IFB #25-062 Shreveport Municipal Courts Building HVAC Renovations

LAGC Plan Room - North

Project documents obtained from www.CentralBidding.com

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SHREVEPORT MUNICIPAL COURTS BUILDING HVAC RENOVATIONS 1244 TEXAS AVENUE SHREVEPORT, LA 71101

JUNE 13, 2025

CITY OF SHREVEPORT
Tom Arceneaux - Mayor

City Council
District A – Tabatha H. Taylor
District B – Gary Brooks
District C – Jim Taliaferro
District D – Grayson Boucher
District E – Dr. Alan Jackson Jr.
District F – James Green
District G – Ursula Bowman

JOHN J. GUTH ASSOCIATES, INC.
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GUTH PN 11-7324

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HVAC RENOVATIONS
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SEALS

Specification Divisions/Sections prepared under my responsible supervision:

DIVISION 01	**GENERAL REQUIREMENTS**
DIVISION 02	**SITE CONSTRUCTION**
DIVISION 03	**CONCRETE**
DIVISION 09	**FINISHES**
DIVISION 22	**PLUMBING**
DIVISION 23	**MECHANICAL**

MICHAEL S. MIDDLETON, P.E.
MECHANICAL ENGINEER– LA LICENSE 27979

Specification Divisions/Sections prepared under my responsible supervision:

DIVISION 26	**ELECTRICAL**

09/18/2025

J. PATRICK FOREMAN, P.E.
ELECTRICAL ENGINEER– LA LICENSE 22378

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1244 TEXAS AVENUE
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SCHEDULE OF DRAWINGS

NUMBER	TITLE
CS1	COVER SHEET
M0	MECHANICAL SCHEDULES
M1	MECHANICAL DEMOLITION FLOOR PLAN
M2	MECHANICAL RENOVATION FLOOR PLAN
M3	MECHANICAL DIAGRAMS AND DETAILS
E1	ELECTRICAL DEMOLITION FLOOR PLAN
E2	ELECTRICAL RENOVATION FLOOR PLAN
E3	ELECTRICAL SCHEDULES, DETAILS AND SITE PLAN
S1	STRUCTURAL DEMOLITION AND RENOVATION FLOOR PLANS AND DETAILS

SECTION 01 01 00 - SUMMARY OF THE WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PROJECT/WORK IDENTIFICATION

A. General: Project name is ***"SHREVEPORT MUNICIPAL COURTS BUILDING HVAC RENOVATIONS 1244 TEXAS AVENUE SHREVEPORT, LA 71101"*** as shown on Contract Documents prepared by John J. Guth Associates, Inc. Drawings and Specifications are dated June 13, 2025**.**

B. Summary by References: Work of the contract can be summarized by references to the Contract, General Conditions, Supplementary Conditions, Specification Sections, Drawings, addenda and modifications to the contract documents issued as part of addenda subsequent to the initial printing of this project manual and including, but not necessarily limited to, printed material referenced by any of these. It is recognized that work of the Contract is also unavoidably affected or influenced by governing regulations, natural phenomenon, including weather conditions, and other forces outside the contract documents.

C. Abbreviated Written Summary: Briefly and without force and effect upon the contract documents, the work of the Contract can be summarized as follows:

1. The work includes removal of cooling towers, pumps, water cooled chillers and electrical. The project includes installation of new air cooled chillers, pumps, hydronic piping, and all associated architectural, electrical and structural work.

D. Sequence of Work: Sequence work for minimum interruption of the Owner's operation. Cooling outages shall be limited to times when the outdoor temperature is less than 55 degrees F or when the facility is not in use. Electrical outages must be limited to the hours of 12 midnight to 6 A.M., must be for a minimum time, and must be approved in advance by the Owner, including holidays, if necessary.

E. Utility Interruptions: Utility interruptions shall be held to a minimum and will be permitted only at times approved by the Owner. The Owner may require that any outages be during nights, weekends, holidays, etc. Provide any required overtime work at no additional cost to the Owner.

F. Completion Date: As required by Instructions to Bidders, the Contractor is required to fully complete construction of project within specified number of days. Contractor shall furnish sufficient forces, construction material and equipment, and work such hours, including weekend and night shifts as may be necessary to ensure that completion of project occurs by the contractual completion date. If, in the opinion of the Architect and Owner, Contractor falls behind progress schedule, Contractor shall take steps as may be necessary to improve his progress by such means as increasing number of men, number of shifts, days of work, and/or

amount of construction plant, all without additional cost to Owner. If access to building is required at other than normal building hours, Contractor shall make arrangements with Owner.

1.3 CONTRACTOR USE OF PREMISES

A. General: The Contractor shall limit his use of the premises to the work indicated, so as to allow for Owner occupancy with minimum interruptions.

B. Use of the Site: Confine operations at the site to the areas permitted under the Contract. Portions of the site beyond areas on which work is indicated are not to be disturbed. Conform to site rules and regulations affecting the work while engaged in project construction.

C. Keep existing driveways and entrances serving the premises clear and available to the Owner and his employees at all times. Do not use these areas for parking or storage of materials.

D. Do not unreasonably encumber the site with materials or equipment. Confine stockpiling of materials and location of storage sheds to the areas approved by Owner. If additional storage is necessary, obtain and pay for such storage off-site. The Owner will not make payments for materials stored off-site unless they are stored in a licensed, bonded and insured warehouse facility.

E. Lock automotive type vehicles, such as passenger cars and trucks and other mechanized or motorized construction equipment, when parked and unattended, so as to prevent unauthorized use. Do not leave such vehicles or equipment unattended with the motor running or the ignition key in place.

F. Use of existing toilets within the buildings by the Contractor and his personnel or sub-contractors will **not** be permitted. **The Contractor shall provide portable toilet facilities. The toilet shall be located where directed by the facility manager.**

G. All existing plumbing fixtures, including floor drains, shall be protected from demolition and construction debris. At project closeout all fixture drains shall be cleaned and restored to proper operation. In addition all plumbing vents receiving A/C condensate shall be cleaned and restored to proper operation.

H. Remove all demolition debris from work areas daily and sweep broom clean. Place refuse in contractor's dumpster.

I. Remove all packaging (boxes, pallets, plastic wrap etc.) from new equipment and materials and place in contractor provided dumpster or remove from site daily.

J. The Owner and/or Architect/Engineer will visit the site weekly. The Owner and/or Architect/Engineer will notify the contractor, by a warning, in writing, of any areas not in compliance with the requirements for a clean construction site. The owner reserves the right to obtain the services of cleaning contractors, whose cost of services **shall** be deducted from the contract amount in the event the contractor does not comply with Owner/Architect/Engineer's warnings.

K. General Requirements: Observe no smoking/tobacco rules. All personnel must wear shirts.

L. Asbestos: No asbestos-containing materials have been identified on items that are indicated to be disturbed. If asbestos-containing materials are encountered, comply with the following:

1. Upon encountering any previously unidentified materials which he suspects may contain asbestos, the Contractor shall immediately cease all work in the immediate vicinity of the suspected materials and notify the Designer and the Owner. The Owner shall retain consultants to identify the suspected materials. Upon identification, the Owner reserves the right to contract separately for the removal, or require the Contractor to remove said materials in accordance with the following provision. In any case, the work shall be performed by a licensed and certified Abatement Contractor.
2. The Louisiana Department of Environmental Quality (D.E.Q.) has issued the Louisiana Emission Standards for Hazardous Air Pollutants. Where asbestos is encountered in a project, the Contractor shall comply with all laws and ordinances pertaining to asbestos handling and abatement, including the latest revision of LAC 33:111, Chapter 25, Subchapter F, Emission Standards for Hazardous Air Pollutants, LAC 33:111, Chapter 27, Asbestos Containing Materials in Schools and Public Buildings and LAC 33:111, Chapter 51, Subchapter M, Section 5151, Emission Standards for Asbestos.
3. Notification should be addressed to:

   Asbestos Coordinator
   Louisiana Department of Environmental Quality
   Air Quality Division
   Post Office Box 82135
   Baton Rouge, Louisiana 70884-2135

4. If the Owner chooses to remove any previously unidentified materials by utilizing different Contractors, the Contractor shall cooperate fully with the Owner's consultants and asbestos abatement Contractor permitting them full access to the project, and shall not resume work in the vicinity of the suspected materials until advised by the Designer and the Owner that it is safe to do so.
5. Refer to Article 7 of the Supplementary Conditions if the Contractor is required to do this work.

1.4 OWNER OCCUPANCY

A. Full Owner Occupancy: The Owner will occupy the site during the entire period of construction. Cooperate fully with the Owner and his representative during construction operations to minimize conflicts and to facilitate Owner usage. Perform the work so as not to interfere with the Owner's operations.

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION (Not applicable)

END OF SECTION

SECTION 01 04 50 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for cutting and patching.

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

1. Requirements of this Section apply to mechanical and electrical installations. Refer to Division 23 and Division 26 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

C. Demolition of selected portions of the building for alterations is included in Division 1 Section 01 73 20, "Selective Demolition."

1.3 SUBMITTALS

A. Cutting and Patching Proposal: Where approval of procedures for cutting and patching is required before proceeding, submit a proposal describing procedures well in advance of the time cutting and patching will be performed and request approval to proceed. Include the following information, as applicable, in the proposal:

1. Describe the extent of cutting and patching required and how it is to be performed; indicate why it cannot be avoided.
2. Describe anticipated results in terms of changes to existing construction; include changes to structural elements and operating components as well as changes in the building's appearance and other significant visual elements.
3. List products to be used and firms or entities that will perform Work.
4. Indicate dates when cutting and patching is to be performed.
5. List utilities that will be disturbed or affected, including those that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.
6. Where cutting and patching involves addition of reinforcement to structural elements, submit details and engineering calculations to show how reinforcement is integrated with the original structure.
7. Approval by the Architect to proceed with cutting and patching does not waive the Architect's right to later require complete removal and replacement of a part of the Work found to be unsatisfactory.

1.4 QUALITY ASSURANCE

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

1. Foundation construction.
2. Bearing and retaining wall.
3. Structural concrete.
4. Structural steel.
5. Lintels.
6. Timber and primary wood framing.
7. Structural decking.
8. Stair systems.
9. Miscellaneous structural metals.
10. Exterior curtain wall construction.
11. Equipment supports.
12. Piping, ductwork, vessels and equipment.
13. Structural systems of special construction in Division 13 Sections.

B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.

1. Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related systems:

a. Shoring, bracing, and sheeting.
b. Primary operational systems and equipment.
c. Air or smoke barriers.
d. Water, moisture, or vapor barriers.
e. Membranes and flashings.
f. Fire protection systems.
g. Noise and vibration control elements and systems.
h. Control systems.
i. Communication systems.
j. Conveying systems.
k. Electrical wiring systems.
l. Special construction specified by Division 13 Sections.

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 INSPECTION

A. Before cutting existing surfaces examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.

1. Before proceeding, meet at the site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

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

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

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

3.3 PERFORMANCE

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

1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

B. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations.

1. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
3. Cut through concrete and masonry using a cutting machine such as carborundum saw or diamond core drill.
4. Comply with requirements of applicable Sections of Division-1 where cutting and patching requires excavating and backfilling.
5. By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated or abandoned. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.

    a. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken containing the patch, after the patched area has received primer and second coat.

4. Patch, repair or rehang existing ceilings as necessary to provide an even plane surface of uniform appearance.

3.4 CLEANING

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

END OF SECTION

SECTION 01 09 00 - DEFINITIONS AND STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF REQUIREMENTS

A. General: This section specifies procedural and administrative requirements for compliance with governing regulations and codes and standards imposed upon the work. These requirements include obtaining permits, licenses, inspections, releases, and similar documentation, as well as payments, statements, and similar requirements associated with regulations, codes, and standards.

B. The term "Regulations" is defined to include laws, statutes, ordinances, and lawful orders issued by governing authorities, as well as those rules, conventions, and agreements within the construction industry which effectively control the performance of the work regardless of whether they are lawfully imposed by governing authority or not.

1.3 DEFINITIONS

A. General Explanation: Certain terms used in Contract Documents are defined in this Article. Definitions and explanations contained in this Section are not necessarily complete, but are general for the work to extent that they are not stated more explicitly in another element of the Contract Documents.

B. General Requirements: Provisions and requirements of other Division 1 Sections apply to the entire work of the Contract and, where so indicated, to other elements which are included in the project.

C. Indicated: The term "indicated" is a cross-reference to graphic representations, notes, or Schedules on the Drawings, to other paragraphs or Schedules in the Specifications, and to similar means of recording requirements in Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for the purpose of helping the reader locate the cross-reference, and no limitation of location is intended except as specifically noted.

D. Directed, Requested, Etc.: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," "accepted," and "permitted" mean "directed by the Architect," "requested by the Architect," and similar phrases. However, no such implied meaning will be interpreted to extend the Architect's responsibility into the Contractor's area of construction supervision.

E. Approve: Where used in conjunction with the Architect's response to submittals, requests, applications, inquiries, reports, and claims by the Contractor, the term "approved" will be held to limitations of the Architect's responsibilities and duties as specified in General and Supplementary Conditions. In no case will the Architect's approval be interpreted as a release

of the Contractor from responsibilities to fulfill requirements of Contract Documents or acceptance of the work, unless otherwise provided by requirements of the Contract Documents.

F. Project Site: The term "project site" means the space available to the Contractor for performance of the work, either exclusively or in conjunction with others performing other construction as part of the project. The extent of the project site is shown on the Drawings, and may or may not be identical with the description of the land upon which the project is to be built.

G. Furnish: The term "furnish" is used to mean "supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, and similar operations."

H. Install: The term "install" is used to describe operations at project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimensions, finishing, curing, protecting, cleaning, and similar operations."

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

J. Installer: The "installer" is "the entity" (person or firm) engaged by the Contractor, its subcontractor, or sub-subcontractor for performance of a particular element of construction at the project site, including installation, erection, application, and similar required operations. It is a requirement that installers are experienced in the operations they are engaged to perform.

K. Testing Laboratory: A "testing laboratory" is an independent entity engaged to perform specific inspections or tests of the work, either at the project site or elsewhere; and to report and (if required) interpret results of those inspections or tests.

1.4 INDUSTRY STANDARDS

A. Applicability of Standards: Except where more explicit or stringent requirements are written into the Contract Documents, applicable construction standards have the same force and effect as if bound into or copied directly into the Contract Documents. Such industry standards are made a part of the Contract Documents by reference. Individual specification sections indicate which codes and standards the Contractor must keep available at the project site for reference.

B. Referenced standards (standards referenced directly in the Contract Documents) take precedence over standards that are not referenced but generally recognized in the industry for applicability to the work.

C. Unreferenced Standards: Except as otherwise limited by the Contract Documents, standards not referenced but recognized in the construction industry as having direct applicability will be enforced for performance of the work. The decision as to whether an industry code or standard is applicable, or as to which of several standards are applicable, is the sole responsibility of the Architect.

D. Publication Dates: Except as otherwise indicated, where compliance with an industry standard is required, comply with standard in effect as of date of Contract Documents.

E. Conflicting Requirements: Where compliance with two or more standards is specified, and where these standards establish different or conflicting requirements for minimum quantities or

quality levels, the most stringent requirement will be enforced, unless the Contract Documents specifically indicate otherwise. Refer requirements that are different, but apparently equal, and uncertainties as to which quality level is more stringent to the Architect for a decision before proceeding.

F. Minimum Quantities or Quality Levels: In every instance, the quantity or quality level shown or specified is intended to be the minimum to be provided or performed. Unless otherwise indicated, the actual work may either comply exactly, within specified tolerances, with the minimum quantity or quality specified, or may exceed that minimum within reasonable limits. In complying with these requirements, the indicated numeric values are minimum or maximum values, as noted, or as appropriate for the context of the requirements. Refer instances of uncertainty to the Architect for decision before proceeding.

G. Copies of Standards: The Contract Documents require that each entity performing work be experienced in that part of the work being performed. Each entity is also required to be familiar with industry standards applicable to that part of the work. Copies of applicable standards are not bound with the Contract Documents.

H. Where copies of standards are needed for proper performance of the work, the Contractor is required to obtain such copies directly from the publication source.

I. Although copies of standards needed for enforcement of requirements may be required submittals, the Architect reserves the right to require the Contractor to submit additional copies as necessary for enforcement of requirements.

J. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where acronyms or abbreviations are used in specifications or other Contract Documents they are defined to mean the recognized name of the trade association, standards generating organization, governing authority or other entity applicable to the context of the text provision. Refer to the "Encyclopedia of Associations," published by Gale Research Company, available in most libraries.

1.5 SUBMITTALS

A. Permits, Licenses, and Certifications: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence and records established in conjunction with compliance with standards and regulations bearing upon performance of the work. Local Building Permits are not required.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 20 00 - PROJECT MEETINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED SECTIONS

A. Construction Schedule: Division 1 Section 01 30 00, "Submittals."

1.3 PRE-CONSTRUCTION MEETING

A. After notification that the contract has been executed, the Engineer shall arrange with the Owner, User Agency, and Contractor, and conduct a pre-construction conference to be held at the project site. The Contractor shall be responsible to see that his Project Foreman and subcontractors are in attendance, and shall furnish the following to the Architect, Owner, and User Agency:

1. Schedule of values (Division 1 Section 01 30 00, "Submittals").
2. List of Subcontractors and major material suppliers (Division 1 Section 01 30 00, "Submittals").
3. Construction Schedule (Division 1 Section 01 30 00, "Submittals").
4. Waste Management Plan (Division 1 Section 01 73 20 “Selective Demolition”

B. The following shall serve as a minimum agenda:

1. Distribute and discuss the list of major subcontractors.
2. Tentative construction schedule.
3. Critical work sequencing.
4. Use of premises.
5. Relation and coordination of major subcontractors.
6. Designation of responsible personnel.
7. Processing of field decisions and change orders.
8. Submittal of shop drawings, project data, and samples.
9. Procedures for maintaining record documents.
10. Safety and first-aid procedures.

1.4 PROGRESS MEETINGS

A. Engineer shall schedule and administer monthly progress meetings during the construction period. Required attendance shall be:

1. Engineer and his professional consultants, as needed.
2. Contractor.

3. Subcontractors, as appropriate.
4. Suppliers, as appropriate.

B. The Owner shall be notified of such meetings and may be represented. It shall be the principal purpose of these meetings or conferences to effect coordination, cooperation, and assistance in every practical way to the end of maintaining progress of the project on schedule and completing the project within the contract time.

C. Suggested Agenda:

1. Review work progress since last meeting.
2. Note field observations, problems, and decisions.
3. Review off-site fabrication problems.
4. Revise construction schedule, as indicated.
5. Review submittal schedules, expedite as required to maintain schedule.
6. Review changes proposed by Owner for effect on construction schedule and effect on completion date.

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION (Not applicable)

END OF SECTION

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This 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.

B. 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 the Project.

B. 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.

1. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each Alternate. Indicated if Alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to Alternates.
2. Execute accepted Alternates under the same conditions as other work of the Contract.
3. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in Schedule contain requirements for materials necessary to achieve the work described under each Alternate.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

1. Provide emergency generator and all associated demolition and renovation work.

END OF SECTION

SECTION 01 30 00 - SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Additional Submittal Requirements: Division 0 Section "General Conditions of the Contract for Construction (AIA-A201)."

B. Closeout Submittals: Division 1 Section 01 70 00, "Project Closeout."

1.3 CONSTRUCTION SCHEDULE

A. General: As required by Article 3.10 of the General Conditions, Contractor shall, within ten days after signing the Contract, prepare and submit to Architect for information purposes, a practical schedule showing order in which Contractor proposes to carry on work, dates on which he will start salient features of work, and contemplated dates for completion. Schedule shall meet or better construction time included on Instructions to Bidders.

B. Form of Schedule: Provide in form of horizontal bar chart. Provide separate horizontal bar column for each trade or operation. Order shall be Table of Contents from Project Manual or the chronological order of beginning of each item of work. Submit three copies to Architect.

C. Content of Schedule: Provide complete sequence of construction activity, dates for beginning, and completion of each element of construction. Identify work of separate phases or other logically grouped activities. Show projected percentage of completion for each item of work as of first day of each month.

1.4 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

A. Shop Drawings:

1. Submit prints of Original Drawings prepared by Contractor, Subcontractor, Supplier, or Distributor which illustrate same portion of work; showing fabrication, layout setting, or erection details.
2. Minor corrections needed on prints will be made by Architect; for extensive modifications, prints may be returned to Contractor for correction. When reviewed, Architect will retain two copies for record and return remaining copies to General Contractor for distribution. Reproducible copies of Shop Drawings will not be reviewed.

B. Product Data:

1. Manufacturer's Standard Drawings: Modify Drawings to delete information which is not applicable to project. Supplement standard information to provide additional information applicable to project.
2. Manufacturer's Catalog Sheet, Brochures, Diagrams: Clearly mark each copy to identify pertinent materials, product, or models. Show dimensions and clearances required. Show performance characteristics and capacities.

C. Samples:

1. Physical examples to illustrate materials, equipment, or workmanship to establish standards by which completed work is judged.
2. Office samples shall be of sufficient size and quantity to clearly illustrate functional characteristics of product or material and full range of color and texture samples.

D. General Submission Requirements:

1. Quantities: Submit the number of copies of product data and Shop Drawings that the Contractor requires for distribution, plus two copies which will be retained by the Architect. Quantity of samples required shall be as specified in Specification Section for respective product.

E. Submittals shall include:

1. Project title.
2. Names of Contractor, Subcontractor, Supplier, Manufacturer.
3. Identification of Product.
4. Relation to adjacent structure or materials.
5. Field dimensions.
6. Reference to Architect's drawing numbers, Specification Section, room numbers, structural framing marks, and/or numbers.
7. Applicable standards: e.g., ASTM.
8. Blank space for Architect's stamp.
9. Identification of deviations from Contract Documents.
10. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of field measurements, and compliance with Contract Documents.

F. These requirements are in addition to those in Article 3.12 of General Conditions.

1.5 SCHEDULE OF VALUES

A. General: As required by Article 9.2 of General Conditions, submit to Architect a Schedule of Values at least ten days prior to submitting first Application for Payment. Upon request by Architect, support values with data that will substantiate their correctness. Use Schedule of Values only as basis for Contractor's Application for Payment. Itemize separate line item cost for work required by each Section of this Specification.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 50 00 - TEMPORARY FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 TEMPORARY UTILITIES

A. Temporary Services: Contractor shall arrange and pay for all hook-ups, meters for all temporary utility services for construction, and, as necessary, for the proper and expeditious prosecution of the work. The Contractor shall provide piping, conduit, etc., and make all connections to existing services and sources of supply, and pay all charges for same. The Contractor shall pay for all utilities usage during the time of construction directly to the utility company. Contractor shall provide all labor, materials, equipment and appliances necessary for the complete installation, operation, and maintenance of all temporary service systems and facilities. Contractor shall remove all such temporary installations and connections when no longer required, or when directed.

B. Electric power used in existing buildings for operating tools and testing of equipment will be furnished by the User Agency at no charge, but the Contractor shall provide any required temporary facilities and remove same when no longer required.

1.3 BARRICADES, LIGHTS, AND WATCHMEN

A. Where the work is constructed in or adjacent to any road, parking area, or public place, the Contractor shall, at his own cost and expense, furnish and erect such barricades, lights, and danger signals, shall provide such watchmen, and take such other precautionary measures for the protection of persons and property and of the work, as are necessary. At the completion of construction, all barricades and all traces thereof, shall be removed, holes filled, paving repaired, etc.

1.4 TEMPORARY LADDERS, SCAFFOLDS, HOISTS, ETC.

A. Contractor shall provide and maintain all equipment such as temporary ladders, ramps, scaffolds, hoists, runways, derricks, chutes, etc., as required for the proper execution of the work.

B. All such apparatus, equipment, and construction shall meet all requirements of the Labor Law and other Federal and State Laws applicable thereto.

C. Contractor shall provide, maintain, and remove at completion of work all scaffolding required for the execution of the work. Erect scaffolding on the side of the wall on which work occurs. No scaffolding shall be built into any work.

D. Scaffolding for all other work shall be provided, installed, maintained, and removed at completion of work by the trade requiring such scaffolding.

1.5 STORAGE OF MATERIALS

A. Refer to Division 1 Section 01 60 00, "Material and Equipment."

B. Building materials, Contractor's equipment, etc., shall be stored on the premises in a manner so that it may be observed at any time by the Architect.

C. All materials affected by the weather shall be covered and protected and kept free from damage while being transported to the site.

D. Subcontractors desiring to store materials scheduled for immediate use in the building may do so only in locations as directed by the Prime Contractor and approved by the Architect.

1.6 SANITARY FACILITIES

A. Provide single-occupant, self-contained toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed with a glass fiber reinforced polyester shell or similar non-absorbent material. Contractor shall keep such place in sanitary condition and remove at completion of contract. Facility fixtures shall not be used by workmen. Comply with all applicable codes, utility, and safety regulations.

