ceramic nozzles. Confirm pressure-drop information.

H. Fill material:

1. Fill Material: PVC or FRP, resistant to rot, decay, and biological attack; with maximum flame-spread rating of five according to ASTM E84; and fabricated, formed, and installed by manufacturer to ensure that water breaks up into droplets.

I. Drift Eliminator: Reduced allowed maximum drift rate of 0.001% of circulated water volume.

1. Drift-Eliminator Material: PVC; resistant to rot, decay, and biological attack; with maximum flame-spread rating of five according to ASTM E84.

J. Louver material: Frames shall be constructed of G-235 galvanized steel or Type 316 stainless steel with easy removal of screens. Louvers shall be “sight tight” to completely block direct sunlight form entering and water from splashing out of the tower.

1. Louver Material: PVC or FRP, resistant to rot, decay, and biological attack; with maximum flame-spread rating of five according to ASTM E84 mounted in removable (galvanized or stainless frames or the same material as the basin).

K. Makeup Water Control:

1. Mechanical Water-Level Control: Manufacturer's standard brass mechanical makeup water valve, and plastic or bronze float with an adjustable linkage, or
2. Electronic Water-Level Control: Electric float switch; characteristics coordinated with solenoid-operated, makeup water valve.

L. Inlet Screen Material:

1. Galvanized steel mesh mounted in removable frames, or,
2. Hot-dip galvanized steel mesh with polymer coating mounted in removable frames, or,
3. Stainless-steel mesh mounted in removable frames.

M. Discharge Hood Material:

1. Galvanized steel according to ASTM A653/A653M, G235 (Z600) coating designation, or,
2. Hot-dip galvanized steel, or,
3. Stainless steel.

2.2 MOTORS

A. Refer to Section 230500 Basic HVAC Materials and Methods for general requirements for factory-installed motors.

B. Motor Construction: NEMA MG 1, general purpose, 1.15 service factor, continuous duty, Design B.

C. Use motor below for operation in dry, moist or corrosive atmosphere.

1. Enclosure Type: Totally enclosed, fan cooled (TEFC) inverter ready premium efficiency.

D. Use motor below when located in cooling-tower discharge airstream.

1. Enclosure Type: Totally enclosed, air over (TEAO) inverter ready premium efficiency.

E. Motor speed: inverter ready controlled by variable frequency drive (VFD).

F. Direct Drive: The fan drive shall be mounted on the motor in a direct drive configuration.

G. Belt Drive: Power Band Belt designed for 150% of the motor nameplate HP.

1. Belt: Multi-groove, solid back V-belt type neoprene reinforced with polyester cord.
2. Sheaves: Aluminum alloy if located inside the airstream.
3. Bearings: Heavy duty, self-aligning pillow block bearings with lubrication lines extended to side access door. Minimum L10 life for bearings shall be 75,000 hours. Provide extended grease lines and fittings.

2.3 VIBRATION SWITCH

A. Provide one mechanical vibration switch for each drive to de-energize fan motors if excessive vibration occurs per mechanical code. All electrical wiring and conduit to be provided by Division 26, coordinate accordingly. Manufacturers: Metrix #5550 or #5550G Series.

B. Cast aluminum enclosure with epoxy coating with the following features:

1. NEMA 250, Type 4 or 4X, depending on manufacturer mounting location.
2. Amplitude Range: 0 to 16 g peak with 1 g resolution adjustment setpoints.
3. Frequency Range: 0 – 60 Hz (0 – 3600 rpm).
4. Manual local reset.
5. Temperature operating range of -40°F to 158°F.
6. Voltage and amperage as required by motor requirements.

C. Mount the vibration switch to be easily accessible for manual resetting.

D. Cooling tower manufacturer shall recommend switch set point for proper operation and protection. Adjust the switch so that during full speed start-up and under normal conditions the contacts do not trip.

2.4 FLOW METERS

A. Provide one flow meter to measure the total makeup water quantity to the cooling tower system. Only one meter required to totalize system volume. Individual meters may be installed in makeup water pipe to each cell, if desired, at contractor's option.

B. Provide one flow meter to measure the total blowdown water quantity from the cooling tower system. Only one meter is required to totalize system volume. Individual meters may be installed in each blowdown pipe from each cell, if desired, at contractor's option. Provide strainer with hose bibb connection on inlet side of meter. Blowdown meter is used for reconciling cycles of concentration and water treatment efficiency.

C. Bronze body, multi-jet design, with epoxy powder coating. Accuracy +/- 1.5%/. Synthetic polymer measuring chambers. Non-wear measurement surfaces. AWWA Standard C-708 compliant. Meter shall be provided with dry contact and 24 volt or 100 mA output signal.

D. Meter Manufacturer: Carlon Meter #MRS Series, Seametrics #MJ Series

2.5 ELECTRIC WATER LEVEL CONTROLLER AND MAKEUP WATER VALVE

A. Provide an electric water level controller with five (5) conductivity actuated liquid level probes and normally closed (NC) makeup water solenoid valve. Controller shall be hermetically sealed with an LED status code light when water and/or probes are dirty. All electrical wiring and conduit to be provided by Division 26, coordinate accordingly.

B. Manufacturer: as provided by cooling tower or equal by Waterline Controls. Mount controller on tower casing as required by manufacturer. Mount near a door or access way for easy adjustment and cleaning.

C. Features:

1. Enclosure: 2" PVC Schedule 40.
2. Contact rating: 3 amps, 120 VAC resistive
3. Temperature rating: -40°F to +150°F ambient
4. Time delay: 6 seconds +/-
5. Probes: 1/4" stainless steel
6. Stilling chamber: 2" PVC pipe.

D. Controller shall have the following probe levels mounted inside an open PVC stilling chamber:

1. Bottom of stilling chamber shall be mounted within 1" of bottom of basin.
2. Lowest probe #1: Ground. Mounted 1" from bottom of stilling chamber basin.
3. Second lower probe #2: Low water alarm, connect to BAS
4. Middle probe #3: Makeup water valve on
5. Fourth probe #4: Makeup water valve off
6. Highest probe #5: High water alarm, connect to BAS. Mount 1/2" to 1" below overflow outlet.

E. Solenoid makeup water valve: Normally closed (NC), 120 VAC slow closing solenoid valve to minimize water hammer. Provide strainer upstream of valve. Connected to controller to open and close based on makeup water probe levels.

2.6 MECHANICAL HIGH WATER LEVEL ALARM AND FLOAT VALVE

A. Water level control: Brass mechanical makeup water valve and plastic/brass float with an adjustable linkage. Size as required for tower makeup water capacity. Provide integral with cooling tower.

B. High water level alarm: single level float switch mounted on side of water basin above the overflow water line. Adjust float to close the contact at water level 1/2" (minimum) below overflow outlet invert with signal monitor by building automation system (BAS). Provide watertight sealant at cooling tower penetration.

C. The high water level switch shall have the following features:

1. 316 Stainless Steel float
2. 316 Stainless Steel stem
3. Water slosh shield
4. Angled support stem with threaded coupling nuts for attachment to side of tower.
5. 30 VA nominal rating, minimum
6. 22-gauge lead wires, minimum 24" long
7. 10 second (adjustable) delay via the BAS

D. High level water switch manufacturer: Madison #MS5010.

2.7 BASIN HEATERS

A. Revise ambient conditions as required.

1. Basin-Heater Capacity: Maintain basin water temperature at 40°F (4.4°C) when ambient temperature is 0°F (minus 18°C) and wind velocity is 10 mph (16 km/h).

B. Select heater type from below.

1. Heater Type: Electric immersion heaters with thermostat and low-water cutout switch, enclosed in weatherproof housing suitable for field wiring.

2.8 MAINTENANCE ACCESS

A. Internal Working / Service Platforms: Provide a complete internal working platform and ladder system for service of all motor and drive components.