1.7 LAYING-OUT OF WORK

A. Contractor shall compare all drawings and verify all dimensions, and shall take any and all measurements necessary to verify the drawing dimensions in relation to conditions already established at the job site before laying out the work. Contractor will be held responsible for subsequent errors which could have been avoided by such checking.

B. Any discrepancy which will affect the proper layout of the work shall be immediately called to the attention of the Architect by the Contractor. No work shall proceed until such discrepancy has been rectified as directed by the Architect.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 60 00 - MATERIAL AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Supplementary Conditions, apply to the work specified in this Section. Refer to other Division 1 Sections for additional requirements which may affect the work of this Section.

1.2 RELATED REQUIREMENTS

A. Warranty: General Conditions, 3.5.

B. Substitutions: Division 0 Section 00100, "Instructions to Bidders."

1.3 GENERAL PRODUCT REQUIREMENTS

A. Provide products, materials, and equipment which comply with the requirements and which are undamaged and unused at the time of installation, and which are complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and for the intended use and effect. Do not use material or equipment for any purpose other than that for which it is designed or specified.

1.4 MANUFACTURER'S INSTRUCTIONS

A. When Contract Documents require that installation of work shall comply with Manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including two copies to Engineer. Maintain one set of complete instructions at the job site during installation and until completion.

B. Handle, install, connect, clean, condition, and adjust product in strict accord with such instructions and in conformity with specified requirements. Should job conditions or specified requirements conflict with Manufacturer's instructions, consult with Engineer for further instructions. Do not proceed with work without clear instructions.

C. Perform work in accord with Manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

1.5 TRANSPORTATION AND HANDLING

A. Arrange deliveries of products in accord with construction schedules, coordinate to avoid conflict with work and conditions at the site. Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible. Immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals, and those products are properly protected and undamaged.

B. Provide equipment and personnel to handle products by method to prevent soiling or damage to products or packaging.

1.6 STORAGE AND PROTECTION

A. Store products in accord with Manufacturer's instructions, with seals and labels intact and legible. Store products subject to damage by the elements in weathertight enclosures. Maintain temperature and humidity within the ranges required by Manufacturer's instructions.

B. Exterior Storage: Store fabricated products above the ground, on blocking or skids, prevent soiling or staining. Cover products which are subject to deterioration with impervious sheet coverings, provide adequate ventilation to avoid condensation. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.

C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration.

D. Protection After Installation: Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove when no longer needed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 70 00 - PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF REQUIREMENTS

A. Definitions: Project closeout is the term used to describe certain collective project requirements, indicating completion of the work that is to be fulfilled near the end of the contract time in preparation for final acceptance and occupancy of the work by the Owner, as well as final payment to the Contractor and the normal termination of the Contract.

B. Specific requirements for individual units of work are included in the appropriate Sections in Division 2 through 26.

1.3 CLOSEOUT SUBMITTALS

A. Submit to Architect for review, four copies each of the following items and other items as specified. Approved copies will be transmitted to Owner by Architect.

B. Operation and Maintenance Data: Refer to Article titled "Operation and Maintenance Manuals" hereinafter this Section.

C. Record Drawings: Refer to "Record Drawings" article hereinafter this Section (one copy required).

D. Release of Liens: AIA Form G706A, refer to Article 9.10 of the General Conditions.

E. Consent of Surety to Final Payment: AIA Form G707, refer to Article 9.10 of General Conditions.

1.4 OPERATION AND MAINTENANCE MANUALS

A. Purpose: Operation and Maintenance Manuals will be used for training of, and use by, the Owner and his employees in the operation and maintenance of the systems and related equipment as specified below. A separate manual or chapter shall be prepared for instructions of each class of equipment or system.

B. Contents: Manuals shall contain the following information on each item of equipment:

1. Routine maintenance operations.
2. Complete operating instructions.
3. Service instructions.

4. Complete control wiring.
5. Emergency procedure.
6. Equipment warranties or guarantees.
7. A complete list of equipment with all nameplate data both in the manual and in a Microsoft Excel file.
8. A compact disk (CD) with PDF files of the operation, maintenance and parts list for all major equipment.

C. Preparation: The manuals shall be prepared to provide for the optimum operation and maintenance of the various systems outlined above and equipment forming a part of these systems. Manufacturer's literature and data shall be that of the actual equipment installed under contract for the particular facility. Each manual containing the systems noted shall be bound in one or more volumes as required for convenience in handling.

1.5 INSTRUCTIONS

A. Instruct Owner's personnel in operation of all systems, mechanical, electrical, and other equipment in accordance with respective Specification Sections and Manufacturer's instructions.

1.6 RECORD DRAWINGS

A. Mark-Up Procedure: During progress of work, maintain a white-print set of Contract Drawings and Shop Drawings, with mark-up of actual installations which vary substantially from the work as originally shown. Mark whatever drawing is most capable of showing actual physical condition, fully and accurately. Where Shop Drawings are marked up, cross-reference on Contract Drawings at corresponding location. Mark with erasable colored pencil, using separate colors where feasible to distinguish between changes for different categories of work at same general location. Mark-up important additional information which was either shown schematically or omitted from original drawings. Give particular attention to information on work concealed, which would be difficult to identify or measure and record at a later date. Note alternate numbers, change order numbers, and similar identification.

B. Submittal: At the conclusion of the Contract, the final set of record prints shall be prepared by the Engineer from information obtained from the Contractor.

1.7 CLEANING UP

A. No rubbish shall be allowed to accumulate or be allowed to remain on the premises or job site beyond a reasonable length of time. Trash shall be removed from within the building and from the site daily. Particular attention shall be given to these requirements.

B. All rubbish shall be removed by means of chutes, hoists, or receptacles. Under no circumstances shall any rubbish or waste be dropped or thrown from one level to another within or outside the buildings. Immediately after unpacking materials, all packing case lumber and other packing materials, excelsior, wrappings, and other like flammable wastes shall be collected and removed from the buildings and premises. Burning of trash on the site will not be permitted.

C. Care shall be taken by all workmen not to mark, soil, or otherwise deface any finishes. In the event that any finishes become defaced in any way by mechanics or workmen, the Contractor or any of his Subcontractors shall clean and restore such surfaces to their original condition.

D. Each Subcontractor engaged upon the work shall bear his full responsibility for leaving all work in a clean and proper condition, satisfactory to the Owner and the Architect.

E. Final Cleaning: Beside the general broom cleaning, the following cleaning shall be done just before final acceptance of the work:

1. Remove all labels not intended for permanent installation.
2. Remove all marks, stains, fingerprints, and other soil or dirt from all painted work, and clean as required to leave in first class condition.
3. Clean all equipment removing all stains, paint, dirt, and dust.

F. Upon completion of the work, the Contractor will be required to thoroughly clean the building site and surrounding ground, and all trash and rubbish left by him in the course of construction of the work shall be removed and disposed of off the site of work.

G. Contractor shall haul off all debris from the site to legal disposal areas and dispose of all debris and excess materials resulting from project work. No burning of material or debris shall be done at site. In hauling material from the site, it shall be the responsibility of the Contractor to prevent debris from dropping from vehicles and littering the site and any public thoroughfare.

1.8 SUBSTANTIAL COMPLETION

A. Inspection and other procedures for Contractor to follow to process Contract through Substantial Completion are specified in General and Supplementary Conditions, Articles 9.8 and 9.9.

1.9 FINAL INSPECTION

A. Contractor shall submit written certification that:

1. Contract Documents have been reviewed.
2. Project has been inspected for compliance with Contract Documents.
3. Work has been completed in accordance with Contract Documents.
4. Equipment and systems have been tested in presence of Owner's Representative and are operational.
5. Project is completed, and ready for final inspection.

B. Engineer will make final inspection after receipt of certification.

C. Should Engineer consider that work is not finally complete, he will notify Contractor, in writing, stating reasons. Contractor shall take immediate steps to remedy the stated deficiencies, and send second written notice to Architect certifying that work is complete. Architect will reinspect work.

1.10 FINAL PAYMENT

A. Application for final payment shall be submitted together with documents specified in General and Supplementary Conditions, Article 9.10 "Final Completion and Final Payment."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 73 20 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Individual trade sections and the drawings indicate specifically the work required.

C. It should be noted that The General Conditions AIA 201, provide for the following:

1. Supervision and Construction Procedures
2. Cutting and Patching
3. Protection of Persons and Property

1.2 DESCRIPTION OF WORK

A. The extent of selective demolition work is generally indicated on drawings. Provide all required materials, equipment and labor to execute the required selective demolition.

B. Demolition Work: Demolition requires the selective removal and subsequent off-site disposal of the following installations:

1. Removal of chillers, pumps, cooling towers and associated piping, electrical and controls.
2. Removal of concrete cooling tower supports.

C. Items Not to be Removed or Disturbed

D. The architect and/or engineer is to be contacted before removal, cutting, disturbing, or tampering in any manner with any item which has or may have any structural property, including walls, beams, joists, lintels, columns, sills, window mullions, etc.

E. Asbestos-Containing Materials: The following are asbestos-containing or asbestos-contaminated installations which are not to be disturbed during work of this section:

1. Vinyl asbestos floor tile (For area not included to be abated)
2. Salvaged equipment and materials
3. Materials and equipment designated for salvage shall be removed and stored on site as directed, or reinstalled where indicated.

F. Related work specified elsewhere:

1. Relocation of pipes, conduits, ducts, other mechanical and electrical work are specified by respective trades.

1.3 SUBMITTALS:

A. Waste Management Plan: Submit plan prior to beginning demolition.

1. Plan shall include the following:

a. List of items to be salvaged for reuse on site.
b. List of items to be removed for owners use Salvaged items shall be set aside on site in a location to be determined by the facility manager.
c. Plan for final disposition of chillers, pumps, cooling towers and refrigerant (recycled, reused, or disposed in landfill, etc.)

B. Schedule: Submit schedule indicating proposed methods and sequence of operations for demolition work to Owner's Representative for review prior to commencement of work. Include coordination for shut-off, capping, and continuation of utility services as required, together with details for dust and noise control protection.

1. Provide detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.
2. Coordinate with Owner's continuing occupation of portions of existing building.

1.4 JOB CONDITIONS:

A. Occupancy: Owner will be continuously occupying areas of the building immediately adjacent to areas of selective demolition. Conduct selective demolition work in manner that will minimize need for disruption of Owner's normal operations. Provide minimum of 72 hours advance notice to Owner of demolition activities which will impact Owner's normal operations.

B. Condition of Structures: Owner assumes no responsibility for actual condition of items or structures to be demolished.

C. Partial Demolition and Removal: Items indicated to be removed but of salvable value to Contractor may be removed from structure as work progresses. Transport salvaged items from site as they are removed.

1. Storage or sale of removed items on site will not be permitted.

D. Protections: Provide temporary barricades and other forms of protection as required to protect Owner's personnel and general public from injury due to selective demolition work.

1. Provide protective measures as required to provide free and safe passage of Owner's personnel and general public to and from occupied portions of building.
2. Erect temporary covered passageways as required by authorities having jurisdiction.
3. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished, and adjacent facilities or work to remain.
4. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.
5. Protect floors with suitable coverings when necessary.

6. Construct temporary insulated solid dustproof partitions where required to separate areas where noisy or extensive dirt or dust operations are performed. Equip partitions with dustproof doors and security locks if required.
7. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces, and installation of new construction to ensure that no water leakage or damage occurs to structure or interior areas of existing building.
8. Remove protections at completion of work.

E. Damages: Promptly repair damages caused to adjacent facilities by demolition work at no cost to Owner.

F. Explosives: Use of explosives will not be permitted.

G. Utility Services: Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.

1. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, acceptable to the Owner.

H. Environmental Controls: Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level. Comply with governing regulations pertaining to environmental protection.

1. Do not use water when it may create hazardous or objectionable conditions, such as ice, flooding, and pollution.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION

3.1 INSPECTION:

A. Prior to commencement of selective demolition work, inspect areas in which work will be performed. Photograph existing conditions of structure, surfaces, equipment or of surrounding properties which could be misconstrued as damage resulting from selective demolition work. Submit copies of photographs to Owner's Representative prior to starting work. If documentation is not submitted to the Owner's Representative prior to start of work the Contractor assumes all responsibility for existing conditions and the repair during or at the completion of the work.

3.2 PREPARATION:

A. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement or collapse of structures to be demolished and adjacent facilities to remain.

1. Cease operations and notify the Owner's Representative immediately if safety of structure appears to be endangered. Take precautions to support structure until determination is

made for continuing operations.

B. Cover and protect furniture, equipment and fixtures to remain from soiling or damage when demolition work is performed in rooms or areas from which such items have not been removed.

C. Erect and maintain dustproof partitions and closures as required for preventing the spread of dust or fumes to occupied portions of the building.

1. Provide weatherproof closures for exterior openings resulting from demolition work.

D. Work Site Isolation: Isolate the site of selective demolition work from occupied portions of the building prior to start of demolition activities. Work site isolation includes:

1. Erection of Critical Barriers as described in Section CONSTRUCTION FACILITIES & TEMPORARY CONTROLS
2. Installation and operation of Pressure Differential and Ventilation System.

E. Locate, identify, stub off and disconnect utility services that are not indicated to remain.

1. Provide by-pass connections as necessary to maintain continuity of service to occupied areas of building. Provide minimum of 72 hours advance notice to Owner if shutdown of service is necessary during change-over.

3.3 DEMOLITION:

A. Perform selective demolition work in a systematic manner. Use such methods as required to complete work indicated on Drawings in accordance with demolition schedule and governing regulations.

B. If unanticipated mechanical, electrical or structural elements which conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit report to Owner's Representative in written, accurate detail. Pending receipt of directive from Owner's Representative rearrange selective demolition schedule as necessary to continue overall job progress without delay.

C. Asbestos contamination: If a disturbance of asbestos-containing materials occurs stop all work and notify the Owner's Representative at once. Work may not resume until the Owner's Representative issues a written clearance to resume work.

3.4 DISPOSAL OF DEMOLISHED MATERIALS:

A. Remove debris, rubbish and other materials resulting from demolition operations from building site. Transport and legally dispose of materials off site.

1. If hazardous materials are encountered during demolition operations, comply with applicable regulations, laws, and ordinances concerning removal, handling and protection against exposure or environmental pollution.
2. Burning of removed materials is not permitted on project site.

3.5 CLEAN-UP AND REPAIR:

A. Upon completion of demolition work, remove tools, equipment and demolished materials from site.

1. The premises shall be kept clean and free of debris which may cause a health, safety or other project related problem. Remove protections and leave interior areas broom clean.

B. Repair demolition performed in excess of that required. Return structures and surfaces to remain to condition existing prior to commencement of selective demolition work. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.

END OF SECTION

SECTION 02 30 00 - EARTHWORK

PART 1 - GENERAL

1.1 RELATED WORK

A. Testing Laboratory Services: Division 1 Sections.

B. Site Clearing: Division 02 Sections.

1.2 SYSTEM DESCRIPTION

A. Excavation, backfilling, filling, and grading for the following:

1. Foundation Structures.
2. Site Work Concrete.
3. Site Improvements.

1.3 SUBMITTALS

A. Test Reports. In accordance with Division 1 Sections, the Testing Laboratory shall submit the following reports:

1. Liquid limits and plasticity index on borrow or existing material to be used as a base beneath concrete slabs, paving, and walks. Approval of tests on base material shall be obtained prior to placement of base material.
2. Field soil density test reports.

B. Topsoil Report: Submit copies of soil analysis report for stock piled on-site and proposed new off-site topsoil if on-site topsoil is unacceptable or if insufficient quantity.

1. Before placement of topsoil, furnish a soil analysis made by an approved soil testing laboratory stating the percentages of silt, clay, sand, and organic matter, the pH and the mineral content of the topsoil.

1.4 SITE CONDITIONS

A. Unknown Utilities & Obstacles: If any unknown or uncharted utilities are encountered during excavation, promptly notify the utility company and the Engineer and if no emergency exists wait for the Engineers instructions before proceeding.

1. If it is ascertained that such utility line has been abandoned, the Contractor shall properly cap the line at a depth of 12 inches or more below finish grade.
2. Unknown Obstacles: Should Contractor encounter any unforeseen major obstacle in excavation, it is the intention of the Owner to cause an investigation to be made to determine a course of action that will provide for a fair and equitable solution.

PART 2 - PRODUCTS

2.1 BACKFILL

A. Shall be approved sand-clay mixture, free of vegetation, debris, waste, and other deleterious matter. Stones larger than 2 inches, maximum dimension, shall not be used in upper 6 inches of fill. Material removed from project excavation, if approved, shall be used for backfill. Provide any additional fill material from off-site source as necessary to produce required grades.

2.2 SELECT FILL

A. Shall be sandy clay or clayey sand (CL or SC groups as per ASTM D-2487). Excavated material may be used from the Project site provided it complies with the following requirements or is made to comply through the use of approved admixtures such as sand or lime.

1. Liquid Limit: 35 max. (AASHTO T-89).
2. Plasticity Index: 5 to 15 max. (AASHTO T-90).
3. The fill shall contain no stones larger than 2 inches in any dimension, or organic matter and debris.

2.3 TOP SOIL

A. A natural, fertile, friable soil possessing characteristics of representative productive soils in the vicinity with a minimum pH of 4. It shall not be excessively acid or alkaline or contain toxic substances which may be harmful to plant growth. It shall be free of weeds, seeds, lumps, stones, debris, roots, or similar substances larger than one inch. Soil may be used from the project site with approval from the Engineer provided it complies with these requirements.

2.4 TOPSOIL REMOVAL

A. Remove topsoil to its entire depth from the areas within lines of project limits 10 feet outside of foundation and from areas to be occupied by paving, walks, and from cut and fill areas. Pile topsoil in designated or approved locations where it will not interfere with building or utility operations. Areas to be stripped shall first be scraped clean of all brush, weeds, grass, roots, and other material that will interfere with lawn maintenance. Topsoil shall be reasonably free from subsoil, debris, and stones larger than one inch in diameter. The stored topsoil shall be left in piles to be used for finished grading.

2.5 PREPARATION – PROTECTION

A. Control of Water: The Contractor shall exercise reasonable care to maintain the site and all excavations free of water at all times especially in the area of and around the building. The contractor shall, after inspection, testing, and approval, fill all excavations and trenches as soon as possible, as specified.

1. Standing water shall not be allowed at the site and shall be removed within a reasonable period of time.

B. Existing Utilities: Before starting any excavation work, Contractor shall locate all existing utilities. Existing utilities to remain shall be protected at all times by approved methods. Damage to existing utilities as the result of Contractor's operations and/or improper protection shall be repaired immediately to the satisfaction of the utility company and/or the Owner without additional expense to the Owner.

C. Other Trades: Protect, as necessary to avoid damage, the equipment, materials, and the installations of other trades who are executing work currently with work of this Section until work of this Section has been completed.

D. Excavations and new work shall be maintained and protected from cave-ins, slides, settlement, and other injurious conditions by bracing, shoring, and other methods which will enable the work to be carried on safely and expeditiously.

2.6 EXCAVATION

A. Unclassified: All excavation shall be unclassified, which shall comprise and include the satisfactory removal and disposition of all materials excavated, regardless of the nature of the materials encountered, at no additional expense to the Owner. Neither the condition of the material at the time it is excavated nor the manner in which it is excavated will have any bearing on or will be given consideration in the classifying of the excavation.

B. Storage: Excavated material shall not be deposited in any manner that will endanger a partly finished structure or that may be detrimental to the work or adjacent facilities and structures in any way. Excavated material shall be handled in such manner as to allow all selected material to be used for backfilling and filling operations of this project. Excess material shall be removed from project site and legally disposed of by the Contractor.

C. Cuts. Excavations shall be cut accurately to the lines, levels, and dimensions necessary for the completion of all work as indicated and specified.

D. Unauthorized Excavation. Except for concrete footing and foundation work requiring soil bearing, all unauthorized excavations below the required depths shall be backfilled with approved material and compacted, as specified hereinafter, without additional expense to the Owner.

1. Unauthorized excavations below the required depths for concrete footing and foundation work requiring soil bearing shall be filled with approved concrete by extending the footing to the new depth, without additional expense to the Owner.

2.7 CRIBBING AND SHORING

A. Provide temporary and/or permanent cribbing and shoring as necessary to safely retain earth banks and protect excavations from caving and other damage. Responsibility for the design, installation, and maintenance of cribbing, sheathing, and shoring required by job conditions is the obligation of the Contractor. All temporary cribbing and shoring shall be removed and legally disposed of off the site when directed or when no longer necessary.

2.8 BACKFILL AND FILL

A. Preparation. Backfill excavations as promptly as work permits, but not until completion of following:

1. Completion of construction below finish grade including, where applicable, damp proofing and waterproofing.
2. Inspection, testing, approval, and recording locations of underground formwork.
3. Removal of concrete framework.
4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.
5. Removal of trash and debris.

2.9 PLACEMENT AND COMPACTION

A. Place backfill and fill materials in layers 6 inches to 8 inches thick in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Soil density requirements are specified herein this Section.

B. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content of the soil material. Compact each layer to the required percentage of maximum dry density or relatively dry for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

C. Place backfill and fill materials evenly adjacent to structures, to the required elevations. Take care to prevent wedging action of the backfill against structures by carrying the material uniformly around the structure to approximately the same elevation in each lift.

D. Provide and place additional earth fill materials needed to bring existing grades to new subgrades indicated in preparation for placing topsoil, paving, or other indicated construction.

E. Placement of Trench Fill: Trenches shall be compacted in 8 inches layers starting from the bottom.

2.10 COMPACTION AND SOIL TESTS

A. Quantity. The number and location of compaction and soil tests shall be determined by the Engineer, but shall be no less than three tests per 8 inches lift.

B. Payment: Refer to Division 0 Sections.

C. Test Requirements: Soil Density – degree of compaction of fill shall be the percent of maximum density as specified immediately hereinafter, density at or above optimum moisture content. Degree of compaction shall be as determined by ASTM D-698, standard Proctor and AASHTO T-238 (Nuclear Method field test). Each layer shall be compacted, tested, and approved before another layer is added.

2.11 SCHEDULE OF REQUIREMENTS

A. General: The percentages stated in following schedule refer to the soil density requirements as stated in preceding article "Test Requirements." Compaction requirements shall be considered to be uniform throughout for the indicated area: i.e., in cut, fill, and undisturbed soils.

B. Beneath Building

1. Subgrade: Grade (cut and/or fill) to elevations indicated. Add select fill to bring the grade up to required elevations and compact to 93 percent.
2. Finish-grade: Top layer to be type and thickness of soil material and compaction required for the specific area.

C. Pipe Trenches

1. Pipe shall be installed on 6 inches thick bed of sand fill. After piping has been tested, place an additional 6 inches layer of sand in trench. Minimum coverage of sand fill surrounding pipe in all directions shall be 6 inches. Compact sand to 93 percent. Place select fill on sand to top of subgrade elevation, compact to 93 percent.
2. Finish-grade: Top layer to be type and thickness of soil material and compaction required for the specific area.

D. Beneath Concrete Paving

1. Subgrade – Remove existing subgrade to 1’ minimum below existing grade under paving, use acceptable excavated soils or, add select fill to bring the grade up to required elevation and compact to 90 percent.

2. Fill to required finish grade with approved CL or SC soils and compact to 93 percent maximum density.

E. Lawns and Landscaped Areas

1. Subgrade: Grade (cut and/or fill) to the elevations required by the Drawings and Specifications. Use the existing soil from the site or add soil equal to the sites soil to bring the grade up to the required elevations and compact to the approximate density of the material soil at the site. The soil shall be free of all plant material, wood, trash, building materials, rock, and stones larger than one inch.
2. Finish-grade: Install a minimum of 4 inches thickness of top soil, grade to elevations required and compact to the approximate density of the material soil at the site.

F. Unsatisfactory Compaction: When testing agency reports that subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, recompact and retest until required density is obtained.

2.12 GRADING TOLERANCES

A. Grading (cut and/or fill) shall be to the elevations as shown and as specified. Unless closer tolerances are required, the maximum deviation from indicated or interpolated elevations shall be plus or minus 1 inch in ten feet.

B. Areas paved with concrete sidewalks: Grade to elevations coinciding with the bottom of the concrete paving which is specified to be furnished and installed under another Section. Maximum deviation from indicated or interpolated elevations shall be plus or minus 1/2 inch in ten feet.

C. Areas under concrete slabs on grade. Grade to elevations coincided with bottom of the capillary water barrier. Maximum deviation from indicated or interpolated elevations shall be plus 0 inches or minus 1/2 inch in ten feet.

D. Grass and Landscaped Areas. Rough grade to elevations indicated, less approximately 4 inches for placement of loose top soil obtained from the site or from approved sources from off the site. Approval shall be obtained before using material from the site. Just prior to completion of the project, all areas shall be raked, compacted if necessary, and finish graded to indicated elevations with a maximum deviation of plus or minus 1 inch. All areas shall be clean and free from debris and rocks.

E. Tolerances referred to above are not additive and can occur only within their specific length.

2.13 PLACING GRANULAR BASE

A. Place granular based over subgrade where indicated or specified to required thickness. Spread evenly over the area and compact to maximum density. Bring to even grade at required elevation.