B. Handrails/Grabrails: Galvanized steel pipe complying with 29 CFR 1910.23. If access to fan deck is required, supply a perimeter handrail with ladder from grade to fan deck.

C. Ladders: Aluminum, sloped “ships type” with grabrail or vertical complying with 29 CFR 1910.27.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All equipment, unless otherwise shown or noted on the Drawings, is to be installed in accordance with industry standards and manufacturer's recommended installation instructions. Maintain manufacturer’s recommended clearances for service and maintenance.

B. Mount cooling tower on support structure using required anchor bolts. Isolate tower from support structure using rubber or fiberglass isolation pads. Where cooling towers are mounted on a roof provide housed spring vibration isolators to minimize vibration into the building structure. The cooling tower support and anchorage shall be designed and manufactured to withstand, within allowable material stress ranges, both seismic and wind forces as prescribed by the governing building codes. Seismic forces shall be based on the project specific data and height above ground. Wind pressure loads shall be assumed to be as defined in Section 230548 Vibration Isolation for Piping, Ductwork and Equipment and 230549 Seismic Restraint for Piping, Ductwork and Equipment. The unit’s anchorage and foundation shall withstand the design forces. Alternately, the contractor may design the support to carry the forces completely independent of the building structure. The tower support and anchoring design shall be certified as in conformance with these requirements by a structural engineer licensed in the jurisdiction having authority.

C. Connect to condensing water and makeup water piping. Arrange piping for easy dismantling and maintenance. Connect bypass piping as required for startup. Connect equalizer line for multiple cooling tower cells and provide hose bibb drain valve at low point. Provide shutoff valves, balancing valves, and drain valves. Provide multiple mechanical grooved couplings or braided stainless steel flexible connections as required and as shown on drawings to minimize vibration through piping system.

D. Coordinate with plumbing service for makeup water piping with strainer, makeup water flow totalizing meter, and reduced pressure principal backflow prevention device to makeup water valve sized for peak flow.

E. Coordinate with plumbing service for blowdown water flow totalizing meter in drain pipe from cooling tower sumps. Provide manual shutoff valve upstream of meter for future maintenance without draining sump. Provide manual balancing valve, with locking position setting, downstream of shutoff valve to allow for setting blowdown flow rate to a flow rate less than the makeup water flow rate to prevent tower sump from draining faster than filling.

F. Coordinate with controls system for monitoring high water alarm and other control signals to the building automation system.

G. Install water treatment system.

H. Connect to electrical service for fan power, vibration switch and electrical valves as scheduled. Refer to Division 26.

I. Install basin or side stream water filtration system on support structure adjacent to cooling tower/fluid cooler. Install distribution piping and nozzles throughout basin. Provide distribution and nozzle layout drawings for review and approval prior to installation.

J. Provide a tempered eyewash adjacent to the chemical treatment system, if installed. If the installation is a non-portable type, provide provisions to prevent scalding should the tempering valve fail.

K. Adjust the vibration switch trip setting. Cooling tower manufacturer shall recommend switch set point for proper operation and protection. Adjust the switch so that during full speed start-up and under normal conditions the contacts do not trip.

L. Flush and clean equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls.

3.2 MANUFACTURER'S START-UP SERVICES

A. The manufacturer shall provide start-up service in the form of a factory trained service technician. The service technician shall verify correct installation, verify piping installation, verify control wiring, verify power wiring, and check for proper operation. The service technician shall provide final adjustments to meet the specified performance requirements. Fully staffed parts and service personnel shall be within four hours travel from the job site.

B. Start-up services shall include:

1. Coordinate with controls installers to verify that a 30 second, or greater, time delay is provided for speed changes or for switching between motor operation in multiple fan systems.
2. For systems with variable frequency drives make sure that the minimum speed requirements have been set per the VFD manufacturer.
3. Verify that the condenser water temperature sensor is placed in the proper location to sense the mixed water temperature for fan sequence control and bypass valve operation.
4. Confirm if control programming included fan cycling on a daily basis for 10 minutes, twice a day, as required by manufacturer for local ambient conditions and operational schedule.
5. Verify that water treatment system is installed and operational
6. Verify a water treatment plan has been implemented for passivation of galvanized steel units.
    a. White rust is a premature failure of the protective zinc layer on hot dip or mill galvanized steel due to improper water treatment control during the start-up of new galvanized equipment.

b. Perform local water analysis including water treatment system operation and visual inspections during the first six (6) to twelve (12) weeks of operation. During this passivation period the pH should be maintained between 7 and 8 at all times.
c. Changes in water chemistry control may be considered after the passivation process is complete as evidenced by the galvanized surfaces taking on a dull gray color.
d. Any changes in the water treatment program or control limits should be made slowly while documenting the impact of changes to the passivated zinc surfaces.

END OF SECTION 236500

DIVISION 26 - ELECTRICAL SPECIFICATIONS

A. GENERAL

1. The "general conditions" and "general requirements" of the architectural specifications govern work under electrical.

2. Provide all labor, materials, equipment and services to construct and install complete new electrical systems and service as described herein and shown on the drawings.

3. Any apparatus, appliance, material or work not shown on drawings but mentioned in the specifications, or vice versa, or accessories necessary to make the work complete in all respects and ready for operation, even if not particularly specified, shall be furnished and installed by the contractor without additional expense to the owner.

4. Design drawings are diagrammatic and do not show all offsets, bends, elbows or other specific elements which may be required for proper installation of work. Such work shall be verified at the job site and the required accessories and routing shall be provided to complete the work at no additional cost to the owner. The right is reserved to make any reasonable changes in outlet, lighting or equipment locations, prior to rough-in without any additional cost to the owner. "reasonable change" shall be interpreted as including any changes of up to six feet from the locations indicated on the drawings.

5. Contractor shall give all necessary notices, obtain all permits and pay all taxes, fees and other costs in connection with this work. Contractor shall obtain all required certificates of inspection for this work and deliver same to the owner before request for acceptance and final payment for the work.

6. Works and materials shall conform to the latest rules of the national board of fire underwriters' code, regulations of the state fire marshal, and with applicable local and state codes. Nothing in these specifications shall be construed to permit work not conforming to the most stringent applicable codes.

7. The national electrical code, uniform building code plus any applicable local amendments to the foregoing codes, and electrical requirements established by the state and local fire marshals are hereby made part of these specifications. The contractor shall notify the owner of any part of the work believed to be in conflict with these codes and regulations.

8. Electrical drawings are arranged for convenience only and do not necessarily determine which trade performs the various portions of the work. The contractor shall perform all necessary work to join with or receive work of other trades. Work shall be coordinated with all trades to provide adequate clearance and eliminate conflicts.

9. The contractor shall visit the job site prior to submitting proposal and be familiar with existing site conditions. Information on drawings relative to existing site conditions is approximate. During the progress of construction, deviations found necessary to conform to actual conditions shall be reported to the owner. Contractor is responsible for any damage caused to existing utilities. By submitting the bid it is understood that the contractor has reviewed the documents, understands the intent and has included all site constraints in the bid accordingly.

10. Shop drawings shall be submitted to owner on all major pieces of electrical equipment, including light fixtures, starters, circuit breakers, panelboards and devices. Each item of the shop drawings shall be properly labeled, indicating the intended service of the material, the project name and the electrical contractor's name. When an error in the shop drawings is not detected in the review, this does not grant the contractor permission to proceed in error. Regardless of any information contained in the shop drawings, the requirements of the drawings and specifications must be followed and are not waived or superseded in any way by the shop drawing review.

11. The electrical contractor shall maintain a set of drawings at the job site for the exclusive purpose of maintaining a record of all work installed and to show any deviations from the work indicated on the drawings. One set of reproducible drawings, showing all as-built conditions, shall be delivered to the owner for acceptance prior to final payment at the completion of the project.