2.14 PLACING TOP SOIL

A. After rough grading has been compacted, place approved top soil material where indicated to a minimum depth of 4 inches. Sprinkle with water to compact. Re-grade after compaction to smooth, uniform condition free of debris and stones larger than one inch.

2.15 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Remove waste materials including excavated material classified as unsatisfactory soil material, trash, and debris, and dispose of it off the Owner’s property.

2.16 PROTECTION

A. Newly graded areas shall be protected from traffic, erosion, and any settlement or washing away that may occur from any cause, prior to date of Substantial Completion, shall be repaired and grades re-established to required elevations and slopes. Temporary erosion control fencing shall be provided around construction perimeter, and shall be placed in accordance with LADOTD EC sTp Drawings.

END OF SECTION

SECTION 02 92 00 - LAWNS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

A. The extent of lawn work shall be the damaged by the Contractor during construction. It shall also include the re-sodding of existing lawn areas damaged by Contractor's operations. The types of work required include the following:

1. Preparation of lawn areas.
2. Sodding of lawn areas affected by construction.

1.3 RELATED SECTIONS

A. Grading, Placing Topsoil: Division 2 Section 02 30 00, "Earthwork."

1.4 ENVIRONMENTAL REQUIREMENTS

A. Work shall be performed only during period when beneficial results are likely to be obtained. When conditions are such, by reason of drought, excessive moisture, or other factors, that satisfactory results are not likely to be obtained; work shall cease and be resumed when desired results are likely to be obtained.

1.5 WARRANTY

A. Contractor shall insure establishment of a viable, uniform, dense stand of grass within lawn areas, by use of methods specified herein, until final acceptance of Project or for a 60 day period, whichever is greater.

PART 2 - PRODUCTS

2.1 FERTILIZER

A. Granular approved commercial brand conforming to the requirements of the State Department of Agriculture. Nitrogen-Phosphorus-Potassium rates shall be 8-8-8 or 12-12-12, or 13-13-13.

2.2 SOD

A. Strongly rooted sod, not less than 2 years old, from off-site source; free of weeds, undesirable plants, large stone and other material detrimental to development and maintenance of lawn. Provide sod composed principally of the same grasses as the surrounding lawn.

PART 3 - EXECUTION

3.1 FERTILIZER

A. Shall be applied to all new lawn areas not more than 24 hours in advance of tilling and seeding operations. Rate of application shall be as follows:

	Type	Pounds Per 1000 Sq.Ft.	Pounds Per Acre
1.	8-8-8	23	1,000
2.	12-12-12	15.3	667
3.	13-13-13	14.1	615

3.2 TILLAGE

A. After application of fertilizer, new lawn areas shall be tilled to depth of 4 inches, using chisel or disk-type breaking plow followed by discing, harrowing, and culti-packing. When chisel plows are used, areas shall be cross-tilled with chisels set not to exceed 10 inches apart.

3.3 SOLID SODDING

A. Provide sodding on all damaged lawns. Lay sod to form a solid mass with tightly-fitted joints. Butt ends and sides of sod strips. Do not overlay edges. Stagger strips to offset joints in adjacent courses. Remove excess sod to avoid smothering of adjacent grass. Provide sod pad top flush with adjacent curbs, sidewalks, drains, and seeded areas.

B. Peg sod on slopes steeper than 3 to 1 to prevent slippage at a rate of 2 stakes per yd. of sod. Water sod thoroughly with a fine spray immediately after laying. Roll with light lawn roller to ensure contact with sub-grade.

3.4 PROTECTION

A. Maintenance period for new lawn areas shall begin immediately after planting and extend for a period of 60 days or until final acceptance of Project by Owner, whichever period is greater.

B. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading, replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas.

C. Watering: Provide and maintain temporary piping, hoses, and lawn watering equipment as required to convey water from water sources and to keep lawn areas uniformly moist as required for proper growth.

1. Mow lawns as soon as there is enough top growth to cut with mower set at 2-1/2 to 3 inches height. Repeat mowing as required to maintain specified height. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet.
2. Re-sod any area that becomes damaged or does not produce an acceptable growth of grass.

3.5 ACCEPTANCE

A. Sodded lawns will be acceptable, provided all requirements including maintenance, have been complied with, and a healthy, well-rooted, even-colored, viable lawn is established, free of weeds, open joints and bare areas.

END OF SECTION

SECTION 03 10 00 - CONCRETE FORMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED SECTIONS

A. Division 3 Section 03 20 00, "Concrete Reinforcement."

B. Division 3 Section 03 30 00, "Cast-in-Place Concrete."

1.3 SYSTEM DESCRIPTION

A. Design Requirements: Unless otherwise shown or specified, design, construct, erect, maintain, and remove forms and related structures for cast-in-place concrete work in compliance with American Concrete Institute Standard ACI 347 "Recommended Practice for Concrete Formwork."

PART 2 - PRODUCTS

2.1 FORMS FOR EXPOSED FINISH CONCRETE

A. Unless otherwise indicated, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.

B. Use overlaid plywood complying with DOC PS-1 "A-C or B-B High Density Overlaid Concrete Form," Class I.

2.2 FORMS FOR UNEXPOSED FINISH CONCRETE

A. Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

2.3 FORM TIES

A. Provide factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete surfaces upon removal. Portion of ties remaining after form is removed shall be 1 inch from outer edge of concrete, within concrete. Form ties fabricated on Project site and wire ties are not acceptable.

2.4 FORMS COATINGS

A. Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds with a maximum VOC of 350 mg/l.

2.5 CORNER FORMERS AND REVEAL STRIPS.

A. Shall be extruded PVC or rigid Geon vinyl shapes or other material as approved by Engineer. Shapes shall be fabricated to conformations as indicated and shall be of types that will prevent leakage at form face or shall be provided with suitable approved gaskets to prevent leakage.

PART 3 - EXECUTION

3.1 FABRICATION OF FORMWORK

A. Structural Responsibility: Contractor shall be solely responsible for the structural adequacy of the forms, ties, shoring, and bracing. Requirements given herein are minimum for appearance purposes only, not to be considered as structural design. Contractor shall verify dimensions of new chiller and pump room prior to dimensioning forms.

B. General Design: Make sufficiently tight to prevent leakage of mortar. Properly brace and tie forms together so as to maintain position and shapes. Forms shall withstand the concrete pressures and weight without deformation beyond 1/360 of spans. Except in unfinished locations, use the form tops or a continuous wood strip to establish accurate top edges for beams, slabs, and construction joints.

C. Chamfers: 1” inch on exposed corners except where shown otherwise.

D. Tolerances: Exposed concrete shall be visually plumb, level, straight, and smooth when viewed at a distance of 30 feet, except for irregularities that will be removed in the finishing process. Maximum deviation shall not be over 1/4 inch in 8 feet – 0 inches for exposed surfaces and 1/2 inch in 8 feet – 0 inches for concealed or covered surfaces.

3.2 COORDINATION

A. Coordinate work of this Section with related work of other Sections as necessary to obtain a proper installation of all embedded items. Items furnished by other Sections for installation into the work of this Section shall be installed in accordance with requirements of other Sections.

Provide framing and formwork for all openings and chases for mechanical, plumbing and electrical ducts, pipes, and conduits. Provide for installation of bolts, anchors, sleeves, reglets, anchor studs, inserts, framing members, and similar items. Examine all architectural, structural, mechanical, and electrical Drawings for requirements to accommodate the work of other Sections.

3.3 FORM CONSTRUCTION

A. Form strips shall be installed straight and true as required to produce reveals, reglets, drip grooves, and similar details as indicated. Strips shall be beveled as indicated for easy removal and to prevent breaking of concrete corners.

B. Beveled construction keys shall be formed at all joint locations shown on the Drawings and at locations as approved when it is necessary to stop pours where no joint is shown. Set beveled pouring strips at joints which will be exposed in the finish. Remove strips before placing next lift. Tighten all forms to compensate for shrinkage at joints before pouring new concrete against previously poured concrete.

C. Temporary openings shall be provided at the base of all wall and column forms and at all other locations where necessary to facilitate cleaning and inspection prior to placing concrete. Locations of openings in exposed cast-in-place concrete shall be subject to approval.

D. Anchoring devices (such as anchor slots, inserts, bolts, fastening devices, reglets, etc.) necessary for attachment of various materials to concrete shall be installed in the forms as required and/or necessary to properly complete the indicated construction. Consult and cooperate with other Sections and trades to insure properly located anchoring devices, whether specified to be installed under this Section or under other Sections of the Specifications.

E. Install wood boxes and block-outs as necessary to form openings through concrete and cooperate with other trades that are required to set sleeves, etc., in forms.

3.4 FORM REMOVAL

A. Formwork not supporting concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 degrees F for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operation, and provided that curing and protection operations are maintained.

B. Formwork, supporting weight of concrete, such as beams, joists, slabs and other structural elements, may not be removed in less than 14 days and until concrete has attained design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

C. Form facing material may be removed four days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

END OF SECTION 03 10 00

SECTION 03 20 00 - CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED SECTIONS

A. Division 3 Section 03 10 00, "Concrete Forms."

B. Division 3 Section 03 30 00, "Cast-in-Place Concrete."

1.3 PERFORMANCE REQUIREMENTS

A. Comply with applicable requirements of the following standards, except as herein modified:

1. ACI "Manual of Standard Practice for Detailing Reinforced Concrete Structures" ACI 315, latest edition.
2. ACI "Building Code Requirements for Reinforced Concrete", ACI 318.
3. Concrete Reinforcing Steel Institute, "Manual of Standard Practice."
4. American Welding Society, AWS D1.4 "Structural Welding Code -Reinforcing Steel."

1.4 SUBMITTALS

A. Shop Drawings:

1. Shop drawings are required, complete, for all items under this Section. No part of any concrete work for this project shall be installed for which reinforcement shop drawings have not been submitted and reviewed for that part.
2. Details of reinforcing shall conform to applicable reinforcements of reference specifications and standards as listed herein.
3. Drawings shall indicate location, general spacing, and sizes and grades of the reinforcing members, together with all slots, chases, recesses, and openings required for installation of other items of work.
4. Diagrams and general schedules shall indicate the bends, sizes, and lengths of reinforcing members and they shall clearly indicate by diagram or other easily recognizable mark exactly where the steel is to be placed in the beam, girder, slab, etc.

B. Certificates: Submit copies of steel mill certificates of mill analysis, tensile and bend tests for reinforcing steel. Mill certificates shall be furnished at time of steel delivery.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver reinforcement to project site bundled, tagged, and marked. Store concrete reinforcement materials at the site to prevent damage and accumulation of dirt or excessive rust.

PART 2 - PRODUCTS

2.1 WIRE FABRIC

A. ASTM A-185. Fabric style designation shall be as indicated on Drawings in accordance with Wire Reinforcement Institute "Manual of Standard Practice."

2.2 BARS

A. ASTM A-615, Grade 60, deformed unless otherwise indicated.

2.3 BARS, WELDING GRADE

A. Max. 0.30 percent carbon; max. 0.60 percent manganese.

2.4 SUPPORTS FOR REINFORCEMENT

A. Chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place shall be in accordance with CRSI Specifications and as specified hereinafter.

B. Exposed Concrete: For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

2.5 TIE WIRE

A. 18 gauge.

2.6 SHOP FABRICATION

A. All bends and hooks shall conform to standard hook and radial bending details of ACI 315. Bars shall be bent cold. Heating of reinforcement or bending by any method not approved will not be permitted. Bars having kinks or bends not required by approved Bending Schedule shall not be used. Steel shall be bent by fabricator and delivered to the job in a prepared condition ready for installation unless otherwise approved.

PART 3 - EXECUTION

3.1 CLEANING

A. Metal reinforcement shall be clean and free from rust, mill scale, oil, earth, ice, and other materials which reduce or destroy bond with concrete.

3.2 INSTALLATION

A. Comply with the specified standards, and Concrete Reinforcing Steel Institute recommended practice for "Placing Reinforcing Bars" for details and methods of reinforcement placement and supports and as herein specified.

3.3 PLACING REINFORCEMENT

A. Metal reinforcement shall be accurately placed in accordance with the Drawings, Details, and approved shop drawings. All reinforcement shall have the clearances shown on Drawings and as herein specified.

B. Adequate chairs shall be placed under all reinforcing to prevent sagging or to prevent being bent when it will be walked on when pouring is taking place.

C. All wire tying of reinforcing shall be tight loop or a double loop which will prevent bars from slipping or turning over as the concrete operation proceeds, using tie wire. Loose ends of the wires shall be close cut to prevent their becoming exposed in the finished surfaces. Stirrups in beams and girders and ties in columns shall be wired to principal reinforcing members. When splices other than those shown on Drawings are required, character and detail of splice shall be as approved.

D. Welding shall not be carried out on any reinforcement without prior approval.

E. Contractor shall have as many qualified men on hand as necessary to check the steel continuously as the concrete placing is in progress. Their job shall be to make sure there are no changes in the positioning of the steel and to keep the personnel who are placing the concrete from walking on or otherwise dislocating the steel.

F. Tieing: Saddle tie reinforcing at intersections with tie wire. Wire stirrups to both top and bottom bars.

G. Outside Bars: Place outside bars of slab reinforcement, both main and temperature, parallel to beams or walls, not more than 1/2 bar spacing away from adjacent face of such parallel members.

3.4 SPLICES

A. General: Splicing of bars not permitted.

3.5 ANCHORS AND FITTINGS

A. Provide all anchors and fittings, etc., required for proper construction of concrete work and the bonding of masonry that is to be anchored to concrete. Locations, spacings, type of fittings and anchors, etc., shall be according to standard practice and as shown on Drawings.

3.6 RODS AND STIRRUPS

A. Where there are no stirrups scheduled and/or indicated on the Drawings for beams, No. 4 bar stirrups shall be provided in accordance with the beam schedule notes as listed on the Drawings, or closer if necessary to tie and support the steel in place.

B. Furnish cut rods of No. 3 or No. 4 bars as may be required for supporting top steel in beams, girders, etc., to hold it in position. These rods shall be securely hung from spreaders or braces on the formwork.

3.7 CONCRETE PROTECTION FOR REINFORCEMENT

A. General: Reinforcement (including stirrups) shall be protected by the thickness of concrete as specified in ACI 318 unless indicated otherwise.

B. Minimum Coverage: Unless otherwise shown, the thickness of concrete over reinforcement including stirrups shall be as follows:

1. Where concrete is deposited against ground without forms, not less than 3 inches.
2. Where concrete may be exposed to the ground but where placed in forms, not less than 2 inches.
3. All concrete exposed to the weather, not less than 2 inches.
4. In slabs not exposed to weather, not less than 3/4 inch.
5. In beams not exposed to the ground or to the weather, not less than 1-1/2 inches.
6. In all cases, the thickness of concrete over reinforcement shall be at least equal to the diameter of the bars except at slabs and joists.

3.8 INSPECTION OF STEEL PLACEMENT

A. Contractor shall give 24 hours notice to obtain approval of placement of reinforcing steel before concrete is placed. Such inspection is in nature of assisting Contractor to minimize errors, and in no case will it operate to relieve Contractor of his responsibility to provide materials and workmanship required by Contract Documents.

END OF SECTION

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

A. Providing cast-in-place concrete materials and construction procedures for normal weight structural concrete for equipment pads.

1.3 RELATED SECTIONS

A. Division 3 Section 03 10 00, "Concrete Forms."

B. Division 3 Section 03 20 00, "Concrete Reinforcement."

1.4 PERFORMANCE REQUIREMENTS

A. Codes and Standards: Comply with applicable provisions of following codes, specifications, and standards except as otherwise shown or specified.

1. ACI 301 "Specifications for Structural Concrete for Buildings."
2. ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete."
3. ACI 318 "Building Code Requirements for Reinforced Concrete."

1.5 SUBMITTALS

A. Laboratory test reports shall be submitted for approval 48 hrs. prior to start of work for concrete materials and mix design tests. Refer to article "Proportioning and Design of Mix" hereinafter this Section for specific requirements. Submit reports of Inspection and Testing as specified under "Field Quality Control".

B. Product Data: Submit data for proprietary materials and items, including admixtures, patching compounds, waterstops, curing compounds, and others as requested by Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cement: Portland, ASTM C-150, Type I (Type III where high early strength is required). Color shall be gray.

B. Aggregate – Normal: ASTM C-33. Maximum size not larger than 1/5 of the narrowest dimension between forms of the member for which the concrete is to be used, nor larger than 3/4 of the minimum clear spacing between reinforcing bars. In walls, beams, and columns, maximum dimension shall be 1-1/2 inches when width, depth, or thickness is 8 inches or less.

C. Aggregate – Fine: Natural sand free from deleterious substances, meeting requirements of ASTM C-33, or LDOTD Standard Specification Article 1003.02(a).

D. Water: Potable.

E. Admixtures:

1. Set Control Retarder: Non-air-entraining conforming to ASTM C-494, Type B.
2. Set Control Accelerator: A water reducing, chlorine-free set accelerating agent conforming to ASTM C-494, Type C or E.
3. Air Entrainment: ASTM C-260, neutralized vinsol resin.
4. Calcium Chloride: Not permitted separately or as an admixture ingredient.

F. Curing Materials:

1. Sheets shall be waterproof paper ASTM C-171 or white polyethylene sheeting: AASHTO M-171.
2. Liquid types shall be ASTM C-309, Type I, Class A, clear with fungitive tint. Type 2, white colored may be used for exterior.
3. Prohibitive Results: Oily, waxy, or loose residue that could interfere with future coatings, flooring adhesives, or sealant bond; discoloration of surfaces designated to remain uncovered.

G. Non-Shrink Grout: A factory mixed, non-metallic, with min. compressive strength at 28 days to be 5000 psi, conforming to ASTM C-1107.

H. Bonding Agent: A two-component, epoxy resin bonding system for application to Portland cement concrete conforming to ASTM C-881, Type I, Grades 1 or 2 Temperature Class as appropriate for application. Acceptable products include "Probond Nos. 821, 822 and 823" by Protex Industries, Inc.; "Epoxy Adhesive System" by Euclid, "Sikadur 32 Hi-Mod" by Sika Corp. or approved equal.

2.2 PROPORTIONING AND DESIGN OF MIX

A. Concrete Compressive Strengths: Unless indicated otherwise on Drawings or elsewhere in Project Manual, the following 28 day strengths shall apply for respective locations.

1. All applications shall be 3,000 psi.

B. General: Submit written reports of proposed mix designs for each type of concrete for review prior to beginning concrete production. At Contractor's option, method used to determine proportioning can be either laboratory trial batch or field experience.

C. Report data shall include following: Aggregate identification, aggregate tests, aggregate scale weight, cement brand, (type, composition), admixture brand, (type, amount), water amount, proportions per cubic yard, gross wt. and yield per cubic yard, slump, air content, strength at 7 and 28 days based on min. of 3 test cylinders.

D. Laboratory Trial Batch Mix Design in accordance with ACI 301.

1. Specimen Preparation: ASTM C-192.
2. Strength Tests: ASTM C-39.
3. Establish a curve showing relationship between water-cement ratio (or cement content) and compressive strength, with at least 3 points representing batches that produce strengths above and below that required. Use not less than 3 specimens tested at 28 days, or an earlier age when time insufficient to establish each point on the curve.

E. Field Experience Mix Design: ACI 301.

1. Establishing Standard Deviation: Where a concrete production facility has a record, based on at least 30 consecutive strength tests that represent similar materials and conditions to those expected, required average compressive strength used as the basis for selecting concrete proportions shall exceed the specified compressive strength at designated test age by at least:

a. 400 psi if standard deviation is less than 300 psi
b. 500 psi if standard deviation is 300 to 400 psi
c. 700 psi if standard deviation is 400 to 500 psi
d. 900 psi if standard deviation is 500 to 600 psi
e. If standard deviation exceeds 600 psi, concrete proportions shall be selected to produce an average strength at least 1200 psi greater than the specified compressive strength.

F. Deviation Reduction: After sufficient experience and test data become available from the job, using ACI 214 methods of evaluation, the standard deviation may be deducted when the probable frequency of tests more than 500 psi below required compressive strength will not exceed 1 in 100, and when the probable frequency of an average of 3 consecutive tests below required compressive strength will not exceed 1 in 100.

G. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows: Not less than l inch nor more than 4 inches.

H. Use of Admixtures:

1. General: Admixtures quantities and application procedures shall be as recommended by manufacturer of admixture for climatic conditions prevailing at time of placing concrete. Refer to articles on "Placing Concrete in Cold and Hot Weather" hereinafter this Section for applicable procedures.
2. Air Entraining: Exterior exposed; 5 percent + 1 percent.

I. Portland Cement - Pozzolan Blend (Contractor's Option): In lieu of a 100 percent pure Portland cement ingredient in the concrete mix design as specified hereinbefore, a Portland cement-pozzolan blend shall be permitted subject to following specifications: Up to 17.5 percent (by weight) of the cement may be replaced, with 1.25 lb. of pozzolan being substituted for each pound of cement replaced.

J. Mix Design Adjustments: Adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Submit adjustments for review prior to making any change. No additional payment will be allowed for adjustments made to achieve specified performance or for the Contractor's benefit.

2.3 CONCRETE MIXING

A. Comply with the requirements of ASTM C-94 for Ready-Mix Concrete. No water shall be added to mix after truck has left plant, unless authorized by Engineer. When air temperature is between 85 degrees F and 90 degrees F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 INSPECTION

A. Immediately in advance of placing concrete, excavation, forms, reinforcement, inserts, etc., will be inspected by the Engineer and if any part of the work is determined to be unsatisfactory, concrete work shall not proceed at that part until all defects have been remedied and approval has been obtained. Such approval shall not in any way relieve Contractor of his obligation to produce the finished concrete required by provisions of the Drawings and Specifications.

3.2 PREPARATION

A. Before depositing concrete, debris and water shall be removed from spaces to be occupied by concrete. Reinforcement shall be thoroughly secured in position. Concrete shall be wheeled over formwork only on runways supported from forms and not on reinforcing steel.

3.3 BONDING AND GROUTING

A. Before depositing new concrete on or against concrete which has set, thoroughly roughen and clean existing surfaces. Re-tighten forms, slush existing concrete surfaces with coat of neat epoxy grout. Place new concrete before grout has attained its initial set.

3.4 PLACING

A. Placing Concrete in Cold Weather: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures. When air temperature has fallen to or is expected to fall below 40 degrees F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F and not more than 80 degrees F at point of placement. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

B. Placing Concrete in Hot Weather: Placing concrete in hot weather shall be in accordance with ACI 305 except as modified herein. Extra care shall be taken to reduce the temperature of the concrete being placed, and to prevent rapid drying of newly placed concrete. When the outdoor ambient temperature is more than 90 degrees F, the temperature of the concrete shall not exceed 90 degrees F; the fresh concrete shall be shaded as soon as possible after placing; and curing shall be started as soon as the surface of the fresh concrete is sufficiently hard to permit it without damage. Concrete placement temperatures shall be controlled by the Contractor at his expense and shall be accomplished by one or a combination of procedures of ACI 305, but not limited to being accomplished by (1) shading and cooling the aggregates; (2) avoiding use of hot cement; (3) cooling mixing water by additions of ice; (4) insulating water supply lines and tanks; (5) insulating mixer drums or cooling them with sprays or wet burlap coverings; (6) working only at night; and (7) addition of a retarder or water reducing retarder in the mix, if approved. Reduce the temperature of side forms by aerating the forms with wet burlap or similar covering materials. Cool underlying material by sprinkling lightly with water.

C. Placing – General: Handle concrete from mixer to place of final deposit as rapidly as practicable by methods which prevent separation and/or loss of ingredients. Under no circumstances shall concrete which has partially hardened be deposited in the work. Pumping shall be permitted with approval as to times and locations. Deposit concrete in forms as near as practicable in its final position to avoid rehandling. Deposit concrete so as to maintain a plastic surface approximately horizontal, until completion of the unit. Lifts shall be 18 inches to 24 inches.

1. Forms for walls and/or thin sections of considerable height shall be provided with openings, or other devices such as tremies, which will permit concrete to be placed in a manner that will prevent segregation and accumulation of hardened concrete on forms or metal reinforcement, above level of concrete.
2. When concrete is conveyed by chutes, equipment shall be of such design as to insure a continuous slide on chute. Chutes shall be of metal or metal lined and different portions shall have approximately the same slope.
3. Slope of chutes shall not be less than one vertical to two horizontal and shall be such as to prevent segregation of ingredients.
4. When operation is intermittent, chute shall discharge into a hopper. Chute shall be thoroughly cleaned before and after each run, and debris and any water shall be discharged outside the forms.
5. Concrete shall be deposited continuously or in layers of such thickness that no concrete will be deposited which has hardened sufficiently to cause formation of seams and planes

of weakness within the section. If a section cannot be placed continuously, construction joints may be located at points as provided for in Drawings or approved. Such joints shall be made in accordance with provisions of "Construction Joints" article hereinafter this Section.

3.5 CONSOLIDATING CONCRETE

A. Formwork: Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with the recommended practices of ACI 309, to suit the type of concrete and project conditions. Vibration of forms and reinforcing will not be permitted, unless otherwise approved.

1. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not further than the visible effectiveness of the machine. Place vibrators to penetrate the layer of concrete rapidly and at least 6 inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcement and other embedded items without causing segregation of the mix.

3.6 CONSTRUCTION JOINTS

A. Location: Locate construction joints so as to least impair the strength and appearance of the structure. Obtain approval of layout showing proposed location of construction joints before proceeding.

3.7 FINISHING - GENERAL REQUIREMENTS

A. Trowelling: All concrete finish so noted shall be troweled smooth, worked to a good hard even surface, free from tool marks and other defects, and finished according to best practice. Last two trowelings shall be hand troweled.

B. Exterior concrete shall not be applied when weather conditions are unsuitable or else temporary protection (canvas, etc.) shall be supplied during finishing and setting period.

C. Screeds: All floor surfaces shall be placed by the use of continuous pipe screeds which are straight and which have been supported by chairs or other approved methods to give surfaces which are within the specified tolerances.

3.8 TOLERANCES

A. Vertical Alignment: ACI 117, 1/4 inch in 10 feet.

B. Cross-section Thickness: (Beams, walls, piers under 12 inches thick) ACI 117, + 3/8 inch -1/4 inch.

C. Tolerances shall not be cumulative.

3.9 CONCRETE SURFACE REPAIRS

A. Formed Surfaces: Immediately after removal of forms, pack holes remaining from bolts or tie rods full with epoxy mortar. Remove and patch all defects or correct as otherwise directed. Finish to match adjoining surfaces.

1. Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Engineer. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes and fill with epoxy mortar.

B. Unformed Surfaces: Repair surface defects including crazing and cracks in excess of 0.01 inch wide or that penetrate to the reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.

1. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days. Correct low areas in unformed surfaces during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
2. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

3.10 FIELD QUALITY CONTROL

A. Inspection and Testing: Inspection and testing of concrete shall be performed by a firm appointed, and paid for by Owner. Contractor shall make arrangements and pay an approved Testing Laboratory for the design of concrete mix proportions as specified hereinbefore this section under "Proportioning and Design of Mix."

1. Sample and test all concrete placed at the job site. Each sample shall consist of three cylinders, one for 7 day testing, two for 28 day testing. Secure samples in accordance with ASTM C-172, curing and packing shall be ASTM C-31.
2. Take at least one sample of each class or type of concrete from each pouring operation each day.
3. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
4. Air Content: ASTM C 173, volumetric method for normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
5. Concrete Temperature: Test hourly when air temperature is 40 degrees F and below, when 80 degrees F and above, and each time a set of compression test specimens is made.

6. Compressive Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cubic yards plus additional sets for each 50 cubic yards more than the first 25 cubic yards of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days.

B. Tests on Hardened Concrete in Structure:

1. General: When there is evidence that the strength of the concrete structure in-place does not meet specification requirements, the Engineer shall request that a testing service take cores drilled from hardened concrete for compressive strength determination complying with ASTM C-42. The Contractor shall pay for drilling and testing cores.
2. Sampling: Take at least 3 representative cores from each member of area of suspect strength, from locations directed by the Engineer.
3. Testing: Test cores in saturated-surface-dry condition per ACI 318 if the concrete will be wet during the use of the completed structure.
4. Test cores in an air-dry condition per ACI 318 if the concrete will be dry at all times during use of the completed structure.
5. Evaluation of Core Test: Strength of concrete for each series of cores will be considered satisfactory if their average compressive strength is at least 85 percent and no single core is less than 75 percent of the 28 day required compressive strength.
6. Static Load Tests: Conduct static load test and elevations complying with ACI 318 if the results of the core tests are unsatisfactory, or if core tests are impracticable to obtain.
7. Correction of Work: Contractor shall remove and replace work found unacceptable by the above tests, at no added expense to the Owner.

C. Evaluation of Concrete Tests (Lab cured):

1. Acceptable Strength Tests: Considered satisfactory if complying with the following: Averages of all sets of three consecutive compressive strength tests results equal or exceed the 28 day design. No individual strength tests falls below the required compressive strength by more than 500 psi.
2. Unacceptable Strength Tests: If the compressive strength tests fail to meet the minimum requirements specified, the concrete represented by such tests will be considered deficient in strength and subject to additional testing as herein specified.

D. Evaluation of Concrete Tests (Field cured):

1. Unacceptable Strength Tests: Provide improved means and procedures for protecting concrete when the 28-day compressive strength of field-cured cylinders is less than 85 percent of compressive laboratory-cured cylinders.
2. Acceptable Low Tests: When laboratory-cured cylinder strengths are appreciably higher than the minimum required compressive strength, field-cured cylinder strengths need not exceed the minimum required compressive strength by more than 500 psi even though the 85 percent criterion is not met.

SCHEDULE OF CONCRETE FINISHES

3.11 SMOOTH FORMED FINISH

A. Location: Interior and exterior formed vertical surfaces exposed to public view or are covered with a coating material applied directly to concrete, such as paint.

B. Procedure: Produce "as cast" finish. Patch honeycombing, tie-holes, and other defects as specified herein under "Patching." Fins, burrs, and other projections shall be removed. Rub smooth, freshly hardened concrete with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.

3.12 NON-SLIP BROOM FINISH

A. Location: Exposed slabs and elsewhere where indicated.

B. Procedure: Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route water sure.

3.13 CONCRETE CURING AND PROTECTION.

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperature, and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete. Start initial curing as soon as free moisture has disappeared from the concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 72 hours. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least 7 days and in accordance with ACI 301 procedures. Avoid rapid drying at the end of the final curing period.

B. Curing Methods: Perform final curing of concrete by one of following methods at Contractor's option.

C. Moisture curing, keeping the surface of the concrete continuously wet by covering with water.

D. Moisture – Cover: Moisture retaining cover shall be placed on surfaces for curing period.

E. Liquid Membrane applied to damp concrete surfaces as water film has disappeared in accordance with manufacturer's directions.

1. Do not use membrane curing compounds on surfaces which are to be covered with a coating material applied directly to the concrete or with a covering material bonded to the concrete, such as other concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring, painting, and other coatings and finish materials.

F. Temperature of Concrete During Curing: When the atmospheric temperature is 40 degrees F and below, maintain the concrete temperature between 50 and 70 degrees F continuously throughout the curing period. When necessary, make arrangements before concrete placing for

continuous heating, covering, insulation, or housing as required for the concrete curing period. Provide cold weather protections complying with the requirements of ACI 306.

3.14 CURING OF POZZOLAN BLEND CONCRETE

A. Concrete shall be protected against moisture loss, rapid temperature change, mechanical injury, and injury from rain or flowing water for a period of ten days. Concrete shall be maintained in a moist condition at temperature above 50 degrees F throughout the curing period. Concrete shall be protected from rapid temperature change and rapid drying for the first 24 hours following the removal of temperature protection. Curing activities shall be started as soon as free water has disappeared from the surface of the concrete after placing and finishing. Curing shall be accomplished by the following methods or combination thereof, as approved: moist curing, impervious sheet curing, membrane-forming compound.

B. Removal of forms over pozzolan blend concrete shall not commence until 14 days after placing concrete.

END OF SECTION 03 30 00

SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS INCLUDED ELSEWHERE

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to the work of this section.

B. Related technical items include but are not limited to the following:

1. Section 09 91 00 - Painting schedule
2. Finish schedule – Match Existing Color & Type of Paint
3. Mechanical / Electrical – Items to be Painted

1.2 SCOPE OF WORK

A. The work to be done by the painting contractor shall include the furnishing of all materials, labor, tools, and equipment required to complete the painting and decorating of the building(s) as specified. The contractor that performs this work shall be fully responsible for having his equipment comply with current OSHA regulations, and to have available all Material Safety Data sheets that pertain to the products used. The submission of a bid by this contract confirms an understanding of all conditions pertaining to this work and proper application of materials specified.

B. At location of removed ceiling mounted fan coil units, paint wall from corner to corner by matching the existing color & paint type of the adjacent wall. See plans.

C. All finish and staining of new cabinetry & casework to match existing adjacent cabinetry & casework at location of demolished fan coil units. See plans.

1.3 WORK NOT INCLUDED, UNLESS OTHERWISE SPECIFIED:

A. Aluminum, copper, brass, bronze, stainless steel, or nickel surfaces.

B. Shop coating on steel doors, door and window sash and frames, structural steel and fittings.

C. Pre-finished wall, ceiling and floor coverings.

D. Baked enamel doors, frames, rails or partitions.

E. Face brick.

F. Concealed items, unless specifically called for to be painted.

G. Code required labels (Example: "UL").

1.4 WORKMANSHIP

A. All materials shall be applied free from runs, sags, wrinkles, streaks, shiners, and brush marks.

B. All materials shall be applied uniformly. If any reduction of the coating's viscosity is necessary, it shall be done in accordance with the manufacturer's label directions.

C. New plaster and other masonry surfaces shall not be primed until it has been determined that these substrates have dried sufficiently to safely accept paint. A reliable electronic moisture meter should be used to make this determination. Unacceptable moisture content should be reported to the architect or his representative.

D. No exterior painting shall be undertaken if air or surface temperature is below 50°F, nor immediately following rain or until frost, dew, or condensation has evaporated. Surfaces should always be tested with moisture meter before proceeding.

E. A minimum interior temperature of 65°F shall be maintained during the actual application and drying of the paint, and until occupancy of the building occurs. Adequate ventilation shall be maintained at all times to control excessive humidity which will adversely affect the curing of coatings. The General Contractor is solely responsible for maintaining suitable temperature and ventilation.

F. Before painting begins, all other crafts shall have completed their work, and shall have removed all dirt and debris resulting therefrom. The rooms or areas are to be left in broom clean condition.

G. Enamel and varnish undercoats are to be sanded smooth prior to recoating. Tops and bottoms of doors are to be finished in same manner as door facing, after the carpenters complete filling of them.

1.5 MATERIALS:

A. Bids are to be based on coatings as manufactured by Benjamin Moore & Co., Sherwin Williams or TNEMEC, except as otherwise specified. Requests for changes or variations must be made by the contractor in writing, stating reasons with detailed extra costs or savings per hour of labor and/or per gallon of material, for approval by the architect prior to the award of the contract. See Section 00 63 20 – Product Options - Prior Approvals.

B. Colors shall be those approved by the architect. A duplicate color chipped schedule will be supplied to the painting contractor. All primers and undercoats are to be tinted to the approximate shade of the selected finish coat. Where the color schedule calls for the use of DEEPTONES (interior or exterior), it is the responsibility of the painting contractor to utilize the appropriate Deep Base Primers for use on the surfaces for which they are intended.

C. The architect reserves the right to take a representative sample of any materials the painting contractor brings on the job and have it tested by an approved testing laboratory to verify that the materials conform to the specification set forth herein. Cost of test, if required, shall be borne by the painting contractor.

D. All paint and coatings must be delivered to the job site in manufacturer's original containers.

E. The contractor shall prepare proper size acceptable samples of each color and sheen required for approval by the project architect.

F. It is to be understood by the general contractor and the painting contractor that all coatings must conform to all state and local regulations including VOC/VOS rules at the time of application.

G. Lead/Mercury - the contractor shall not use paints formulated with these materials. If the architect references a product that contains one of these materials, the contractor shall notify the architect in writing.

H. Contractor is wholly responsible for compatibility and bonding of all materials including application to both new and existing surfaces.

1.6 PREPARATION OF SURFACES:

A. The contractor shall be wholly responsible for the quality of his work, and is not to commence any part of it until surface is in proper condition.

B. If the contractor considers a surface unsuitable for proper finishing, he is to notify the architect of this fact in writing. He is not to apply any material until corrective measures have been taken, or the architect has instructed him to proceed.

C. All surfaces are to be clean. If for any reason the surface cannot be cleaned, this condition shall be promptly reported to the architect.

D. If the painting contractor has been instructed by the General Contractor to begin painting under conditions and circumstances he believes could result in poor performance and early failure of the coatings, he shall request the architect for a decision in writing.

E. The prime coat should be applied soon after surface preparation has been completed, to prevent contamination of the substrate.

1.7 EXTRA WORK:

A. Payment for work over the amount agreed upon in the contract will not be allowed to the contractor unless authorized in writing by the architect.

1.8 STORAGE:

A. The Contractor will provide for a secure space for the storage of all painting materials and equipment, for the exclusive use of the painting contractor. He will be responsible to maintain and leave it free from fire hazards relating to improperly stored rags or thinners.

1.9 INSPECTION:

A. Any work not conforming to the specifications or not meeting the approval of the architect shall be removed or corrected and/or repainted as approved by the architect.

1.10 REMOVAL:

A. Upon completion of a room or area, it shall be left in a clean and orderly condition, and all paint

spatters, contaminated rags, and trash shall be removed.

B. Upon completion of the job, the contractor is to remove all surplus materials, scaffolds, etc., that relate to his trade, from the premises. He shall clean all window glass free of excess paint and spatters, and remove paint that has been misplaced on other surfaces.

1.11 PAINT REMOVAL/DISPOSAL:

A. When the removal of paint containing lead or mercury is required, the contractor is responsible for complying with federal, state and local laws and regulations concerning abatement.

B. In particular:

1. Louisiana Revised Statutes of 1950 (R.S. 30:2351-2351.60) Chapter 15-A Lead Hazard Reduction, Licensure and Certification.
2. U.S. Department of Labor OSHA regulation 29CFR Part 1926 Lead Exposure in Construction; Interim Final Rule

1.12 EXTRA MATERIALS:

A. The contractor shall provide two unopened gallon of paint of each type and color specified for the Owner's use upon completion of the project. Deliver to the Owners representative prior to close-out.

PART 2 - PRODUCTS: (Not Applicable) See Section 09 91 00

PART 3 - EXECUTION:

3.1 INTERIOR SURFACES - NEW CONSTRUCTION:

A. Wood, to be painted:

1. All surfaces shall be dry and sanded smooth, free of loose dirt, dust and oil.
2. Putty all nail holes, cracks, and blemishes after undercoater has been applied. Knots are to be coated with SPS or QD 30 before overall coat of enamel underbody is applied.
3. All coats must be thoroughly dry before applying succeeding coats, and lightly sanded between coats.
4. Avoid general use of shellac as an undercoat.
5. After fitting by the carpenter, top and bottom of all doors must be primed with the same as the face of the doors.

B. Wood, to be stained; Natural Wood (clear finish):

1. All surfaces shall be dry and sanded smooth, free of loose dirt, dust or grit.
2. Fill all nail holes, cracks, and blemishes after staining with filler tinted to match the color of the wood or stain.
3. After fitting by the carpenter, top and bottom of all doors must be sealed with a clear

coating.

3.2 INTERIOR SURFACES - PREVIOUSLY PAINTED SURFACES:

A. Wood, to be painted (Doors, trim, cabinets, plywood, paneling):

1. Surfaces must be clean and free of wax, grease, and water-soluble materials.
2. Glossy surfaces should be dulled by sanding. Do not use liquid deglossers on surfaces to be top-coated with latex enamels.
3. Remove loose or scaling paint by scraping and sanding. Repair holes, crevices, and cracks with appropriate patching compound.
4. Surfaces that have been defaced with marking pens, crayons, lipsticks, etc., should be washed with solvents, then spot primed with SPS or QD 30 to control residual "bleeding."
5. Scarred or chipped spots should be aggressively sanded so as to feather them flush with the surface.

B. Wood, Clear Finish (Doors, trim, cabinets, paneling):

1. Surfaces that have been treated with wax or oily surface restoration compounds must be aggressively cleaned with appropriate solvents. Periodically change to clean wiping cloths to prevent redistribution of waxy or oily residue.
2. All flaking or scaling must be removed by scraping and sanding with #00 sandpaper.
3. All standing surfaces that are in good restoration condition should be dulled with fine steel wool and wiped clean with a tack rag before coating.

C. Plaster and Drywall, Walls and Ceilings:

1. Remove all peeling or scaling paint by scraping. Sand areas thoroughly to feather edges smooth with adjacent surface.
2. Cracks, holes and blemished areas are to be filled and sanded flush with adjacent surfaces, then spot primed with finish coating.
3. Surfaces that have been defaced with marking pens, crayons, lipsticks, etc., should be washed with solvents, then spot primed with SPS or QD 30 to control residual "bleeding."
4. Walls and ceiling in kitchens and bathrooms are to be thoroughly washed with a detergent solution.
5. Glossy surfaces should be dulled by sanding lightly with #00 sandpaper.
6. Ceilings or walls that exhibit water stains are to be sealed with SPS or QD 30.

D. Masonry, Poured/Precast Concrete, Cement/Cinderblock Walls:

1. Remove all peeling and scaling paint by scraping and sanding.
2. All surfaces must be free from greasy and oily deposits. Structural cracks and holes should be filled with appropriate patching compound, then spot primed with finish coating.
3. Glossy surfaces should be dulled by sanding lightly with #00 sandpaper.
4. Surfaces that have been defaced with marking pens, crayons, lipsticks, etc., should be washed with solvents, then spot primed with SPS or QD 30 to control residual "bleeding."

END OF SECTION

SECTION 22 11 16 - DOMESTIC WATER PIPING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent of domestic water piping systems work is indicated on the Drawings and schedules and by requirements of this Section.

B. Applications for domestic water piping systems include the following:

1. Domestic cold-water piping.

C. Refer to appropriate Division 22 and 23 Sections for insulation required in connection with domestic water piping; not work of this Section.

D. Trenching and backfill required in conjunction with exterior water piping is specified in applicable Division 2 Sections and is included as work of this Section.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of domestic water piping systems products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service.

B. Plumbing Code Compliance: Comply with applicable portions of governing Plumbing Code pertaining to plumbing materials, construction, and installation of products.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's data for domestic water piping systems, materials, and products.

PART 2 - PRODUCTS

2.1 DOMESTIC WATER PIPING MATERIALS AND PRODUCTS

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated and scheduled. Where not indicated or scheduled, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in domestic water piping systems. Where more than one type of material or product is indicated, selection is Installer's option.

2.2 BASIC IDENTIFICATION

A. General: Provide identification complying with Division 23 Section, "Basic Mechanical Materials and Methods."

2.3 BASIC PIPE, TUBE, AND FITTINGS

A. General: Provide pipe, tube, and fittings complying with Division 23 Section, "Basic Mechanical Materials and Methods," in accordance with the schedule on the Drawings.

2.4 BASIC HANGERS AND SUPPORTS

A. General: Provide hangers and supports complying with Division 23 Section, "Hangers and Supports."

2.5 BASIC VALVES

A. Ball Valves – 2 Inches (DN50) and Smaller: MSS SP-110, Class 150, 600 psi (4140 kPa) CWP, ASTM B 584 bronze body and bonnet, 2-piece construction; chrome-plated brass ball, standard port for 1/2 inch (DN15) valves and smaller and conventional port for 3/4 inch (DN20) valves and larger; blowout proof; bronze or brass stem; teflon seats and seals; threaded end connections.

1. Operator: Vinyl-covered steel lever handle.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equivalent:

a. Milwaukee, BA100.
b. Appollo, #70-100.
c. Hammond, #8501.
d. Nibco, #585.

B. Gate Valves 2-1/2 Inches and Larger:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equivalent:

a. Crane #461.
b. Jenkins #7326.
c. Nibco #F-619.
d. Hammond #1R1138.

2.6 SPECIAL VALVES

A. General: Special valves required for domestic water piping systems include the following types:

1. Interior Hose Bibb: 3/4 inch angle sill faucet, polished chrome plated, fixed wheel handle, and with vacuum breaker.

2. Exterior Sillcocks: 3/4 inch size, non-freeze type with anti-siphon backflow preventer and brass casing:

   a. Wade: Model 8600.
   b. Josam: Model Z-1321.

3. Exterior Sillcocks: For locations where wall thickness will not permit non-freeze sillcock and piping to be fully concealed, provide mild climate type with integral backflow preventer.

   a. Wade: Model 8600MT.
   b. Zurn: Model Z-1333.

2.7 DRAIN VALVES

A. Hose-End Drain Valves: MSS SP-110, NPS 3/4 (DN 20) ball valve, rated for 400-psig (2760-kPa) minimum CWP. Include two-piece, copper-alloy body with standard port, chrome-plated brass ball, replaceable seats and seals, blowout-proof stem, and vinyl-covered steel handle.

1. Inlet: Threaded or solder joint.

2. Outlet: Short-threaded nipple with ASME B1.20.7, garden-hose threads and cap.

2.8 WATER HAMMER ARRESTERS

A. General: ASSE 1010 or PDI-WH 201, piston type with pressurized metal-tube cushioning chamber. Sizes indicated are based on ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

1. Manufacturers:

   a. Josam Co.
   b. Precision Plumbing Products, Inc.
   c. Sioux Chief Manufacturing Co., Inc.
   d. Zurn Industries, Inc.; Wilkins Div.

2.9 BACKFLOW PREVENTERS

A. General: Provide reduced pressure, principle backflow preventers consisting of assembly, including shutoff valves on inlet and outlet and strainer on inlet. Backflow preventers shall include test cocks and pressure-differential relief valve located between two positive seating check valves and drain. Construct in accordance with ASSE Standard 1013. Include air gap and elbow for drain.

B. Manufacturer: Subject to compliance with requirements, provide backflow preventers of one of the following:

1. Febco, 825 Series

2. Hersey, "Aergap" Series

3. Orion, BRP

4. Watts, 009 Series

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavating, trenching, and backfilling are specified in Division 2 Section, "Earthwork."

3.2 INSTALLATION OF DOMESTIC WATER PIPING

A. General: Install water distribution piping in accordance with Division 23 Section, "Basic Mechanical Materials and Methods."

3.3 INSTALLATION OF PIPING SPECIALTIES

A. Water Hammer Arresters: Install in upright position, in locations and of sizes in accordance with PDI Standard WH-201, and elsewhere as indicated.

B. Install wood blocking reinforcement for wall mounting and recessed type plumbing specialties.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers and supports in accordance with Division 23 Section, "Hangers and Supports."

3.5 EQUIPMENT CONNECTIONS

A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by governing Plumbing Code.

B. Rough-in and connect all equipment, including kitchen equipment, including any interconnecting piping. Provide stops at each item. Rough-in in accord with equipment suppliers rough-in drawings. Provide all water piping work required for equipment installation, adjust, and leave in operation according to manufacturer's recommendations.

3.6 INSTALLATION OF BACKFLOW PREVENTERS

A. Install backflow preventers where indicated and where required by International Plumbing Code or Louisiana Amendments. Locate in same room as equipment being protected. Pipe relief outlet to nearest floor drain. Include (soft disc) check valve ahead of the installation to lock in the downstream pressure as not to affect the operation pressure differential between the supply and downstream of the first check in the backflow preventer. Provide aboveground insulated enclosure where indicated.

3.7 FIELD QUALITY CONTROL

A. Test water and hot water piping throughout hydrostatically at 150 p.s.i.g. (four hours).

B. Repair or replace domestic water piping as required to eliminate leaks and retest as specified to demonstrate compliance.

C. Sterilization: Sterilize all water lines in strict accordance with State Board of Health requirements. After flushing out, obtain approval of water sample analysis from State Board of Health and submit to Architect.

END OF SECTION

SECTION 22 14 00 - FUEL GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Extent of natural gas piping system work is indicated on Drawings and Schedules and by requirements of this Section.

B. Applications for natural gas piping systems include the following:

1. Gas service from street main or main on site to building meter.
2. Building distribution system from gas meter to gas-fired equipment connections.

C. Trenching and backfill required in conjunction with gas service piping is specified in applicable Division 2 Sections, and is included as work of this Section.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of natural gas piping products, of types, materials, and sizes required, whose products have been in satisfactory use in similar service.

B. Comply with NFPA 54 "National Fuel Gas Code" and International Fuel Gas Code for gas piping materials and components; installations; and inspection, testing, and purging.

C. Local Utility Compliance: Comply with requirements of serving utility company.

D. Local and State Codes: Comply with governing code and State Fire Marshal requirements.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's data for gas piping systems materials and products.

PART 2 - PRODUCTS

2.1 NATURAL GAS PIPING MATERIALS AND PRODUCTS

A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with ANSI B31.2 where applicable, base pressure rating on natural gas piping system maximum design pressures. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in natural

gas piping systems. Where more than one type of materials or products are indicated, selection is Installer's option.

2.2 BASIC IDENTIFICATION

A. General: Provide identification complying with Division 23 Section, "Mechanical Identification”

2.3 BASIC PIPE, TUBE, AND FITTINGS

A. General: Provide pipe, tube, and fittings complying with Division 23 Section, "Basic Mechanical Materials and Methods," in accordance with the Schedule on Drawings.

B. Gas Transition Fittings: Gas transition fittings shall be manufactured steel fittings approved for jointing metallic and thermoplastic pipe. Approved transition fittings are those that conform to AGA-01 requirements for transitions fittings.

C. Risers: A manufacturer's standard transition fitting, transition from plastic to plastic-coated steel pipe with O-ring seals and swaged gas-tight with metal insert. Provide manufacturer's standard protective sleeve.