12. The right is reserved to inspect and test any portion of the equipment and/or materials during the progress of its installation. The contractor shall test all wiring and connections for continuity and grounds before connecting any fixtures or equipment. A full-scale working test with all lights, equipment, speakers, appliances, etc., in operation shall be made, in the presence of the building engineer or representative, and the electrical systems proven satisfactory for operation and free from defects. Any defects found shall be remedied immediately by the contractor.

13. The contractor shall participate in and provide standby labor for required life safety tests including after hour testing if required by landlord or authorities having jurisdiction.

14. On completion of the entire installation, the approval of the owner shall be secured. The contractor shall obtain and pay for a certificate of approval from the public authorities having jurisdiction. A final inspection certificate shall be submitted to the owner prior to final payment. Any and all cost incurred for fees shall be paid for by the contractor.

15. Coordinate all outages and cut-overs with the landlord. Power shall not be interrupted to the occupied portions of the building during business hours, except by permission of the owner.

16. Provide underwriters' laboratories, inc. Or etl testing laboratories, inc. Listed and labeled equipment for all items for which u.l carries a listing or labeling, unless items are specifically exempted.

B. RACEWAYS AND FITTINGS

1. Apply raceway products for outdoor locations as specified below unless otherwise indicated.
   a. Exposed conduit: GRC or IMC.
   b. Above ground concealed conduit: GRC, IMC, or EMT.
   c. Underground conduit: RNC, type epc-40 PVC, direct buried or concrete encased where shown.
   d. Connection to vibrating equipment, including transformers, solenoids, or motor-driven equipment: LFMC.
   e. Above ground boxes and enclosures: NEMA 250, type 3r.

1. Apply raceway products for indoor locations as specified below unless otherwise indicated.
   a. Exposed conduit, not subject to physical damage: EMT.
   b. Exposed conduit, not subject to severe physical damage: EMT.
   c. Exposed conduit, subject to severe physical damage: GRC or IMC.

d. Concealed conduit in ceilings and interior walls and partitions: EMT.
e. Connection to lighting fixtures and vibrating equipment, including transformers, solenoids, or motor-driven equipment: FMC, except use LFMC in damp or wet locations. Max 6' length.
f. Conduit in damp or wet locations: GRC or IMC.
g. Boxes and enclosures: NEMA 250, type 1. Use NEMA 250, type 4 stainless steel or nonmetallic in institutional and commercial kitchens and damp or wet locations.

2. Rigid conduit shall be of threaded type, hot dip galvanized steel or aluminum. Electrical metallic tubing shall be galvanized steel. All steel conduit shall be protected by an overall zinc coating. Flexible conduit shall be steel, minimum 3/4" size.

3. EMT connectors and couplings shall be steel set screw or compression type; crimp-on type is not acceptable. Connectors in plenums shall be compression type. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4” trade size and insulated throat metal bushings on 1-1/2” trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

4. Conceal all conduit wherever possible except in mechanical or electrical equipment areas. Exposed conduit shall be run parallel or at right angles to the lines of the building. Conduit concealed in ceiling spaces shall be run parallel to building lines where possible.

5. Conduit shall be supported from the building structure; supports from air conditioning ducts or piping shall not be permitted. Ream conduits after threads are cut; ends shall be cut square and shall butt solidly into couplings and connectors.

6. Vertical conduit runs shall be supported at every floor with support intervals not exceeding 10 feet. All horizontal conduit and boxes shall be securely supported by means of clamps, hangers, trapeze supports or wall brackets.

7. Annular space in and around sleeves that pass through fire resistive or fire rated partitions, floors, or ceilings shall be closed by packing with a fire resistive material that will maintain the rating of the barrier penetrated.

8. Conduits shall be continuous from outlet to outlet and from outlets to cabinets, junction or pull boxes, and shall enter and be secured at all boxes so that each system shall be electrically continuous throughout.