2.4 BASIC HANGERS AND SUPPORTS

A. General: Provide hangers and supports seals complying with Division 23 Section, "Hangers and Supports."

2.5 VALVES

A. General: Valves required for natural gas piping systems include the following types:

1. Gas Cocks:

a. Gas Cocks 2 Inches and Smaller: 150 psi non-shock WOG, bronze straightway cock, flat or square head, threaded ends.
b. Gas Cocks 2-1/2 Inches and Larger: 125 psi non-shock WOG, iron body bronze mounted, straightway cock, square head, flanged ends.

2.6 PRESSURE REGULATORS

A. General Requirements:

1. Single-stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 (DN 50) and smaller; flanged for regulators NPS 2 1/2 (DN 65) and larger.

PART 3 - EXECUTION

3.1 INSTALLATION OF BASIC IDENTIFICATION

A. General: Install mechanical identification in accordance with Division 23 Section, "Mechanical Identification."

3.2 INSTALLATION OF NATURAL GAS PIPING

A. General: Install natural gas distribution piping in accordance with Division 23 Section, "Basic Mechanical Materials and Methods," and in accordance with applicable codes and serving utility company requirements. The contractor shall include all costs of metering, service lines and connections to serving utility distribution lines in his bid.

B. Use sealants on metal gas piping threads which are chemically resistant to natural gas. Use sealants sparingly and apply to only male threads of metal joints.

C. Remove cutting and threading burrs before assembling piping.

D. Do not install defective piping or fittings. Do not use pipe with threads which are chipped, stripped, or damaged.

E. Plug each gas outlet, including valves, with threaded plug or cap immediately after installation, and retain until continuing piping or equipment connections are completed.

F. Ground gas piping electrically and continuously within project, and bond tightly to grounding connection.

G. Install drip-legs in gas piping where indicated, at equipment connections, and where required by code or regulation.

H. Install "Tee" fitting with bottom outlet plugged or capped, at bottom of pipe risers.

I. Use dielectric unions where dissimilar metals are joined together.

J. Install piping with 1 inch drop in 60 degree pipe run (0.14 percent) in direction of flow.

K. Install piping parallel.

L. Do not install gas piping below floor slab or in unventilated concealed spaces. Provide protective metal sleeves for pipes passing through walls, floors, or partitions.

M. Coordinate with gas utility company as necessary to interface gas piping with gas service supply work.

3.3 INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers and supports in accordance with Division 23 Section, "Hangers and Supports."

3.4 INSTALLATION OF VALVES

A. Gas Cocks: Provide at connection to gas train for each gas-fired equipment item; and on risers and branches where indicated.

B. Locate gas cocks where easily accessible and where they will be protected from possible injury.

3.5 EQUIPMENT CONNECTIONS

A. General: Connect gas piping to each gas-fired equipment item, with drip leg and shutoff gas cock. Comply with equipment manufacturer's instructions.

3.6 PIPING TESTS

A. Test and purge natural gas piping in accordance with ANSI B31.2, and local utility requirements. Test at not less than 100 p.s.i.g. and prove tight for 2 hours.

B. Repair or replace fuel gas piping as required to eliminate leaks and retest as specified to demonstrate compliance.

3.7 SPARE PARTS

A. Furnish to Owner, with receipt, 2 valve wrenches for each type of gas valve installed, requiring same.

END OF SECTION

SECTION 23 00 00 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Sleeves.
4. Escutcheons.
5. Mechanical demolition.
6. Equipment installation requirements common to equipment sections.
7. Painting and finishing.
8. Concrete bases.
9. Supports and anchorages.
10. Motor starters.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. "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": Except as otherwise defined in greater detail, the term "provide" means furnish and install, complete in every respect and ready for the intended use, as applicable in each instance.

I. Wiring: the term "wiring" shall include providing raceway, conductors, and cable in accordance with the requirements of Division 26.

J. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

K. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Dielectric fittings.

B. Coordination Drawings: Submit, as soon as feasible after award of contract, equipment room and exterior equipment layouts at a scale not less than 1/4 inch = 1 foot showing the layout of the actual equipment to be used. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the work.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

C. Equipment Selection: Equipment of higher electrical characteristics, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are appropriately modified. The Contractor will be responsible for any added costs for

such modifications. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.

D. Drawings: The Mechanical drawings show the general arrangement of piping, equipment, and appurtenances, and shall be followed as closely as actual building construction and the work of other trades will permit. The Mechanical work shall conform to the requirements shown on all the drawings. Because of the small scale of the mechanical drawings, it is not possible to indicate all offsets, fittings, and accessories which may be required. The Contractor shall investigate the structural and finish conditions and other building components affecting the work and shall arrange his work accordingly, providing such offsets, fittings, and accessories as may be required to meet such conditions. No extras will be approved for required additional offsets and fittings. Any offsets or additional fittings required to coordinate mechanical systems with existing conditions and other trades, or that are necessary for the complete installation of the system, including modifications to shop or off-site fabricated piping and/or ductwork, all shall be provided by the Contractor at no additional cost to the Owner.

E. Codes and Standards: comply with the following codes. Comply with the latest edition except where indicated otherwise or a specific edition is required by the authority having jurisdiction:

1. International Building Code.
2. International Fuel Gas Code.
3. International Mechanical Code.
4. International Plumbing Code with Louisiana Amendments.
5. NFPA 54, 70, 90A, 90B, and 101.
6. All applicable local codes.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

1.7 COORDINATION

A. Coordinate mechanical equipment installation with other building components and existing conditions.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Coordinate installation of large equipment requiring positioning before closing in building.

E. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and other concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by firms regularly engaged in the manufacture of products required, whose products have been in satisfactory use in similar service.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 Piping Sections and "Pipe and Fitting Material Schedule" on the Drawings for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 Piping Sections and "Pipe and Fitting Material Schedule" on the Drawings for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8 inch (3.2 mm) maximum thickness unless thickness or specific material is indicated.

    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BAg1, silver alloy.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, flanged, solder-joint, plain, or weld-neck end connections that match piping system materials and isolate joined dissimilar metals to prevent galvanic action and stop corrosion.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300 psig (2070 kPa) minimum working pressure at 225 degrees F (107 degrees C).

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239 inch (0.6 mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. Split-Plate, Stamped-Steel Type: With concealed hinge, spring clips, and chrome-plated finish.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000 psi (34.5 MPa), 28 day compressive strength.
3. Packaging: Premixed and factory packaged.

2.8 MOTOR STARTERS

A. Square D TeSys D-Line, General Electric CR300-Line, or approved equivalent (except where reduced voltage type are specified) with overload protection in each phase (with correctly sized heaters) in NEMA Type I enclosure unless noted otherwise, reset button in cover, and all of the same manufacturer. Provide auxiliary contacts for interlocking where required. Coordinate auxiliary contact needs with Division 23 Section 23 09 23, "Building Management and Control Systems." Include HOA switch and pilot light in cover. Provide control power step-down transformer with sufficient additional capacity to handle essential control requirements (coordinate with Division 23 Section 23 09 23, "Building Management and Control Systems").

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION

A. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material. Equipment to Be Removed: Disconnect and cap services and remove equipment.
3. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
4. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

B. If pipe, to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Install components with pressure rating equal to or greater than system operating pressure.

C. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

D. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.

E. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

F. Install couplings according to manufacturer's written instructions.

G. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

H. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

I. Install all buried water piping, regardless of content, a minimum of 12 inches below and 12 inches laterally from any buried electrical line. Whether in conduit or direct buried cable, this requirement shall apply regardless of voltage of the electrical line.

J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

K. Install piping to permit valve servicing.

L. Install piping at indicated slopes.

M. Install piping free of sags and bends.

N. Install fittings for changes in direction and branch connections.

O. Pulled-tee, extruded-tee, thread-o-let, weld-o-let, and mitered elbow connections are not acceptable unless specifically indicated otherwise. Provide manufactured tee and elbow fittings.

P. Install tees with removable threaded cleanout plugs at each change in direction in all condensate drain piping.

Q. Select system components with pressure rating equal to or greater than system operating pressure.

R. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Chrome-Plated Piping: Cast-brass type with chrome-plated finish, split-casing for existing piping, and one-piece for new piping.

c. Insulated and Bare Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
d. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

S. Sleeves are not required for core-drilled holes in masonry or concrete walls.

T. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

U. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4 inch (6.4 mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating interior walls.

3. Seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.

V. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1 inch (25 mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.

W. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

X. Verify final equipment locations for roughing-in.

Y. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements, Division 23 Sections, and Schedules on the Drawings, specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Manufacturer's Installation and Operating Instructions: All equipment and material shall be installed and operated in strict accord with manufacturer's "Installation and Operating Instructions." The manufacturer's installation instructions shall become part of this Specification, and shall take precedence over and/or supplement any Specification herein and as shown and/or described on Plans. All individual items of equipment and components thereof shall be 100 percent accessible for repair, removal, or replacement without functional impairment or dismantling of any adjoining major surfaces or assemblies.

B. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

E. Install equipment to allow right of way for piping installed at required slope.

F. Cut and drill floors, roofs, walls, partitions, ceilings, and other surfaces as required to permit installation of mechanical piping, ducts, and equipment. Perform cutting by skilled mechanics of trades involved. 24-hour notice to Owner must be given before hammer drilling, coring, etc. (noise) to owner.

G. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

H. Electrical Work: Wherever equipment requiring electrical power connection is specified, all wiring shall be furnished and installed under Division 26 of the Specifications. Motor starters, starting switches, protective devices, and other means for the operation and control of equipment shall be furnished under the various Division 23 Sections, and installed and electrically connected complete under Division 26 unless otherwise specifically noted, except that control devices that are installed in or on ducts, piping, or mechanical equipment shall be mounted under Division 23. If equipment is furnished requiring power wiring different

from that indicated on the electrical drawings, the Contractor furnishing the equipment shall be responsible for any required revisions and pay any additional costs connected therewith. Wiring revisions shall be submitted to the Architect for approval prior to installation.

1. Motor starters shall be provided for each poly phase motor and for single phase motors requiring automatic control. See motor control center schedule on electrical drawings for starters that will be provided under Division 26. Additional disconnects required by the National Electrical Code shall be furnished, installed, and connected under Division 26 of the Specifications.
2. Contractors furnishing items to be wired shall provide adequate wiring diagrams.
3. Temperature control wiring shall be furnished and installed in raceway under Division 23 according to the requirements of Division 26, specifically Section "Conductors and Cables," and Section "Raceways and Boxes."

3.6 PAINTING

A. Touching Up: Provide cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

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

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases 8 inches thick, of dimensions indicated, but not less than 6 inches (100 mm) larger in both directions than supported unit.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
4. Use 3000 psi (20.7 MPa), 28 day compressive-strength concrete and reinforcement as follows:

    a. Reinforcing bars: ASTM A 615/A 615M, Grade 60; deformed.
    b. Number 5 bars, top and bottom at 12 inches o.c. each way.

END OF SECTION

SECTION 23 05 10 - METERS AND GAGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes meters and gages for mechanical systems.

1.3 SUBMITTALS

A. Product Data: Include scale range, ratings, and calibrated performance curves for each meter, gage, fitting, specialty, and accessory specified.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equivalent:
   1. Bimetal Dial Thermometers:
      a. Marsh Bellofram, L Series.
      b. Miljoco, MX Series.
      c. Trerice: H. O. Trerice Co., B Series.
      d. Weiss Instruments, Inc., 5BVM Series.
      e. Weksler Instruments, AF Series.
   2. Pressure Gages:
      a. Marsh Bellofram, H Series.
      b. Miljoco, P45 Series.
      c. Trerice: H. O. Trerice Co., 890 Series.
      d. Weiss Instruments, Inc., 4CTS Series.
      e. Weksler Instruments, EA Series.
   3. Test Plugs:
      a. Flow Design, Inc., "Super Seal".
      b. Peterson Equipment Co., Inc., #110.
      c. Sisco Manufacturing Co., #BNE-025.

2.2 THERMOMETERS, GENERAL

A. Scale Range: Temperature ranges for services listed are as follows:

1. Hot Water: 30 to 300 degrees F, with 2-degree scale divisions (0 to 150 degrees C, with 1-degree scale divisions).
2. Chilled Water: 0 to 100 degrees F, with 2-degree scale divisions (minus 18 to plus 38 degrees C, with 1-degree scale divisions).

B. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

2.3 BIMETAL DIAL THERMOMETERS

A. Description: ASME B40.3; direct-mounting, universal-angle dial type.

B. Case: Stainless steel with 5 inch (125 mm) diameter, glass lens.

C. Adjustable Joint: Finish to match case, 180 degree adjustment in vertical plane, 360 degree adjustment in horizontal plane, with locking device.

D. Element: Bimetal coil.

E. Scale: Satin-faced nonreflective aluminum with permanently etched markings.

F. Stem: Stainless steel for separable socket, of length to suit installation.

2.4 SEPARABLE SOCKETS

A. Description: Fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.
1. Material: Stainless steel, for use in steel piping.
2. Extension-Neck Length: Nominal thickness of 2 inches (50 mm), but not less than thickness of insulation. Omit extension neck for sockets for piping not insulated.
3. Insertion Length: To extend 2 inches (50 mm) into pipe.
4. Heat-Transfer Fluid: Oil or graphite.

2.5 THERMOMETER WELLS

A. Description: Fitting with protective well for installation in threaded pipe fitting to hold test thermometer.
1. Material: Stainless steel, for use in steel piping.
2. Extension-Neck Length: Nominal thickness of 2 inches (50 mm), but not less than thickness of insulation. Omit extension neck for wells for piping not insulated.
3. Insertion Length: To extend 2 inches (50 mm) into pipe.
4. Cap: Threaded, with chain permanently fastened to socket.
5. Heat-Transfer Fluid: Oil or graphite.

2.6 PRESSURE GAGES

A. Description: Phosphor-bronze bourdon-tube type with bottom connection; dry type, unless liquid-filled-case type is indicated.

B. Case: Drawn steel, brass, or aluminum with 4-1/2 inch (115 mm) diameter, glass lens.

C. Connector: Brass, NPS 1/4 (DN8).

D. Scale: White-coated aluminum with permanently etched markings.

E. Accuracy: Grade A, plus or minus 1 percent of middle 50 percent of scale.

F. Range: Comply with the following:
   1. Fluids under Pressure: Two times the operating pressure.

2.7 PRESSURE-GAGE FITTINGS

A. Valves: NPS 1/4 (DN8) brass or stainless-steel needle type.

B. Snubbers: NPS 1/4 (DN8) brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

C. Syphons: NPS 1/4 (DN8) coil of brass tubing with threaded ends.

2.8 TEST PLUGS

A. Description: Nickel-plated, brass-body test plug in NPS 1/2 (DN15) fitting.

B. Body: Length as required to extend beyond insulation.

C. Pressure Rating: 500 psig (3450 kPa) minimum.

D. Core Inserts: Two self-sealing valves, suitable for inserting 1/8 inch (3 mm) OD probe from dial-type thermometer or pressure gage.

E. Core Material for Air and Water: Minus 30 to plus 275 degrees F (Minus 35 to plus 136 degrees C), ethylene-propylene-diene terpolymer rubber.

F. Test-Plug Cap: Gasketed and threaded cap, with retention chain or strap.

G. Test Kit: Pressure gage and adapter with probe, two bimetal dial thermometers, and carrying case.
   1. Pressure Gage and Thermometer Ranges: Approximately two times the system's operating conditions.

PART 3 - EXECUTION

3.1 METER AND GAGE INSTALLATION, GENERAL

A. Install meters, gages, and accessories according to manufacturer's written instructions for applications where used.

3.2 THERMOMETER INSTALLATION

A. Install thermometers and adjust vertical and tilted positions.

B. Install separable sockets in vertical position in piping tees where fixed thermometers are indicated.
   1. Install with socket extending a minimum of 2 inches (50 mm) into fluid.
   2. Fill sockets with oil or graphite and secure caps.

C. Install thermometer wells in vertical position in piping tees where test thermometers are indicated.
   1. Install with stem extending a minimum of 2 inches (50 mm) into fluid.
   2. Fill wells with oil or graphite and secure caps.

3.3 PRESSURE-GAGE INSTALLATION

A. Install pressure gages in piping tees with pressure-gage valve located on pipe at most readable position.

B. Install pressure-gage needle valve and snubber in piping to water pressure gages.

C. Install pressure-gage needle valve and siphon in piping to steam pressure gages.

3.4 TEST PLUG INSTALLATION

A. Install test plugs in piping tees where indicated, located on pipe at most readable position. Secure cap.

3.5 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
   1. Install meters and gages adjacent to machines and equipment to allow service and maintenance.

3.6 ADJUSTING AND CLEANING

A. Calibrate meters according to manufacturer's written instructions, after installation.

B. Adjust faces of meters and gages to proper angle for best visibility.

C. Clean windows of meters and gages and clean factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

END OF SECTION

SECTION 23 05 19 - VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes general duty valves common to several mechanical piping systems.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.

C. Maintenance data for valves to include in the operation and maintenance manual specified in Division 1. Include detailed Manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9 for building services piping.

B. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set globe and gate valves closed to prevent rattling.
4. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.

2. Store indoors and maintain valve temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equivalent:

1. Ball Valves:

	2 Inches and Smaller
a. Milwaukee	BA110
b. Stockham	S216

2. Gate Valves, Class 125:

	2-1/2 Inches and Larger
a. Crane	461
b. Jenkins	326
c. Hammond	IR 1138
d. Walworth	719-F

3. Butterfly Valves:

	2-1/2 Inches and Larger
a. Crane	42
b. Jenkins	200
c. NIBCO	LC-2000

2.2 BASIC, COMMON FEATURES

A. Design: Rising stem or rising outside screw and yoke stems, except as specified below.

1. Nonrising stem valves may be used only where headroom prevents full extension of rising stems.

B. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.

C. Sizes: Same size as upstream pipe, unless otherwise indicated.

D. Operators: Use specified operators and handwheels, except provide the following special operator features:

1. Handwheels: For valves other than quarter turn.

E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

F. Threads: ASME B1.20.1.

G. Flanges: ASME B16.1 for cast iron, ASME B16.5 for steel, and ASME B16.24 for bronze valves.

H. Solder Joint: ASME B16.18.

1. Caution: Where soldered end connections are used, use solder having a melting point below 840 degrees F (450 degrees C) for gate, globe, and check valves; below 421 degrees F (216 degrees C) for ball valves.

2.3 GATE VALVES

A. Gate Valves, Class 125, 2-1/2 Inches (DN65) and Larger: MSS SP-70, Class 125, 200 psi (1380 kPa) CWP, ASTM A 126 cast-iron body and bonnet, solid cast-iron wedge, brass-alloy stem, outside screw and yoke, teflon-impregnated packing with 2 piece packing gland assembly, flanged end connections; and with cast-iron handwheel.

2.4 BALL VALVES

A. Ball Valves - 2 Inches (DN50) and Smaller: MSS SP-110, Class 150, 600 psi (4140 kPa) CWP, ASTM B 584 bronze body and bonnet, 2-piece construction; chrome-plated brass ball, standard port for 1/2 inch (DN15) valves and smaller and conventional port for 3/4 inch (DN20) valves and larger; blowout proof; bronze or brass stem; teflon seats and seals; threaded end connections.

B. Operator: Vinyl-covered steel lever handle.

C. Stem Extension: For valves installed in insulated piping.

D. Memory Stop: For operator handles.

2.5 BUTTERFLY VALVES

A. Butterfly Valves: MSS SP-67, 150 psi (1035 kPa) maximum pressure differential, ASTM A536, cast iron or ductile iron, extended neck, stainless-steel stem, aluminum bronze disc, or elastomer-coated ductile iron disk, EPDM sleeve and stem seals, full lug or grooved as indicated, valves 2 inches to 6 inches with latch lock lever handles, valves 8 inches and larger with gear operators and position indicator. All valves certified by manufacturer for dead-end service at full-rated working pressure without a down stream flange.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

A. Install valves as indicated, according to Manufacturer's written instructions.

B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.

C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.

D. Locate valves for easy access and provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above the center of the pipe.

F. Install valves in a position to allow full stem movement.

G. For chain-wheel operators, extend chains to 60 inches (1500 mm) above finished floor elevation.

H. Installation of Check Valves: Install for proper direction of flow as follows:

1. Swing Check Valves: Horizontal position with hinge pin level.

3.3 SOLDERED CONNECTIONS

A. Cut tube square and to exact lengths.

B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket.

C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.

D. Open gate and globe valves to fully open position.

E. Remove the cap and disc holder of swing check valves having composition discs.

F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.

G. Apply heat evenly to outside of valve around joint until solder melts on contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.4 THREADED CONNECTIONS

A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.

B. Align threads at point of assembly.

C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.

D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.5 FLANGED CONNECTIONS

A. Align flange surfaces parallel.

B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

3.6 VALVE END SELECTION

A. Select valves with the following ends or types of pipe/tube connections:

1. Copper Tube Size, 2 Inches (DN50) and Smaller: Solder ends.
2. Steel Pipe Sizes, 2 Inches (DN50) and Smaller: Threaded.
3. Steel and Copper Pipe Sizes, 2-1/2 Inches (DN65) and Larger: Flanged.

3.7 APPLICATION SCHEDULE

A. General Application: Use gate, ball, and butterfly valves for shutoff duty; globe, ball, and butterfly for throttling duty. Refer to Piping System Specification Sections for specific valve applications and arrangements.

B. Domestic Water Systems: Use the following valve types:

1. Ball Valves: For 2 inches and smaller, Class 150.

C. Chiller Water Systems: Use the following valve types:

1. Gate Valves: Class 125, cast-iron body to suit piping system, for 2 inches and smaller.
2. Butterfly Valves: Cast-iron or ductile-iron body for 2-1/2 inches and larger.

3.8 ADJUSTING

A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

END OF SECTION

SECTION 23 05 29 - HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes hangers and supports for mechanical system piping and equipment.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 SUBMITTALS

A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.

B. Welding Certificates: Copies of certificates for welding procedures and operators.

1.5 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Firms regularly engaged in manufacture of supports and hangers, of types and sizes required, whose products have been in satisfactory use in similar service.

2.2 MANUFACTURED UNITS

A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.

1. Nonmetallic Coatings: On hangers for electrolytic protection where hangers are in direct contact with copper tubing.

2.3 MISCELLANEOUS MATERIALS

A. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

B. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger requirements are specified in Sections specifying equipment and systems.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.

C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN15 to DN750).

D. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 degrees F (49 to 232 degrees C) piping installations.
3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

E. Building Attachments: Except as otherwise indicated, provide factory-fabricated building attachments complying with ANSI/MSS SP-58, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods.

F. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:

1. Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.

H. Thermal-Hanger Shield Inserts:

1. Description: 100 psig (690 kPa) minimum, compressive-strength insulation insert encased in sheet metal shield.

2. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier.
3. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass.
4. For Hangers and Clamped Systems: Insert and shield shall cover entire circumference of pipe.
5. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

3.2 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. All hangers for equipment and piping are to be supported from building structure even if structural enhancements to roof support is required.

B. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping.

C. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

D. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

E. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

F. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," are not exceeded.

H. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

I. Support vertical piping at each floor and roof.

J. Insulated Piping: Comply with the following:

1. All hangers and supports shall be external of insulation.
2. Install MSS SP-58, Type 40 protective shields on all insulated piping. Shields shall span arc of 180 degrees.
3. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2 (DN8 to DN90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.

b. NPS 4 (DN100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
c. NPS 5 and NPS 6 (DN125 and DN150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
d. NPS 8 to NPS 14 (DN200 to DN350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.

3.4 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.

B. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

C. Any vertical structural members required to form overhead attachments for hangers or equipment supports shall be located adjacent to walls and any horizontal members be adjacent to the roof structure.

3.5 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint.

END OF SECTION

SECTION 23 05 33 - ELECTRIC HEAT TRACING FOR PIPING

PART 1 - GENERAL

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

B. DESCRIPTION OF WORK: Extent of electric heat tracing work is indicated by drawings and the requirements of this section. Provide electric heat tracing for all exterior chilled water piping and fittings.

C. QUALITY ASSURANCE:

1. Installer: Qualified with successful installation experience on projects with electric heat tracing cable work similar to that required for project.

2. NEC Compliance: Comply with NFPA No. 70 Article 427.

3. UL Compliance: Provide electric heat tracing cables which are UL-listed and labeled.

D. SUBMITTALS: Submit manufacturer's data on electric heat tracing cables.

E. PRODUCT DELIVERY, STORAGE AND HANDLING:

1. Protect electric heat tracing cables from damage during shipping and handling.

2. Store electric heat tracing cables in original cartons and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.

PART 2 - PRODUCTS

A. GENERAL:

1. Electric Heat Tracing Cable: The self-regulating heater shall consist of two (2) 16-AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heater to be crossed over itself without overheating, to be used directly on plastic pipe, and to be cut to length in the field. The heating cable shall be covered by a radiation cross-linked, modified polyolefin dielectric outer jacket. Below the outer jacket shall be a braided metal cable cover separated from the self-regulating polymer core by a modified polyolefin inner jacket.

2. Regulation: In order to provide energy conservation and to prevent overheating, the heater shall have a self-regulating factor of at least 90 percent. The self-regulation factor is defined as the percentage reduction, without thermostatic control, of the heater output going from 40 degrees F pipe temperature operation to 150 degrees F pipe temperature operation.

3. Electrical: The heater shall operate on line voltage of 277 volts without the use of transformers.

4. Capacity: The heater shall be sized according to this table. The required heater output rating is in watts per foot at 50 degrees F. (Heater selection based on 1 inch fiberglass insulation on metal piping).

   a. Minimum Ambient Pipe Size: -10 degreesF
   b. 4 inch or less: 5 watt
   c. 5 inch or larger: 8 watt

5. Accessories: Power connection and end seal kits components shall be applied in the field.

6. Controls: The system shall be controlled by an ambient sensing thermostat set at 40 degrees F.

7. Manufacturer: Subject to compliance with requirements, provide electric heat tracing cable of one of the following or approved equivalent:

   a. Delta-Therm PSB series
   b. Nelson Type LT
   c. Raychem, XL-Trace

PART 3 - EXECUTION

A. INSTALLATION: Apply the heater linearly on the pipe after piping has been successfully pressure tested. Secure the heater to piping with cable ties or fiberglass tape. Apply "electric traced" signs to the outside of the thermal insulation.

B. Provide ground fault protection of equipment for heat tracing cable.

C. TESTS: After installation and before and after installing the thermal insulation, subject heat tracing cable to testing using a 1000 VDC megger. Minimum insulation resistance should be 20 to 1000 megaohms regardless of length. Replace faulty cable.

END OF SECTION

SECTION 23 05 53 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following mechanical identification materials and their installation:

1. Equipment nameplates.
2. Equipment markers.
3. Pipe markers.
4. Valve tags.

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:

    a. Manufacturer, product name, model number, and serial number.
    b. Capacity, operating and power characteristics, and essential data.
    c. Labels of tested compliances.

2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.

1. Terminology: Match schedules as closely as possible.
2. Data:

    a. Name and number as indicated on plans.
    b. Equipment service (area served).

3. Size: 4-1/2 by 6 inches (115 by 150 mm) for equipment (chillers, pumps, air units).

C. Access Panel and Door Markers: 1/16 inch (1.6 mm) thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification.

1. Fasteners: Contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Pre-printed, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME A13.1, unless otherwise indicated.
2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
3. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Full-band pipe markers extending 360 degrees around pipe at each location.
4. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pre-Tensioned Pipe Markers: Pre-coiled, semi-rigid, plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

1. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

2.3 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4 inch (6.4 mm) letters for piping system abbreviation. Provide 5/32 inch (4 mm) hole for fastener.

1. Material: 0.032 inch (0.8 mm) thick brass.
2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

1. Chillers
2. Pumps
3. Variable Frequency Drives

B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment.

1. Letter Size: 1/2 inch (13 mm).
2. Locate markers where accessible and visible. Include markers for the following general categories of equipment:

    a. Chillers
    b. Pumps
    c. Variable Frequency Drives

C. Install access panel markers on equipment access panels.

3.3 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow. Use size to ensure a tight fit.

B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 5 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves.

B. Valve-Tag Size and Shape:

1. Cold Water: 1-1/2 inches (38 mm) round.
2. Hot Water: 1-1/2 inches (38 mm) round.
3. Gas: 1-1/2 inches (38 mm) round.

3.5 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.6 CLEANING

A. Clean faces of mechanical identification devices.

END OF SECTION

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All Division 23 Specification Sections, Drawings, and general provisions of the Contract apply to work of this Section, as do other documents referred to in this Section.

1.2 SCOPE OF WORK

A. The Contractor shall obtain the services of an independent Test and Balance (TAB) Company which specializes in the testing and balancing of heating, ventilating and air conditioning (HVAC) systems to test, adjust and balance all HVAC systems in the building(s).

B. The work included in this Section consists of furnishing labor, instruments, and tools required in testing, adjusting and balancing the HVAC systems as described in these Specifications or shown on accompanying Drawings. Services shall include checking equipment performance, taking the specified measurements, and recording and reporting the results. The testing, adjusting, and balancing agency shall act as a reporting agency; that is, list and report each piece of equipment as to identification number, manufacturer, model number, serial number, proper location, specified performance, and report actual performance of all equipment as found during testing. The report is intended to be used during the life of the building as a ready reference indicating original conditions, equipment components, etc.

C. Representatives of the Test and Balance Company shall visit the job site during installation of the HVAC equipment, piping, and ductwork as required.

D. Upon completion of the HVAC system installation, the Test and Balance Company shall perform all required testing and balancing with the full cooperation of the Contractor and his Sub-Contractors. The Contractor shall make changes and/or adjustments to the HVAC system components that are required by the Test and Balance Company to accomplish proper balancing. The TAB agency shall not supply or install any materials or balancing devices such as pulleys, drives, belts, etc. All of this work is by the Contractor and shall be performed at no additional cost to the Owner.

E. The test and balance report complete with a summary page listing all deficiencies shall be submitted to the Architect for review by his Mechanical Engineer. If the Mechanical Engineer agrees with the report, he shall sign it and return it to the Architect. The test and balance report must be complete and must be accepted by the Mechanical Engineer prior to acceptance of the project. Any outstanding test and balance items shall be placed on the punch list and a monetary value shall be assigned to them.

F. After all deficiencies have been corrected, the Mechanical Engineer shall sign the testing and balancing report, and the Test and Balance Company shall supply 4 copies of the

final and complete report to the Architect for inclusion in the Operation and Maintenance Manuals.

G. The items requiring testing, adjusting, and balancing include (but are not restricted to) the following:

1. Hydronic Systems:

a. New and existing Pumps
b. System mains and branches
c. Control Valves
d. Chillers

1.3 DEFINITIONS, REFERENCES, STANDARDS

A. All work shall be in accordance with the latest edition of the Associated Air Balance Council (AABC) National Standards or the latest standards of the National Environmental Balancing Bureau (NEBB). If these contract documents set forth more stringent requirements than the AABC National Standards or the NEBB Standards, these Contract Documents shall prevail.

1.4 QUALIFICATIONS

A. Agency Qualifications: The TAB Agency shall be a current member of the AABC or the NEBB.

1.5 SUBMITTALS

A. Procedures and Agenda: The TAB agency shall submit the TAB Procedures and agenda proposed to be used.

B. Sample Forms: The TAB agency shall submit sample forms, which shall include the minimum data required by the AABC National Standards or the NEBB Standards.

C. Job Site Inspection Report: Inspect the installation of all HVAC systems prior to TAB work. Provide inspection report to the Architect and Contractor.

1.6 TAB PREPARATION AND COORDINATION

A. Shop drawings, submittal data, up-to-date revisions, change orders, fan curves, pump curves and other data required for planning, preparation, and execution of the TAB work shall be provided when available and no later than 30 days after the Designer has returned the final approved submittal data to the Contractor.

B. System installation and equipment startup shall be complete prior to the TAB agency's being notified to begin.

C. The building control system (BMCS) contractor shall provide and install the control system, including all temperature, pressure and humidity sensors. These shall be calibrated for accurate control. If applicable, the BMCS contractor shall install all necessary computers and computer programs, and make these operational. Assistance shall be provided as required for reprogramming, coordination, and problem resolution.

D. All test points, balancing devices, identification tags, etc., shall be accessible and clear of insulation and other obstructions that would impede TAB procedures.

E. Qualified installation or startup personnel shall be readily available for the operation and adjustment of the systems. Assistance shall be provided as required for coordination and problem resolution.

1.7 REPORTS

A. TAB Report: The TAB agency shall submit the preliminary TAB report for review by the Architect. On plans provided, all outlets, devices, HVAC equipment, etc., shall be identified (including manufacturer, model number, serial number, motor manufacturer, HP, drive type, fan and motor sheaves and belt number), along with a numbering system corresponding to report unit identification. The TAB agency shall submit an AABC "National Project Performance Guaranty" (or similar NEBB Guaranty) assuring that the project systems were tested, adjusted and balanced in accordance with the project specifications and AABC National Standards (or similar NEBB Standards). The Designer shall review the TAB report and note any items which do not appear to be within the allowable tolerances. The contractor shall make corrections to the installation of these items and the TAB contractor shall retest the corrected items and resubmit the complete TAB report. The designer shall indicate his approval of the Final Tab Report and return to the contractor.

1. The Contractor shall Submit the Final TAB Report to the Architect and include in each copy of the Operation and Maintenance Manuals.

PART 2 - INSTRUMENTATION

2.1 GENERAL

A. All instruments used for measurements shall be accurate and calibrated. Calibration and maintenance of all instruments shall be in accordance with the requirements of AABC National Standards (or similar NEBB Standards).

PART 3 - EXECUTION

3.1 GENERAL

A. The specified systems shall be reviewed and inspected for conformance to Design Documents. Testing, adjusting and balancing on each identified system shall be performed. The accuracy of measurements shall be in accordance with AABC National

Standards (or similar NEBB Standards). Adjustment tolerances shall be + or - 10 percent unless otherwise stated.

B. Equipment settings, including manual damper quadrant positions, valve indicators, fan speed control levers, and similar controls and devices shall be marked to show final settings.

C. All information necessary to complete a proper TAB project and report shall be per AABC or NEBB standards unless otherwise noted. The descriptions of work required, as listed in this section, are a guide to the minimum information needed.

D. TAB contractor shall cut insulation, ductwork and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. Upon completion, patch insulation, ductwork, and housings using materials identical to those removed. Seal insulation to reestablish integrity of the vapor barrier.

E. TAB work shall include additional inspection and adjustment of components during the season following the initial balance to include re-balance of any items influenced by seasonal changes or as directed by the Owner.

3.2 HYDRONIC SYSTEMS

A. The TAB agency shall, as applicable, verify that all hydronic equipment, piping, and coils have been filled and purged; that strainers have been cleaned; and that all balancing valves (except bypass valves) are set full open. Examine water in system and determine if it has been treated and cleaned. As applicable, it shall check air vents and expansion or compression tank for proper operation. The TAB agency shall perform the following testing and balancing functions in accordance with the AABC National Standards (or similar NEBB Standards):

1. For system mains and branches:

    a. Adjust water flow in pipes to within design GPM requirements. As applicable, at least one branch balancing valve shall be completely open.

2. For Chillers/Boilers/Cooling Towers: Measure flow, inlet and outlet pressures, and temperatures. Include current draw and capacity
3. For coils:

    a. Tolerances: Test, adjust, and balance all chilled-water and hot-water coils within 10 percent of design requirements.
    b. Verification: Verify the type, location, final pressure drop and GPM of each coil. This information shall be recorded on coil data sheets.

4. For control valves:

    a. Check operation of automatic valves.
    b. Test and record pressure drop and flow across control valves at full flow.

5. For Pumps: Measure flow, intended outlet pressures. Include current draw and capacity.

3.3 ADDITIONAL TAB SERVICES

A. Job Site Inspections: During construction, the TAB agency shall inspect the installation of pipe systems, sheet metal work, temperature controls, and other component parts of the HVAC systems as required.

B. Verification of HVAC Controls: The TAB agency shall be assisted by the building control systems Contractor in verifying the operation and calibration of all HVAC and temperature control systems. The following tests shall be conducted:

1. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air and water resets, fire and freeze stats, and other safety devices.

2. Verify that all controlling instruments are calibrated and set for design operating conditions.

C. Temperature Testing: To verify system control and operation, a series of three temperature tests shall be taken at approximately two hour intervals in each separately controlled zone. The resulting temperatures shall not vary more than two degrees Fahrenheit from the thermostat or control set point during the tests. Outside temperature and humidity shall also be recorded during the testing periods.

D. TAB Report Verification: At the time of final inspection, the TAB agency may be required to recheck, in the presence of the owner's representative, specific and random selections of data, air quantities, and air motion recorded in the certified report. Points and areas for recheck shall be selected by the owner's representative. Measurements and test procedures shall be the same as approved for the initial work for the certified report. Selections for recheck, specific plus random, will not exceed 10 percent of the total number tabulated in the report.

END OF SECTION

SECTION 23 07 16 - EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes blanket insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

B. Related Sections include Division 23 Section, "Pipe Insulation," for insulation for piping systems.

1.3 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

B. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Insulation firm with successful installation experience on projects with mechanical systems insulation similar to that required for this project.

B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
   1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate clearance requirements with equipment Installer for insulation application.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Mineral-Fiber Board Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.

B. Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.

C. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
   1. Adhesive: As recommended by insulation material manufacturer.

2.2 FIELD-APPLIED JACKETS

A. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils (0.5 mm) thick; roll stock ready for shop or field cutting and forming.
   1. Adhesive: As recommended by insulation material manufacturer.
   2. PVC Jacket Color: White.

2.3 ACCESSORIES AND ATTACHMENTS

A. Bands: 3/4 inch (19 mm) wide, in one of the following materials compatible with jacket:
   1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch (0.5 mm) thick.

B. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.
   1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb (45 kg) for direct pull perpendicular to the adhered surface.

C. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

2.4 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of equipment.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each equipment system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either the wet or dry state.

D. Apply multiple layers of insulation with longitudinal and end seams staggered.

E. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

F. Keep insulation materials dry during application and finishing.

G. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

H. Apply insulation with the least number of joints practical.

I. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

J. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.

K. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

L. Install vapor-retarder mastic on equipment scheduled to receive vapor retarders. Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.

M. Insulate the following indoor equipment:
1. Chilled water pumps.

N. Omit insulation from the following:
1. Testing agency labels and stamps.
2. Nameplates and data plates.
3. Handholes.
4. Cleanouts.

3.4 FIELD-APPLIED JACKET APPLICATION

A. PVC Jackets: Apply jacket with longitudinal seams along top and bottom of tanks and vessels for horizontal applications. Secure and seal seams and end joints with manufacturer's welding adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along the seam and joint edge.

3.5 EQUIPMENT APPLICATIONS

A. Insulation materials and thicknesses are specified in the Schedules at the end of this Section.

B. Materials and thicknesses for systems listed below are specified in the Schedules at the end of this Section.

3.6 INTERIOR TANK AND VESSEL INSULATION APPLICATION SCHEDULE

A. Equipment: Chilled water pumps, air separators and expansion tanks.
1. Operating Temperature: 400 degrees F.
2. Insulation Material: Rigid mineral fiber.
3. Insulation Thickness: 2 inch.
4. Field-Applied Jacket: PVC.

END OF SECTION

SECTION 23 07 19 - PIPE INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

B. Related Sections include Division 23 Section, "Hangers and Supports," for pipe insulation shields and protection saddles.

1.3 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

B. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An insulation firm with successful installation experience on projects with mechanical systems insulations similar to that required for this project.

B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for insulation application.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after testing piping systems and, where required, after installing and testing heat-trace tape. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Firms regularly engaged in the manufacture of piping insulation products, of types and sizes required, whose products have been in satisfactory use in similar service.

2.2 INSULATION MATERIALS

A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:

1. Preformed Pipe Insulation: Minimum 4 pound density, 0.23 maximum k factor at 75 degrees F mean temperature, with factory-applied, all-purpose, vapor-retarder jacket.
2. Blanket Insulation: Minimum 3/4 pound density 0.3 maximum k factor at 75 degrees F mean temperature, without facing.
3. Insulation Accessories: Provide staples, bands, wires, cement, tape, anchors, corner angles, and similar accessories as recommended by the insulation manufacturer for the applications indicated.
4. Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes, and similar compounds as recommended by the insulation manufacturer for the applications indicated.
5. Lagging Adhesive: Foster Sealfas Coating 30-36, Insul. Coustic I-C 102, St. Clair Rubber Co. Z41A, or approved equal.

B. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials, with smooth skin on both sides. Thermal conductivity 0.30 average maximum at 75 degrees F.

1. Adhesive: As recommended by insulation material manufacturer.

2.3 FIELD-APPLIED JACKETS

A. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils (0.5 mm) thick; roll stock ready for shop or field cutting and forming.

1. Adhesive: As recommended by insulation material manufacturer.
2. PVC Jacket Color: White.

B. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20 mil (0.5 mm) thick, high-impact, ultraviolet-resistant PVC.

1. Shapes: 45 and 90 degree, short and long radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
2. Adhesive: As recommended by insulation material manufacturer.

C. Aluminum Jacket: Factory cut and rolled to the indicated sizes. Comply with ASTM B 209 (ASTM B 209M), 3003 alloy, H-14 temper.

1. Finish and Thickness: Smooth finish, 0.010 inch (0.25 mm) thick.
2. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish and thickness as jacket.

2.4 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd. (270 g/sq. m).

1. Tape Width: 4 inches (100 mm).

B. Bands: 3/4 inch (19 mm) wide, in one of the following materials compatible with jacket:

1. Stainless Steel: Type 304; 0.020 inch (0.5 mm) thick.

C. Wire: 062-inch (1.6-mm), soft-annealed, stainless steel.

2.5 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.

E. Apply multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

H. Keep insulation materials dry during application and finishing.

I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

J. Apply insulation with the least number of joints practical.

K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, and other projections with vapor-retarder mastic.

1. Apply insulation continuously through hangers and sleeves. All hangers and supports shall be external of insulation.
2. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.

3. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

O. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Circumferential Joints: Cover with 3 inch (75 mm) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches (100 mm) o.c.
3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches (40 mm). Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.

    a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.

4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

P. Comply with MICA Insulation Standards. Insulate valves per Plate No. 14.

Q. Provide removable insulated covers for all balancing valves, temperature/pressure plugs, and any other items that require access. No openings in the insulation or vapor barrier will be permitted on cold lines.

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Where pipe expansion is anticipated, detail expansion compensation for insulation on Drawings and indicate intervals for its occurrence. See MICA's "National Commercial & Industrial Insulation Standards," Plate No. 41A.
2. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
3. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet (4.5 to 6 meters) to form a vapor retarder between pipe insulation segments.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:

1. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When pre-molded insulation elbows and fittings are not available, apply mitered sections of pipe insulation to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
3. Cover fittings with standard PVC fitting covers. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

D. Apply insulation to valves and specialties as follows:

1. Apply pre-molded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When pre-molded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
3. Apply insulation to flanges as specified for flange insulation application.
4. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Follow manufacturer's written instructions for applying insulation.
2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to fittings and elbows as follows:

1. Apply mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.6 PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

3.7 FIELD QUALITY CONTROL

A. Inspection: Perform the following field quality-control inspections, after installing insulation materials, jackets, and finishes, to determine compliance with requirements:

1. Inspect fittings and valves randomly selected by Architect.
2. Remove fitting covers from 5 elbows or 1 percent of elbows, whichever is less, for various pipe sizes.
3. Remove fitting covers from 5 valves or 1 percent of valves, whichever is less, for various pipe sizes.

B. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective work and replace with new materials according to these Specifications.

C. Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.

3.8 INSULATION APPLICATION SCHEDULE, GENERAL

A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.

3.9 INTERIOR INSULATION APPLICATION SCHEDULE

A. Chilled-water supply and return.

1. Operating Temperature: 35 to 75 degrees F (2 to 24 degrees C).
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: Apply the following insulation thicknesses:

    a. Pipe sizes smaller than 1”: 3/4 inch.
    b. Pipe sizes 1 ¼” to 2 ½”: 1-1/2 inch
    c. Pipe size 3” to 6”: 2 inches.
    d. Pipe sizes 8” and Larger: 2 inches.

4. Field-Applied Jacket: PVC for exposed piping.
5. Vapor Retarder Required: Yes.
6. Finish: None.

B. Domestic cold water

1. Operating Temperature: < 40 degrees F (4 degrees C).
2. Insulation Material: flexible elastomeric.
3. Insulation Thickness: Apply the following insulation thicknesses:

a. Pipe sizes smaller than 1”: 3/4 inch.
b. Pipe size 1” to 6”: 1 inch.

4. Field-Applied Jacket: none.
5. Vapor Retarder Required: Yes.
6. Finish: None.

3.10 EXTERIOR INSULATION APPLICATION SCHEDULE

A. Service: Chilled water supply and return.

1. Operating Temperature: 35 to 75 degrees F (2 to 24 degrees c).
2. Insulation Material: Mineral fiber.
3. Insulation Thickness: Apply the following insulation thicknesses:

a. Pipe sizes smaller than 1”: 3/4 inch.
b. Pipe sizes 1 ¼” to 2 ½”: 1-1/2 inch
c. Pipe size 3” to 6”: 2 inches.
d. Pipe sizes 8” and Larger: 2 inches.

4. Field-Applied Jacket: Aluminum.
5. Vapor Retarder Required: Yes.
6. Finish: None.

3.11 FIELD-APPLIED JACKET APPLICATION

A. Apply PVC jacket over all piping, fittings, valves, flanges, etc. located in equipment rooms and mechanical rooms, up to an elevation of 8 feet above the finished floor of the space. Apply with 1 inch (25-mm) overlap at longitudinal seams and end joints. Seal with Manufacturer’s recommended adhesive.

B. Apply metal jacket over all piping, fittings, valves, flanges, etc. on the building exterior. Apply with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by Insulation Manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

END OF SECTION

SECTION 23 09 23 - BUILDING MANAGEMENT AND CONTROL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. This section describes the Enterprise Level Energy Management Systems (ELEMS) scope of work for the project. This section also coordinates the responsibilities of the Mechanical and Electrical trade contractors pertaining to control products or systems, furnished by each trade that will be integrated by this Division.

B. All labor, material, equipment, programming, graphics and software not specifically referred to herein or on the plans, that is required to meet the functional intent of this specification, shall be provided without additional cost to the Owner.

C. The BMCS shall be provided by a single consultant (The Systems Integrator) for this facility. This package consists of providing a BMCS for the following projects:

1. Shreveport Municipal Courts Building – HVAC Renovations.

D. It is the owner's goal to implement an open system that will allow products from various suppliers to be integrated into a unified system in order to provide flexibility for expansion, maintenance, and service of the system. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s).

E. Controllers for all equipment shall be provided by the Division 23 contractor, installed and wired by the Division 23 contractor, and integrated into the new BMCS and the existing Johnson Controls Inc. Metasys BMCS and control system by the Division 23 09 23 contractor.

F. The system network will be BACnet/MSTP or BACnet/IP. No Exceptions will be made

G. Save all points, sequences, set points, set backs, time schedules, and safeties for all existing equipment prior to demolition of any existing items.

H. Provide new JACE, controllers, actuators, hardware, software, wiring and conduit as required by this Section and the drawings.

1.2 SYSTEM DESCRIPTION

A. The new BMCS shall interface with the existing BMCS, Technician shall be certified in Tridium Niagra N4 Web Supervisor with current license.

B. The Building Management and Control System (BMCS) as provided in the Division shall be Based on the Niagara Framework (or "Niagara"), a Java-based framework. Niagara provides an open automation infrastructure that integrates diverse systems and devices (regardless of manufacturer, communication standard or software) into a unified platform that can be easily managed in real time over the Internet using a standard Web browser. Systems not developed on the Niagara Framework platform are unacceptable.

C. The Building Management and Control System (BMCS) shall be comprised of Network Area Controller or Controllers (NAC) within each facility. The NAC shall connect to the existing BMCS and the wide area network. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network. Each NAC shall communicate to BACnet control devices provided under Division 23.

D. All Network Area Controllers provided in this section shall integrate seamlessly to existing BMCS. All control points shall be viewable and writable utilizing the existing BMCS. Use of additional IP address or access to this system from any device not resident in the existing Web Supervisor is not acceptable.

1.3 QUALITY ASSURANCE

A. Manufacturer: Firms regularly engaged in manufacture of electric-electronic temperature control equipment, of types and sizes which are similar to required equipment, and which have been in satisfactory use in similar service for not less than 5 years. Manufacturer shall have an established factory authorized service organization in Shreveport, Louisiana.

B. Installer: A firm specializing and experienced in electric-electronic control system installations for not less than 5 years.

C. Electrical Standards: Provide electrical products which have been tested, listed, and labeled by Underwriters' Laboratories (UL) and comply with NEMA standards.

D. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for electric-electronic temperature control systems.

1.4 SUBMITTALS

A. Submit 5 complete sets of documentation in the following phased delivery schedule:

1. Technician current license for Tridium Niagara Web Supervisor.
2. BACnet Testing Laboratories Listing and Certification documents
3. Valve and damper schedules
4. Equipment data cut sheets
5. System schematics, including:

    a. Sequence of operations
    b. Point names
    c. Point addresses
    d. Point to point wiring
    e. Interface wiring diagrams
    f. Panel layouts
    g. System riser diagrams

6. AutoCAD compatible or equal as-built drawings

B. Upon project completion, provide owner with BMCS programming software and submit operation and maintenance manuals, consisting of the following:

1. Manufacturer's equipment parts list of all functional components of the system
2. Description of sequence of operations
3. As-Built interconnection wiring diagrams
4. User’s documentation containing product, system architectural and programming information.
5. Trunk cable schematic showing remote electronic panel locations, and all trunk data
6. List of connected data points, including panels to which they are connected and input device
7. Conduit routing diagrams
8. Copy of the warranty
9. Operating and maintenance cautions and instructions
10. Recommended spare parts list

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide factory shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protected from weather.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. General: Provide electric-electronic temperature control products in sizes and capacities indicated, consisting of valves, dampers, thermostats, sensors, controllers, and other components as required for complete installation. Except as otherwise indicated, provide Manufacturer's standard temperature control system components as indicated by published product information, designed and constructed as recommended by Manufacturer. All new components shall be manufactured to be completely compatible and interchangeable with existing Niagara N4 Web Supervisor. Provide temperature control systems with the following functional and construction features as indicated.