9. A nylon pull cord shall be left in all conduits in which permanent wiring is not installed.

10. Provide sleeves for all telecom cabling which penetrates slabs and full height partitions.

C. WIRE AND CABLE

1. Conductors shall be copper and rated at not less than 600 volts, except for signal cable specifically rated lower. Power and lighting conductors shall be minimum #12 awg. Signal cable quantity and size shall be as indicated. All wire #8 awg or larger shall be stranded.

2. Fixture extensions shall be #12 awg except those individual fixture extensions that do not exceed 4 feet in length may be #14 awg. Fixture extensions shall have temperature rating to conform to

individual fixture requirements.

3. Wiring shall be type THWN or THHN, minimum 75 degree c insulation. Feeders sized #2 awg and above shall be type THW, 75 degree c insulation, or THHN, 90 degree c insulation.

4. Special pre-manufactured cabling systems, such as modular wiring and mc type cable may be used for final terminations to fixtures and devices within the room where permitted by building owner. All homeruns shall be in EMT or rigid.

5. Life safety system wiring shall be color coded to match base building system wiring.

6. All wiring shall be color coded as follows: 120/208 volt system phase "a" - black; phase "b" - red; phase "c" - blue; neutral - white; grounding conductor - green. 277/480 volt system phase "a" - brown; phase "b" - orange; phase "c" - yellow; neutral - white with brown or black stripes.

7. All wire and cable shall be installed in raceway except as specifically permitted otherwise. Vertical runs of cable shall be supported at junction and pull boxes per code requirements.

8. All life safety (fire alarm, public address) system wiring shall be installed in raceway. Raceway and j-box covers shall be red.

9. At each fixture outlet a loop or end of wire not less than 8" long shall be left for connection to fixtures.

D. SPLICES AND INSULATION

1. Joints in branch circuits shall occur only where such circuits divide and shall consist of one through circuit to which shall be spliced the branch from the circuit. No splices shall be made in conductors except at outlet boxes, junction boxes and splice boxes.

2. All joints for power wiring #10 awg or smaller shall be made with wire nuts or compression type connectors. Joints in signal cables shall be made only with compression type connectors.

3. All joints or splices for #8 awg or larger shall be made with a mechanical compression connector. After the conductors have been made mechanically and electrically secure, the entire joint or splice shall be covered with tape to make the insulation of the joint or splice equal to the insulation of the conductors.

E. WIRING DEVICES AND OUTLET BOXES

1. Wall receptacle outlets shall be NEMA 5-20r, unless otherwise noted.

2. Outlet boxes for concealed work shall be one piece, pressed steel, knockout type with zinc or cadmium coating. Boxes shall not be smaller than 4” square nominal size except where indicated. Provide extension rings, plaster rings and covers necessary for flush finish.

3. Provide 3/4" conduit from all data outlets stubbed up into accessible ceiling space, unless otherwise noted.

4. Mount devices in approved outlet boxes at mounting heights determined by architects. Where more than one wall switch is indicated at one location, switches shall be ganged under a common wall plate. More than 6 switches at one location shall be ganged in two rows, one above the other.

5. Before locating outlet boxes, check all architectural drawings for type of construction and to make sure that there are no conflicts with other equipment.

6. Bar hangers shall be used to support outlet boxes in stud or furred partitions and ceilings. Screws shall be used with expansion shields for fastening to concrete or masonry. Provide approved knockout seals on unused open knockout holes.

F. PANELBOARDS AND CIRCUIT BREAKERS

1. Panelboards shall be sequence phased, factory assembled, with copper bus, sized as indicated on drawings.

2. Cabinet shall be minimum 20” wide, unless otherwise noted. Front trim shall be dead front and contain a typewritten directory behind clear plastic in a metal frame. Cabinets, doors and trims shall be fabricated from code gauge steel.

3. Molded case circuit breakers shall be by panelboard manufacturer to match existing with frame, trip and short circuit rating as indicated on the drawings.