B. Control Valves: Provide factory-fabricated electrical control valves of type, body material and pressure class indicated. Where type or body material is not indicated, provide selection as determined by Manufacturer for installation requirements and pressure class, based on maximum pressure and temperature rating of piping system. Except as otherwise indicated, provide valves which mate and match material of connecting piping. Equip control valves with control valve motors, and with proper shutoff ratings for each individual application. All valves shall be proportional control, except for fan coil units which shall be on/off.

C. Water Service Valves: Equal percentage characteristics with range of 50 to 1.

D. Single-Seated Valves: Cage type trim, providing seating and guiding surfaces for plug on "top and bottom" guided plugs.

E. Valve Trim and Stems: Polished stainless steel for all sizes, trim as recommended by Manufacturer.

F. Packing: Spring-loaded Teflon, self-adjusting.

G. Valve Pressure Drop: Two (2) psi maximum unless noted otherwise.

2.2 All new controllers connected to the Niagara network will not have additional software required to perform any programming functions. All programming will be accomplished through the Niagara Workbench.

A. All Applied controllers shall BACnet/IP controllers and will require an IT connection furnished by the installing contractor and that must be coordinated with the owners IT department.

2.3 JACE Equipment Controller (JEC)

B. Provide an IP based Equipment controller based on the Tridium the Niagara N4 Framework® JACE and Integral IO Modules. The JACE Equipment Controller (JEC) shall be an embedded controller/server platform designed for monitoring and control applications. The unit shall support integrated control, supervision, data logging, alarming, and scheduling, 34 points of IO, with Internet connectivity and web serving capabilities. The JEC shall support all Niagara bases programming tools and integrate with Niagara based N4 supervisory servers.

C. The JEC shall provide applications for controlling and monitoring building systems including HVAC equipment, lighting, and meters. An integral 34 point IO module shall be provided with each controller. The Input/Output module shall provide 34 points for local control. In addition to local control, the JEC shall be licensed for up to 5 remote devices that can come into the controller via Lon, BACnet, or Modbus. The JEC shall serve data and rich graphical displays to a standard web browser via an Ethernet LAN or remotely over the Internet. Where specified, Niagara N4 software can be used to aggregate information (real-time data, history, alarms, etc.) from large numbers of JECs into a single unified application to manage global control functions, support data passing over multiple networks, connect to enterprise level software applications, and host multiple, simultaneous client workstations connected over the local network, the Internet.

D. Features shall include

1. Web User interface shall serve rich presentations and live data to any browser
2. Supports simultaneous stand-alone control, energy management, and multi-protocol integration
3. BTL® listed when BACnet driver is used – shall comply with B-BC (BACnet Building Controller)
4. Built-in 24 volt AC/DC input power supply
5. Support for 2 additional onboard 16 point IO modules and 4 additional 16 point remote IO modules.
6. Pre-Licensed for five total remote devices – integrated via BACnet.
7. Din Rail mountable for quick installation
8. IO-34 - 34 Point I/O Module

    a. 16 Universal Inputs (Type 3 (10k) Thermistors, 0-1000 ohm, 0-10 volts, 0-20 mA with external resistor)
    b. 10 relay outputs (Form A contacts, 24 VAC @.5 amp rated)
    c. 8 analog outputs (0-10 volt DC)

9. Communications

    a. 2 Ethernet Ports – 10/100 Mbps (RJ-45 Connectors)
    b. 1 RS 232 Port (RJ-45 connector)
    c. 1 RS 485 non isolated port (Screw Connector on base board)
    d. 2 card slots for optional communication cards

E. Provide all necessary hardware, software, and programming for the specified sequence of operation, graphics, alarms, histories, and trends. Provide JEC with the Tridium open NIC for connection by any Niagara N4 based engineering tool.

F. UPS/Surge Protection device with full time EMI/RFI filter and rated for 490 Joules.

1. Resettable, 15 Amp circuit breaker.
2. 600 YA, 330 watt battery output.
3. 3 year warranty and #75,000 equipment protection.
4. Audible and visual alarms.
5. APC (Schneider Electric) BE600M1 or approved equal.

2.4 SENSORS

A. System and Sensor Accuracy: The system shall maintain an end-to-end accuracy for two years from sensor to diagnostic display for the applications specified.

1. Space temperature with a range of 50 to 85 degrees F, plus or minus 0.75 degrees F for conditioned space.
2. Outside Air (OA) temperature with a range of minus 40 to plus 130 degrees F, plus or minus 2.0 degrees F, with a sub-range of plus 30 to 100 degrees F, plus or minus 1.0 degree F.
3. Water temperature with a range of 30 to 100 degrees F, plus or minus 0.75 degrees F; the range of 100 to 250 degrees F within plus or minus 2.0 degrees F.

B. Temperature Sensors: Temperature sensors shall be resistance temperature detectors (RTD's). Sensing element shall be nickel with common reference of 1000 ohms at 70 degrees F. Provide sensing elements as follows:

1. Liquid immersion RTD shall be provided with brass thermowell. Length of sensor and thermowell shall be selected based on diameter of pipe to facilitate accurate, reliable, homogeneous and steady temperature sensing of the liquids.
2. Room temperature sensors shall have setpoint adjusters with no thermometer.

C. Humidity Sensors: Provide sensors capable of measuring relative humidity over the entire 0% to 100% range with $\pm$ 2% accuracy.

D. Current Sensing Status Relays: The on and off status of each pump motor and fan motor shall be indicated via a current sensing relay and current transformer on one of the power legs to the associated motor. Relay shall provide dry contact closure with motor on but shall indicate open contact whenever fan belt breaks or if the motor fails to run. Current sensing relay and start/stop relay shall not be combination type.

E. Valve and Damper Operators: Valve operators shall be electronic type. Operator shall be designed for maximum pressure differential or torque required (plus 50 percent) across the

valve. Valve operators shall be complete with feedback position indicator for interface to DDC controller. Operators shall be spring return type to fail safe in event of signal or power loss.

F. Local Control Panels: Provide a central control panel located in the mechanical room with suitable brackets for wall mounting. Locate panel adjacent to systems served.

G. Provide standard steel cabinets as required to contain temperature controllers, relays, switches, and similar devices, except limit controllers and other devices excluded in sequence of operations. Provide full-enclosure cabinets with painted gray finish.

PART 3 - EXECUTION

3.1 INSTALLATION and WIRING

A. General: Install system and materials in accordance with Manufacturer's instructions and roughing-in Drawings and details on Drawings. Mount controllers at convenient locations and heights.

B. All input and output wiring for devices needed to perform the indicated sequence of operation for a specific equipment item shall be connected to a single equipment controller so that the equipment may fully function upon a loss of BMCS network communication. Multiple equipment items may be connected to a single controller provided that all inputs and outputs necessary are connected to that controller. Input/Output expansion modules may be utilized.

C. Number-code or color-code conductors, excluding those used for local individual room controls, appropriately for future identification and servicing of control system.

D. All wiring, low and line voltage shall be run in conduit (wireless communication is not permitted). NO EXCEPTIONS.

E. The electrical contractor (Div. 26) shall furnish all power wiring to electrical starters and motors.

3.2 GRAPHICAL USER INTERFACE

A. Introduction:

1. The goal is to provide the end user with a fully functional set of graphics with which to operate, test and trouble shoot their systems with, while still maintaining a standard look and “feel” across all graphics.

B. Base Graphic (Graphic Template)

1. The base of the graphic consists of its background color and title bar. The title bar includes a forward, back, home, schedule, trends, alarm, and help buttons. Outdoor air temperature and humidity (if available) should be on the title bar also.

    a. Standards for the “base” of all graphics should include:

        1) All graphics should be sized to fit nicely on a monitor running 1280x1024 resolution and shall scale to any given resolution.
        2) All graphics should be displayed in Niagara without any scroll bars,

when viewed at the resolution listed above.

3) Display background should be RGB (64, 64, 64) in color.
4) Display of the frame and navigation tree should be RGB (32, 32, 32) in color.
5) Interactive navigation tree should be located on the left-hand side of every graphic page.

2. The navigation tree graphic should:

    a. Navigate from building to building
    b. Select a unit or summery to view

3. The Unit Name and Job Name should be in Tahoma, 12pt Bold, Black.

C. Mechanical Equipment

1. All mechanical equipment graphics should match that being used. IE: absorption vs. centrifugal chillers; plate-and-frame vs. tube heat exchangers; sectional vs. fire tube boilers; air-to-air vs. heat wheel heat exchangers.

D. AHU and Duct Work

1. All ducts should be laid out using the appropriate pieces from the 3D library as to ensure all shading, shadows and color variations line up. Inserting a single piece, such as an elbow, and rotating it is not acceptable as this causes misalignment.

2. All duct terminations or "ends" should be labeled as appropriate: OA, DA, SA, EA etc...

    a. Tahoma font
    b. 12pt Bold
    c. "Black" or RGB(255,255,255) in color

E. Sensors

1. All duct sensors, probes and meters of any kind should be animated with a "red" color around the text if the device is in the alarm state and the alarm state is available. This is especially important for freeze-stats and smoke detectors.

F. Dampers

1. Dampers should be animated and the dampers should match the control signal type (use two position dampers for digital control, and modulating dampers for analog control)

G. Heating/Cooling Coils & DX

1. Heating coil type shown should match actual coil type (electric vs. hot water or steam). Bypass piping and pumps should be shown or not shown to match the actual system. Bypass pumps should be animated if the data is available. The percent open will be shown on the coil ex: if the valve is 25% open then 25% of the coil will be shaded red.

2. Cooling coils should match actual coil type (DX vs. chilled water). Bypass piping and

pumps should be shown or not shown to match the actual system. Bypass pumps should be animated if the data is available. The percent open will be shown on the coil ex: if the valve is 25% open then 25% of the coil will be shaded blue.

H. Floor Plan Graphics

1. Floor plan graphics consist of 4 major parts:

    a. Base Graphic
    b. 3D Floor Plans
    c. Data
    d. Labeling/Legend

2. The base graphic will follow the standards for "Base Graphics" detailed earlier in this document. The actual floor plan on a graphic should be comprised of 3 parts:

    a. Floor Plan Image: This should be a 3D CAD drawing which has been converted to a png image (png images support the "invisible" color). Specific layers of the CAD drawings should be turned off to leave only building wall, door, window and major partitions visible. The color of all visible layers should be Dark Grey RGB (105,105,105)
    b. Room Numbering/Labeling

        1) Labels shall include box/room number and change color on a gradient scale up and down in 1 degree increments with dark blue being coldest and red being the hottest.

    c. Zoning; this helps visually determine what equipment is serving an area and if the equipment is maintaining a suitable comfort level

3. Data displayed on a floor plan graphic will utilize a custom created dynamic shape. This shape will display space temperature, equipment name and include a link to the equipment. As you place the cursor over a zone, the name of the zone will be located in the frame above the floor plan and can also be edited by the end user. In the event this data is not available for a specific zone, the dynamic shape should not be placed within that space. Upon clicking on the link, the user will navigate to the specific equipment for that zone. All detail pages will utilize the template graphics for terminal units as discussed earlier in this document.

I. Points List

1. Refer to points list on drawings.
2. In addition to the points indicated, all points necessary to perform the sequence of operation shall be displayed for all equipment or space associated with that point.
3. Restore/reprogram all points, sequences, set points, set backs, time schedules, and safeties for all existing equipment through the new JACE. Verify operation and demonstrate to the owner/engineer proper function.

3.3 FINAL ADJUSTMENT

A. After completion of installation, adjust thermostats, control valves, motors, and similar equipment provided as work of this section.

B. Final adjustment shall be performed by specially trained personnel in direct employ of manufacturer (or factory authorized installer) of primary temperature control system. Provide certification that all work has been tested, balanced, and adjusted and that all systems are working as intended. The contractor shall provide qualified personnel for at least an 16 hour period to demonstrate and to train owner's personnel in proper operation of the systems.

3.4 WARRANTY

A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of two years from the time of system acceptance.

B. Within this period, upon notice by the Owner, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by the Division 23 09 23 contractor at no expense to the Owner

END OF SECTION

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes piping, special-duty valves, and hydronic specialties for hot-water heating and chilled-water cooling; makeup water for these systems; and blowdown drain lines; and condensate drain piping.

B. Related Sections include the following:

1. Division 23 Section 23 00 00, "Basic Mechanical Materials and Methods," for general piping materials and installation requirements.
2. Division 23 Section 23 05 29, "Hangers and Supports," for pipe supports, product descriptions, and installation requirements.
3. Division 23 Section 23 05 53, "Mechanical Identification," for labeling and identifying hydronic piping.
4. Division 23 Section 23 05 19, "Valves," for general-duty gate, globe, ball, butterfly, and check valves.
5. Division 23 Section 23 09 23, "Building Management and Control System," for temperature-control valves and sensors.

1.3 SUBMITTALS

A. Product Data: For each type of hydronic specialty.

B. Welding Certificates: Copies of certificates for welding procedures and personnel.

C. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Failed test results and corrective action taken to achieve requirements.

D. Maintenance Data: For hydronic specialties and special-duty valves to include in maintenance manuals specified in Division 01.

1.4 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1.5 COORDINATION

A. Coordinate layout and installation of hydronic piping and suspension system components with HVAC equipment and existing construction.

B. Coordinate pipe fitting pressure classes with products specified in related Sections.

C. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

D. Coordinate installation of pipe sleeves for penetrations through floor assemblies.

PART 2 - PRODUCTS

2.1 BASIC IDENTIFICATION

A. General: Provide identification complying with Division 23 Section 23 05 53, "Mechanical Identification," in accordance with the following listing:

1. Piping: Plastic pipe markers.
2. Valves: Plastic valve tags.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equivalent:

1. Calibrated Balancing Valves:

a. Armstrong Pumps, Inc., CBV Series.
b. Flow Design, Inc., Model AS.
c. ITT Bell & Gossett; ITT Fluid Technology Corp., CB Series.
d. Taco, Inc., CS Series.
e. Wheatley, BV Series.

2.3 PIPING MATERIALS

A. General: Comply with the Piping Material Schedule on the Drawings for product requirements of piping materials. For each system, provide the piping materials indicated including pipe, tube, fittings, hangers, supports, anchors, valves, and accessories. Where more than one type is indicated, selection is Installer's option. Provide materials and equipment indicated and as required for complete and functioning systems. Where type is not indicated, provide materials and equipment to comply with function and operation requirements.

2.4 VALVES

A. Gate, globe, and check valves are specified in Division 23 Section 23 05 19, "Valves."

B. Refer to Part 3 "Valve Applications" Article for applications of each valve.

C. Calibrated Balancing Valves, NPS 2 (DN 50) and Smaller: Bronze body, ball type, 125 psig (860 kPa) working pressure, 250 degrees F (121 degrees C) maximum operating temperature, and having threaded ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.

D. Calibrated Balancing Valves, NPS 2-1/2 (DN 65) and Larger: Cast-iron or steel body, ball type, 125 psig (860 kPa) working pressure, 250 degrees F (121 degrees C) maximum operating temperature, and having flanged or grooved connections. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.

2.5 HYDRONIC SPECIALTIES

A. Manual Air Vent: Bronze body and nonferrous internal parts; 150 psig (1035 kPa) working pressure; 225 degrees F (107 degrees C) operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 (DN 6) discharge connection and NPS 1/2 (DN 15) inlet connection.

B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150 psig (1035 kPa) working pressure; 240 degrees F (116 degrees C) operating temperature; with NPS 1/4 (DN 8) discharge connection and NPS 1/2 (DN 15) inlet connection.

C. Y-Pattern Strainers: 125 psig (860 kPa) working pressure; cast-iron body, flanged ends for NPS 2-1/2 (DN 65) and larger, threaded connections for NPS 2 (DN 50) and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.

D. Basket Strainers: 125 psig (860 kPa) working pressure; high-tensile cast-iron body, flanged-end connections, bolted cover, perforated stainless-steel basket, and bottom drain connection.

E. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 degrees F (121 degrees C) and pressures up to 150 psig (1035 kPa).

PART 3 - EXECUTION

3.1 INSTALLATION OF BASIC IDENTIFICATION

A. General: Install mechanical identification in accordance with Division 23 Section 23 05 53, "Mechanical Identification."

3.2 VALVE APPLICATIONS

A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:

1. Shutoff Duty: Gate valves.
2. Throttling Duty: Globe valves.

B. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.

C. Install calibrated balancing valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.

3.3 PIPING INSTALLATIONS

A. Refer to Division 23 Section 23 00 00, "Basic Mechanical Materials and Methods," for basic piping installation requirements.

B. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

C. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

D. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

E. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

F. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.

G. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, pump, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and ball valve

in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 50).

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section 23 05 29, "Hangers and Supports." Comply with requirements below for maximum spacing of supports. All hangers and supports shall be external of insulation.

B. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 meters); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 meters); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 meters); minimum rod size, 3/8 inch (10 mm).
4. NPS 2 (DN 50): Maximum span, 10 feet (3 meters); minimum rod size, 3/8 inch (10 mm).
5. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 meters); minimum rod size, 3/8 inch (10 mm).
6. NPS 3 (DN 80): Maximum span, 12 feet (3.7 meters); minimum rod size, 3/8 inch (10 mm).
7. NPS 4 (DN 100): Maximum span, 14 feet (4.3 meters); minimum rod size, 1/2 inch (13 mm).
8. NPS 6 (DN 150): Maximum span, 17 feet (5.2 meters); minimum rod size, 1/2 inch (13 mm).
9. NPS 8 (DN 200): Maximum span, 19 feet (5.8 meters); minimum rod size, 5/8 inch (16 mm).
10. NPS 10 (DN 250): Maximum span, 20 feet (6.1 meters); minimum rod size, 3/4 inch (19 mm).
11. NPS 12 (DN 300): Maximum span, 23 feet (7 meters); minimum rod size, 7/8 inch (22 mm).

C. Support vertical runs at roof and at each floor.

3.5 PIPE JOINT CONSTRUCTION

A. Refer to Division 23 Section 23 00 00, "Basic Mechanical Materials and Methods," for joint construction requirements for threaded, welded, and flanged joints in steel piping.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents in mechanical equipment rooms only at high points of system piping, at heat-transfer coils, and elsewhere as required for system air venting.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be same as for equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If multiple, parallel control valves are installed, only one bypass is required.

D. Install ports for pressure and temperature gages at coil inlet connections.

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush system with clean water. Clean strainers.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
3. Check expansion tanks to determine that they are not air bound and that system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

3.9 ADJUSTING

A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

B. Perform these adjustments before operating the system:

1. Open valves to fully open position. Close coil bypass valves.
2. Check pump for proper direction of rotation.
3. Set automatic fill valves for required system pressure.
4. Check air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Check operation of automatic bypass valves.
7. Check and set operating temperatures of converter to design requirements.
8. Lubricate motors and bearings.

3.10 CLEANING

A. Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

END OF SECTION

SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following categories of hydronic pumps for hydronic systems:

1. End Suction pumps.
2. Vertical split-coupled in-line pumps.
3. Pump specialty fittings.
4. Variable Frequency Drives.

1.3 SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities; shipping, installed, and operating weights; furnished specialties; final impeller dimensions; and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: Show pump layout and connections. Include Setting Drawings with templates for installing foundation and anchor bolts and other anchorages.
1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

C. Maintenance Data: For pumps to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

A. UL Compliance: Fabricate and label pumps to comply with UL 778, "Motor-Operated Water Pumps," for construction requirements.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Mechanical Seals: One mechanical seal for each pump.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equivalent:

   1. End Suction Pumps.

      a. Bell and Gossett ITT; Div. of ITT Fluid Technology Corp., 1510 Series.
      b. TACO FI Series.
      c. Patterson HVES Series.
      d. Armstrong 4030 Series.

   2. Vertical split-coupled In-line pumps.

      a. Armstrong 4300 Series
      b. Taco KS Series
      c. Patterson V Series
      d. Bell & Gossett e80SCXL Series

B. Suction Diffusers:

   1. Bell & Gossett ITT; Div. of ITT Fluid Technology Corp., "Suction Diffuser".
   2. Taco, "Suction Diffuser".
   3. Elbi, CISD Series.
   4. Patterson SD Series.
   5. Armstrong SG Series.

C. Triple-Duty Valves:

   1. Bell & Gossett ITT; Div. Of ITT Fluid Technology Corp., Model 3DS-S.

2. Taco, Model MPV.
3. Elbi, ETDV.
4. Patterson, TSV Series.
5. Armstrong FTV Series.

D. Variable Frequency Drives

a. Yaskawa
b. Danfoss
c. Toshiba
d. Trane

2.2 GENERAL PUMP REQUIREMENTS

A. Pump Units: Factory assembled and tested.

B. Motors: Include built-in, thermal-overload protection and grease-lubricated ball bearings. Select each motor to be nonoverloading over full range of pump performance curve.

2.3 FLEXIBLE-COUPLED, END-SUCTION PUMPS

A. Description: Base-mounted, centrifugal, flexible-coupled, end-suction, single-stage, bronze-fitted, back-pull-out, radially split case design; rated for 175 psig (1200 kPa) minimum working pressure and a continuous water temperature of 225 degrees F (107 degrees C).

a. Casing: Cast iron, with flanged piping connections, drain plug at low point of volute, threaded gage tappings at inlet and outlet connections, and integral feet or other means on volute to support weight of casing and attached piping. Casing shall allow removal and replacement of impeller without disconnecting piping.
b. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, keyed to shaft, and secured by locking cap screw.
c. Wear Rings: Replaceable, bronze casing ring.
d. Shaft and Sleeve: Steel shaft with bronze sleeve.
e. Seals: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
f. Coupling: A Woods "S", Falk or Thomas "DBZ" coupling shall be provided between the pump and motor. The coupling shall be secured by set screws and 316 stainless steel shaft keys.
g. Coupling Guard: Steel, removable, and attached to mounting frame.
h. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate for mounting pump casing, coupling guard, and motor. Field-drill motor-mounting holes for field-installed motors.
i. Option: Cast-iron frames are acceptable.
j. Motor: Secured to mounting frame, with adjustable alignment.
k. Motor: TEFL with regreasable ball bearings.

2.4 VERTICAL SPLIT-COUPLED IN-LINE PUMPS

B. Description: Centrifugal, flexible-coupled, in-line, single-stage, bronze-fitted, vertical design; rated for 175 psig (1200 kPa) minimum working pressure and a continuous water temperature of 225 degrees F (107 degrees C).

l. Casing: Cast iron, with flanged piping connections, drain plug at low point of volute, threaded gage tappings at inlet and outlet connections, and integral feet or other means on volute to support weight of casing and attached piping. Casing shall allow removal and replacement of impeller without disconnecting piping.
m. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, keyed to shaft, and secured by locking cap screw.
n. Wear Rings: Replaceable, bronze casing ring.
o. Shaft and Sleeve: Stainless Steel shaft with bronze sleeve.
p. Seals: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
q. Coupling: A Woods "S", Falk or Thomas "DBZ" coupling shall be provided between the pump and motor. The coupling shall be secured by set screws and 316 stainless steel shaft keys.
r. Coupling Guard: Steel, removable, and attached to mounting frame.
s. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate for mounting pump casing, coupling guard, and motor. Field-drill motor-mounting holes for field-installed motors.
t. Option: Cast-iron frames are acceptable.
u. Motor: Secured to mounting frame, with adjustable alignment.
v. Motor: TEFL with regreasable ball bearings.

2.5 VARIABLE FREQUENCY DRIVES

A. Provide a pre-wired variable torque package for each pump. This package shall include a vented NEMA 1 enclosure containing the variable speed inverter as well as a by-pass contactor with overload relays and through the door interlock disconnect switch. It shall also include a manual by-pass feature. On the front of the panel shall be mounted: power on light, fault light, start-stop switch, speed meter (calibrated 0 to 100 percent), speed setting potentiometer, manual by-pass switch, and by-pass on light. The inverter shall be compact, high efficiency VVVF transistor inverter type.

B. The speed command signal can be selected from 0 to 5 vdc, 0 to 10 fdc, or 4 to 20 mA by a select switch. Load torque characteristics can be set to either variable torque or constant torque depending on the application by means of a switch. Maximum frequency can be selected by a switch which will establish maximum frequency. Acceleration and deceleration time can be set digitally up to 15 seconds by means of switches. The setting of the electronic thermal relay is to be done by a dial switch. Protective functions shall be provided with indication pilot lights for over current, motor overload, regenerative over-voltage, instantaneous power failure and load side ground fault.