4. Circuit breakers shall be of the bolt-on type mounting. Multi-pole breakers shall be single devices, in one enclosure, with one operating handle and common trip.

5. Minimum rms symmetrical rating of circuit breakers shall match panel rating.

6. Panelboards shall be mounted plumb and trim adjusted to be vertical and covering all openings. Top of panelboard shall be maximum 6'-6" above finished floor. Remove all wiring from panel boards where circuits are deleted or abandoned.

7. Circuit breaker terminations shall not be double lugged to tap off for additional circuit runs. All branch circuit taps shall be made outside of panels in appropriate junction boxes.

8. Provide fully rated electrical equipment. Series rated equipment is not allowed.

9. Provide multi-pole circuit breaker or single-pole circuit breakers with handle tie for disconnecting means of multiwire branch circuit with a shared neutral.

G. MOTOR STARTERS AND DISCONNECTS

1. Magnetic starters shall be across-the-line, combination motor circuit protector type with thermal overload protection, control transformer, h-o-a switch and "on-off" indicating lights in suitable enclosure. Sizes shall be as shown or required, minimum NEMA size 1, with overload devices sized to suit application.

2. Disconnecting devices shall be provided for each motor. Switches shall be motor-rated, except where otherwise indicated.

3. Disconnect switches for motors rated 1/2 hp or larger shall be unfused, three pole, 480 volts in NEMA general purpose or weatherproof enclosures, unless otherwise noted.

4. Switches for motors less than 1/2 hp shall be toggle type, quick make and break, rated at 277 volts, with the number of poles required, in surface mount type, NEMA 1 enclosures.

H. GROUNDING

1. Provide all grounding for electrical systems and equipment in accordance with article 250 of the N.E.C. grounding lugs may be used where provided as standard manufacturer's items on equipment furnished.

2. Provide separate green insulated equipment ground conductor in all non-metallic and flexible electrical raceways. Effectively ground all fixtures, panels, controls, motors, disconnect switches, and non-current carrying metallic enclosures. Use bonding jumpers, grounding bushings, lugs, buses, etc., for this purpose. Provide grounding bushings on all feeder conduit entrances to panels and equipment enclosures and bond bushings to enclosures with minimum #10 awg conductor. Connect the equipment ground to the building system ground. Use the same size equipment ground conductors as phase conductors, up through #10 awg. Use N.E.C. table 250-95 for conductor size with phase conductors #8 and larger, if not shown on the drawings.

3. Receptacles: permanently connect the ground terminal on each receptacle to the green ground conductor or grounded metal raceway system with a ground wire.

4. Motors: connect the ground conductor to the conduit with an approved grounding bushing, and to the metal frame with a bolted solderless lug. Bolts, screws and washers shall be bronze or cadmium plated steel.

5. Ground conductors shall be 600 volt - #12 awg stranded copper minimum, with green insulation; and shall be continuous from terminal to terminal without splice.

I. JUNCTION AND PULL BOXES

1. Drawings do not necessarily show every pull box required. Additional boxes may be added when desirable to save labor and avoid difficulties; and when code requirements limit the number of bends between boxes. Additional boxes shall be provided without added cost to the owner. Boxes shall be sized according to code and shall be underwriters' laboratories listed. Boxes shall be accessible at the time of completion and in finished areas shall be located only after approval of architect due to appearance considerations.

2. All junction boxes in ceiling spaces shall be marked with black marking pen as to the panel and circuits passing through the box.

J. LABELS

1. White core black engraved plastic nameplates shall be attached to all new equipment (panelboards, transformers, starters, etc.) Indicating equipment, designation and voltages.

2. Self-adhesive computer-generated type labels with black lettering on clear background shall be provided for each light switch, power and signal outlet cover plate. Label to indicate panel and branch circuit or data cable(s) number serving the receptacles/outlet. Controls with flip up cover shall be labeled under the cover.