C. Speed drive inputs and outputs to BMCS system shall be opto-isolated or direct digital interface.

D. The variable frequency ac drives shall be used to control centrifugal pumps. The VFD must be capable of operating with a standard NEMA B design induction motor, with multiple motor operation capability.

E. The VFD shall be of the pulse-width modulated design and shall produce adjustable voltage and adjustable frequency through a two-step process.

F. AC utility power shall be converted to a fixed dc voltage through the use of a full-wave diode bridge. This shall be done to provide an input displacement power factor of .95 and above throughout the entire speed range. VFD's employing a phase-controlled front end will not be acceptable due to the inherent reduction of power factor with speed change (with possible utility power factor penalty) as well as power line notching considerations.

G. The second step shall convert the fixed dc bus voltage to a three-phase adjustable voltage, adjustable frequency output with the use of power transistors in the inverter circuit for high reliability.

H. The VFD shall be capable of operating with the following power sources:

w. 480 v., 50/60 hz. with a +10 percent, -15 percent line voltage fluctuation.

I. The drive shall be capable of rated operation in an ambient temperature of -10 degrees C to +50 degrees C; with a relative humidity of 0 to 95 percent (non-condensing) and at an altitude of 3300 feet. Altitude derating should be no more than 3 percent per thousand feet altitude above 3300 feet.

J. The VFD must have the following diagnostic indicators:

a. ground fault trip (LED)
b. overload/overcurrent trip (LED)
c. overvoltage trip (LED)
d. instantaneous power failure (LED)
e. thermal trip (LED)

K. The VFD shall have stall prevention (current foldback) circuitry in an operational mode, whenever the output current exceeds 150 percent of the rated VFD current, the VFD micro-processor stops increasing the output frequency and decreases it according to the set deceleration ramp until the output current goes below 150 percent. At that time, the inverter resumes normal operation and the output frequency then accelerates to set frequency and resumes normal operation.

L. Control functions shall be:

a. Start/stop and speed-setting available on inverter chassis.
b. Capability of receiving input reference signals of 0-5v dc, 0-10v dc, 4-20mA or 3-15 psi.
c. Timed linear accel/decel adjustment from 1-150 seconds.
d. Maximum output frequency setting of 50/60 hz.
e. Reduced V/HZ pattern selectable for energy savings and "soft torque" operation on variable torque loads.
f. Dynamic braking.

M. The VFD shall have the following protective features:

N. The VFD shall not cause "notching" in the power source or interfere in any way with the operation of computers or similar electronic equipment.

O. Unit shall not require external transient protection for reliable operation.

P. The VFD shall have a maximum of 5% voltage and current harmonic distortion on the input. If the manufacturer's standard equipment can't meet this criteria, he shall be responsible for providing accessory filters or isolation transformers as required to stay within this limit.

Q. The VFD shall be Bacnet compatible without any additional communication modules, interface cards, etc.

R. Control and monitoring shall be provided remotely through BMCS

2.6 PUMP SPECIALTY FITTINGS

A. Suction Diffuser: Angle or straight pattern, 175-psig (1200-kPa) pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory- or field-fabricated support.

B. Triple-Duty Valve: Angle or straight pattern, 175-psig (1200-kPa) pressure rating, cast-iron body, pump-discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation.
   1. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
   2. Examine foundations for suitable conditions where pumps are to be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

A. Install pumps according to manufacturer's written instructions.

B. Install pumps to provide access for periodic maintenance, including removing motors, impellers, couplings, and accessories.

C. Support pumps and piping separately so piping is not supported by pumps.

D. Set base-mounted pumps on concrete foundation. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.
   1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches (19 to 38 mm) between pump base and foundation for grouting.

2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

3.3 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting them on foundations, after grout has been set and foundation bolts have been tightened, and after piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Electrical power and control wiring and connections are specified in Division 16 Sections.

D. Ground equipment.
1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

3.5 COMMISSIONING

A. Verify that pumps are installed and connected according to the Contract Documents.

B. Verify that electrical wiring installation complies with manufacturer's written instructions and the Contract Documents.

C. Perform the following preventive maintenance operations and checks before starting:
1. Lubricate bearings.
2. Remove grease-lubricated bearing covers, flush bearings with kerosene, and clean thoroughly. Fill with new lubricant according to manufacturer's written instructions.
3. Disconnect coupling and check motor for proper rotation that matches direction marked on pump casing.
4. Verify that pumps are free to rotate by hand and that pumps for handling hot liquids are free to rotate with pumps hot and cold. Do not operate pumps if they are bound or drag, until cause of trouble is determined and corrected.
5. Check suction piping connections for tightness to avoid drawing air into pumps.
6. Clean strainers.
7. Verify that pump controls are correct for required application.

D. Starting procedure for pumps with shutoff power not exceeding safe motor power is as follows:
   1. Prime pumps by opening suction valves and closing drains, and prepare pumps for operation.
   2. Start motors.
   3. Open discharge valves slowly.
   4. Check general mechanical operation of pumps and motors.
   5. Close circulating line valves once there is sufficient flow through pumps to prevent overheating.

E. When pumps are to be started against closed check valves with discharge shutoff valves open, steps are the same, except open discharge valves before starting motors.

F. Refer to Division 23 Section 23 05 93, "Testing, Adjusting, and Balancing," for detailed requirements for testing, adjusting, and balancing hydronic systems.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train User's maintenance personnel to adjust, operate, and maintain hydronic pumps as specified below:
   1. Train User's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining pumps.
   2. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
   3. Schedule training with User, through Engineer, with at least seven days' advance notice.

END OF SECTION

SECTION 23 25 00 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes water-treatment systems for the following:

1. Chilled-water piping (closed-loop system).
2. Heating-water piping (closed-loop system).

1.3 CHEMICAL FEED SYSTEM DESCRIPTION

A. Closed-Loop System Existing: One bypass feeder on each system with isolating and drain valves downstream from circulating pumps, unless otherwise indicated.

1. Introduce chemical treatment through bypass feeder.

1.4 PERFORMANCE REQUIREMENTS

A. Maintain water quality for HVAC systems that controls corrosion and build-up of scale and biological growth for maximum efficiency of installed equipment without posing a hazard to operating personnel or the environment.

PART 2 - PRODUCTS

2.1 CHEMICALS

A. Provide chemicals to supplement system cleaning as recommended by User Agency's chemical supplier. Operating chemicals will be provided by User Agency's chemical supplier. Make arrangements with User Agency's chemical supplier for installation of chemicals. Hydronic systems shall not be operated until clearance is received from User Agency's chemical supplier.

2.2 MANUAL CHEMICAL-FEED EQUIPMENT

A. Bypass Feeders: Provide steel feeders with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Provide quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.

1. Capacity: 5 gal.
2. Minimum Working Pressure: 125 psig.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Add cleaning chemicals as recommended by manufacturer.

3.2 FIELD QUALITY CONTROL

A. Engage a factory-authorized service representative to perform startup service.

1. Inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.

B. Test chemical feed piping as follows:

1. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
2. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
3. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
5. Repair leaks and defects with new materials and retest piping until satisfactory results are obtained.
6. Prepare test reports, including required corrective action.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.

B. Review manufacturer's safety data sheets for handling of chemicals.

C. Review data in maintenance manuals, especially data on recommended parts inventory and supply sources and on availability of parts and service. Refer to Division 1 Section "Contract Closeout."

D. Review data in maintenance manuals, especially data on recommended parts inventory and supply sources and on availability of parts and service. Refer to Division 1 Section "Project Closeout."

E. Schedule at least four hours of training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION

SECTION 23 64 26 - AIR COOLED CHILLERS (50 TO 360 TONS)

PART 1: GENERAL

1.01 SUMMARY

A. Section includes design, performance criteria, refrigerants, controls, and installation requirements for air-cooled screw or scroll compressor chillers.

1.02 REFERENCES

A. Comply with applicable Standards/Codes of AHRI 550/590, ANSI/ASHRAE 15, ETL, cETL, NEC, and OSHA as adopted by the State.

B. Units shall meet the efficiency standards of the current version of ASHRAE Standard 90.1, and FEMP standard 2012.

C. Comply with AHRI 370 – sound rating of large outdoor refrigerating and air conditioning equipment.

1.03 SUBMITTALS

A. Submit shop drawings and product data in accordance with the specifications.

B. Submittals shall include the following:

1. Dimensioned plan and elevation view drawings, required clearances weights and loadings, and location of all field connections
2. Summary of all auxiliary utility requirements such as electricity, water, etc. Summary shall indicate quality and quantity of each required utility.
3. Single line schematic drawing of the field power hookup requirements, indicating all items that are furnished.
4. Schematic diagram of control system indicating points for field interface/connection.
5. Diagram shall fully delineate field and factory wiring.
6. Installation and operating manuals.
7. Sound data per AHRI 370.

1.04 QUALITY ASSURANCE

A. Qualifications: Equipment manufacturer must specialize in the manufacture of the products specified and have minimum ten (10) years of experience with the type of equipment and refrigerant offered.

B. Regulatory Requirements: Comply with the codes and standards specified.

C. Chiller manufacturer plant must be ISO 9001 Registered.

1.05 DELIVERY AND HANDLING

A. Chiller shall be delivered to the job site completely assembled and charged with refrigerant and oil by the manufacturer.

B. Comply with the manufacturer's instructions for rigging and handling equipment.

1.06 WARRANTY

A. The refrigeration equipment manufacturer's guarantee shall be for a period of one year from date of substantial completion but not more than 18 months from shipment. The guarantee shall provide for repair or replacement due to failure by material or workmanship that prove defective within the above period.

B. Extended Compressor Warranty: Four (4) years extended compressor warranty, parts and labor.

C. Extended Unit Warranty: four (4) years parts and labor.

D. Refrigerant Warranty: five (5) years from substantial completion.

1.07 MAINTENANCE

A. Maintenance of the chillers shall be the responsibility of the owner and performed in accordance with the manufacturer’s instructions.

PART 2: PRODUCTS

2.01 BASIS OF DESIGN

A. Johnson Controls YLAA (Scroll) or YVAA (Screw) Series [Monterey Mexico]

2.02 ACCEPTABLE MANUFACTURERS

A. Daikin Applied AGZ (Scroll) or AWV (Screw) Series [Stauton, VA]

B. Johnson Controls YLAA (Scroll) or YVAA (Screw) Series [Monterey Mexico]

C. Carrier 30RC (Scroll) or 30XV (Screw) Series [Charlotte, NC]

D. Quantech QTC3 (Scroll) or QTC4 Screw [Monterey Mexico]

2.03 UNIT DESCRIPTION

A. Provide and install as shown on the plans factory-assembled, factory-charged air-cooled scroll or screw compressor packaged chillers in the quantity specified. Each chiller shall consist of hermetic scroll or screw compressors, evaporator, air-cooled condenser section, microprocessor-based control system and all components necessary for controlled unit operation.

B. Chiller shall be functionally tested at the factory to ensure trouble free field operation

2.04 DESIGN REQUIREMENTS

A. Flow Range: The chiller shall have the ability to support variable flow range down to 40% of nominal design (based on AHRI conditions).

B. Operating Range:

1. The chiller shall have the ability to control leaving chilled fluid temperature from 15°F to 65°F (-9°C to 18°C).

2. The chiller shall have the ability to operate in ambient temperatures from 32°F to 125°F (-17°C to 52°C).

C. General: Provide a complete packaged chiller as specified herein and as shown on the drawings. The unit shall be in accordance with the standards referenced in section 1.02 and any local codes in effect.

D. Performance: Refer to the schedule of performance on the drawings. The chiller shall be capable of stable operation to a minimum percentage of full load (without hot gas bypass) of 17%. Performance shall be in accordance with AHRI Standard 550/590.

E. Electrical: Chillers shall not exceed the minimum circuit ampacity or the maximum over current protection values scheduled.

F. Acoustics: Sound pressure levels for the unit shall not exceed the level specified on the drawings. All manufacturers shall provide the necessary sound treatment (parts and labor) to meet these levels if required. Sound data shall be provided with the quotation. Test shall be in accordance with AHRI Standard 370.

2.05 CHILLER COMPONENTS

A. Compressor

1. The compressors shall be sealed hermetic, scroll or screw type with crankcase oil heater and suction strainer. The compressor motor shall be refrigerant gas cooled, high torque, hermetic induction type, two-pole, with inherent thermal protection on all three phases and shall be mounted on RIS vibration isolator pads. The compressors shall be equipped with an internal module providing compressor protection and communication capability.

B. Evaporator

1. Brazed Plate (option)

    a. The evaporator shall be a compact, high efficiency, dual circuit, brazed plate-to-plate type heat exchanger consisting of parallel stainless-steel plates. Provide strainer on chilled water inlet with mesh as recommended by the manufacturer.
    b. The evaporator shall be protected with an external, electric resistance heater plate and insulated with 3/4" (19mm) thick closed-cell polyurethane insulation. This combination shall provide freeze protection down to -20°F (-29°C) ambient air temperature.
    c. The water-side maximum design pressure shall be rated at a minimum of 653 psig (4502 kPa). Evaporators shall be designed and constructed according to, and listed by Underwriters Laboratories (UL).
    d. Provide water drain connection, vent and fittings. Factory installed leaving water temperature control and low temperature cutout sensors.
    e. Water connections shall be grooved pipe.
    f. Proof of flow shall be provided by the equipment manufacturer, mechanically installed and electrically wired, at the factory of origin.

2. Shell and Tube (option)

    a. The evaporator shall be designed, tested, and stamped in accordance with ASME code for a refrigerant side working pressure of 200 psig. Waterside working pressure shall be 150 psig.
    b. Insulate the evaporator with a minimum of 0.75 inch (K=0.28) UV rated insulation. If the insulation is field installed, the cost to add additional heat tracing and insulation in the field shall be included in the bid.
    c. Evaporator heaters shall be factory installed and shall protect chiller down to -20ºF (-29ºC). Contractor shall wire separate power to energize heat tape and protect evaporator while chiller is disconnected from the main power.
    d. Provide shell and tube type evaporator, seamless or welded steel construction with cast iron or fabricated steel heads, seamless internally and externally finned copper tubes, roller expanded into tube sheets.
    e. Provide ability to remove evaporator tubes from either end of the heat exchanger.
    f. Evaporator shall have cleanable tubes
    g. Provide water drain connection, vent and fittings. Factory installed leaving water temperature control and low temperature cutout sensors.
    h. Water connections shall be grooved pipe.
    i. Proof of flow shall be provided by the equipment manufacturer, mechanically installed and electrically wired, at the factory of origin.

C. Condenser

1. Condenser fans shall be propeller type arranged for vertical air discharge and individually driven by direct-drive fan motors. The fans shall be equipped with a heavy-gauge vinyl-coated fan guard. Fan motors shall be TEAO type with permanently lubricated ball bearings, inherent overload protection, three-phase, direct-drive, 1140 rpm. Each fan section shall be partitioned to avoid cross circulation.
2. Coil shall be microchannel design and shall have a series of flat tubes containing multiple, parallel flow microchannels layered between the refrigerant manifolds. Tubes shall be 9153 aluminum alloy. Tubes made of 3102 alloy or other alloys of lower corrosion resistance shall not be accepted. Coils shall consist of a two-pass arrangement. Each condenser coil shall be factory leak tested with high-pressure air under water. Coils shall withstand 1000+ hour acidified synthetic sea water fog (SWAAT) test (ASTM G85-02) at 120°F (49°C) with 0% fin loss and develop no leaks.

D. Refrigerant Circuit

1. Provide a minimum of two independent refrigerant circuits.
2. Each of the two refrigerant circuits shall include a replaceable-core refrigerant filter-drier, sight glass with moisture indicator, liquid line solenoid valve (no exceptions), expansion valve, and insulated suction line.

E. Construction

1. Unit casing and all structural members and rails shall be fabricated of pre-painted or galvanized steel. Painted parts shall be able to meet ASTM B117, 1000-hour salt spray test.
2. Upper section of unit shall have protective and decorative louvers covering the coils, including distribution headers and all refrigerant piping. The base section of unit shall have protective, 12 GA, PVC-coated, wire grille guards and have painted steel wraps enclosing the compressor and evaporator compartments.

F. Control System

1. A centrally located weatherproof control panel shall contain the field power connection points, control interlock terminals, and control system. Box shall be designed in accordance with NEMA 3R rating. Power and starting components shall include factory circuit breaker for fan motors and control circuit, individual contactors for each fan motor, solid-state compressor three-phase motor overload protection, inherent fan motor overload protection and two power blocks (one per circuit) for connection to remote, contractor supplied disconnect switches. Hinged access doors shall be lockable. Barrier panels or separate enclosures are required to protect against accidental contact with line voltage when accessing the control system.
2. Chiller shall include high short circuit current rating of 65,000 amps (25,000 amps at 575Volt) with single-point disconnect switch or standard multi point power locks per schedule.

G. Unit Controller

1. An advanced DDC microprocessor unit controller with a 5-line by 22-character liquid crystal display provides the operating and protection functions. The controller shall take preemptive limiting action in case of high discharge pressure or low evaporator pressure. The controller shall contain the following features as a minimum:
2. The unit shall be protected in two ways: (1) by alarms that shut the unit down and require manual reset to restore unit operation and (2) by limit alarms that reduce unit operation in response to some out-of-limit condition. Shut down alarms shall activate an alarm signal.
3. Shutdown Alarms

    a. No evaporator water flow (auto-restart)
    b. Sensor failures
    c. Low evaporator pressure
    d. Evaporator freeze protection
    e. High condenser pressure
    f. Outside ambient temperature (auto-restart)
    g. Motor protection system
    h. Phase voltage protection

4. Limit Alarms

    a. Condenser pressure stage down, unloads unit at high discharge pressures.
    b. Low ambient lockout, shuts off unit at low ambient temperatures.
    c. Low evaporator pressure hold, holds stage #1 until pressure rises.
    d. Low evaporator pressure unload, shuts off one compressor.

5. Unit Enable Section

    a. Enables unit operation from either local keypad, digital input, or Building Automation System (BAS) or Building Management and Control System (BMCS).

6. Unit Mode Selection

    a. Selects standard cooling, ice, glycol, or test operation mode

7. Analog Inputs:

    a. Reset of leaving water temperature, 4-20 mA\
    b. Current Limit

8. Digital Inputs

    a. Unit off switch
    b. Remote start/stop

c. Flow switch
d. Motor protection

9. Digital Outputs

a. Shutdown alarm; field wired, activates on an alarm condition, off when alarm is cleared
b. Evaporator pump; field wired, starts pump when unit is set to start
c. Chilled water valves; field wired, open valves when unit is set to start

10. Condenser fan control - The unit controller shall provide control of condenser fans based on compressor discharge pressure.

11. Building Automation System (BAS) Interface

a. Factory mounted DDC controller(s) shall support operation on a BACnet® network via one of the data link / physical layers listed below as specified by the successful Building Automation System (BAS) supplier.
b. BACnet MS/TP master (Clause 9)
c. BACnet IP, (Annex J)
d. BACnet ISO 8802-3, (Ethernet)
e. The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.
f. All communication from the chiller unit controller as specified in the points list shall be via standard BACnet objects. Proprietary BACnet objects shall not be allowed. BACnet communications shall conform to the BACnet protocol (ANSI/ASHRAE135-2001). A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided along with the unit submittal.

2.06 ACCESSORIES

A. The following options are to be included:

1. BAS interface module to provide interface with the BACnet MSTP protocol.
2. Condenser coil hail guards shall be architectural louvered panels.
3. Compressor compartment guards.

4. The following accessories, are to be included:

a. Spring vibration isolators for field installation at chillers larger than 100 tons nominal capacity and all chillers not installed on slab on grade.

b. Rubber-in-shear vibration isolators for field installation at chillers 100 tons nominal capacity and smaller, mounted on slab on grade.
c. Factory-mounted thermal dispersion type flow switch
d. Field-mounted, paddle type, chilled water flow switch field wired to the control panel
e. Wye strainer, to be installed at the evaporator inlet and sized for the design flow rate. Strainer shall have mesh size as recommended by chiller manufacturer and blowdown valve.
f. 115V GFI convenience outlet.
g. Motorized shut off valve to be closed when chiller is de-energized.
h. Evaporator drain with shut off valve and hose end.

PART 3: EXECUTION

3.01 INSTALLATION

A. Install in strict accordance with manufacturer's requirements, shop drawings, and contract documents.

B. Adjust and level chiller in alignment on supports.

C. Coordinate electrical installation with electrical contractor.

D. Coordinate controls with control contractor.

E. Provide a field-supplied or manufacturer-supplied strainer in the chilled water return line at the evaporator inlet that meets manufacturer's perforation size specifications.

F. Provide flexible connections at chilled water inlet and outlet.

G. Provide pressure gauge, snubber and needle valve and separate test port at chilled water inlet and outlet.

H. Provide vent and drain line with valve and hose end.

3.02 START-UP

A. Provide testing and starting of machine, and instruct the Owner in its proper operation and maintenance.

END OF SECTION

SECTION 26 05 00 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Codes and Standards: Where indicated, the referenced edition shall govern. Where not indicated, the latest edition shall govern.

1.2 SUMMARY

A. This Section includes the following:

1. Supporting devices for electrical components.
2. Electrical identification.
3. Control wiring.
4. Electrical demolition.
5. Cutting and patching for electrical construction.
6. Touchup painting.

1.3 SUBMITTALS

A. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.4 DEFINITIONS

A. General Explanation: A substantial amount of the Contract Document Specification language constitutes specific definitions for terms found in other Contract Documents, including the Drawings which must be recognized as diagrammatic in nature and not completely descriptive of the requirements indicated thereon. Certain terms used repetitiously in the Contract Documents are defined generally in this Article.

B. General Requirements: The provisions or requirements of the Division 1 Sections. The General Requirements apply to the entire work of the Contract, and where so indicated, to other elements of work which are included in the project.

C. Indicated: The term "Indicated" is a cross reference to details, notes or schedules on the Drawings, other paragraphs or schedules in the Specifications, and similar means of recording requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for the purpose of helping the reader locate the cross reference, and no limitation of location is intended except as specifically noted.

D. Directed, Requested, Etc.: Where not otherwise explained, terms such as "directed," "requested," "authorized," "selected," "approved," "required," "accepted," and

"permitted" mean "directed by the Architect," "requested by the Architect," etc. However, no such implied meaning will be interpreted to extend the Architect's responsibility into the Contractor's area of construction supervision.

E. Refer: Used to indicate that the subject is defined or specified in further detail at another location in the Contract Documents, or elsewhere as indicated. Except as otherwise noted, "refer" does not imply that the Contractor must purchase or subcontract the subject work in any special manner.

F. Approve: Where used in conjunction with the Architect's response to submittals, requests, applications, inquiries, reports and claims by the Contractor, the meaning of the term "approved" will be held to the limitations of the Architect's responsibilities and duties as specified in the General and Supplementary Conditions. In no case will "approval" by the Architect be interpreted as a release of the Contractor from responsibilities to fulfill the requirements of the Contract Documents.

G. Project Site: The space available to the Contractor for the performance of the work, either exclusively or in conjunction with others performing other work as part of the project. The extent of the project site may or may not be identical with the description of the land upon which the project is to be built.

H. Furnish: Except as otherwise defined in greater detail, the term "furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

I. Install: Except as otherwise defined in greater detail, the term "install" is used to describe operations of the project site including unloading, unpacking, assembly, erection, placing, anchoring, connecting utilities, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations, as applicable in each instance.

J. Provide: Except as otherwise defined in greater detail, the term "provide" means furnish and install, complete and ready for the intended use, as applicable in each instance.

K. Installer: The entity (person or firm) engaged by the Contractor or its subcontractor or sub-subcontractor for the performance of a particular unit of work at the project site, including installation, erection, application and similar required operations. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70 (2020).

1.6 COORDINATION

A. The electrical Plans and Specifications are a portion of the entire project. Other portions of the project contain information and requirements that will affect the electrical work. It is the responsibility of the Electrical Contractor to review all of the Contract Documents and to include those requirements in the bid.

B. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

C. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the work. Coordinate installing large equipment requiring positioning before closing in the building.

D. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.

B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.

C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16 inch (14 mm) diameter slotted holes at a maximum of 2 inches (50 mm) o.c., in webs.

D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

F. Expansion Anchors: Carbon-steel wedge or sleeve type.

G. Toggle Bolts: All-steel springhead type.

H. Powder-Driven Threaded Studs: Heat-treated steel.

2.2 ELECTRICAL IDENTIFICATION

A. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.

B. Cable Labels: Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each cable size.

1. Type: Preprinted, flexible, self-adhesive, vinyl. Legend is overlaminated with a clear, weather- and chemical-resistant coating.

C. Colored Adhesive Marking Tape for Wires, and Cables: Self-adhesive vinyl tape, not less than 3/4 inch wide by 3 mils thick (18 mm wide by 0.08 mm thick).

D. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

E. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16 inch (1.6 mm) minimum thickness for signs up to 20 sq. inch (129 sq. cm) and 1/8 inch (3.2 mm) minimum thickness for larger sizes. Engraved legend in black letters on white background.

F. Interior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Preprinted, aluminum, baked-enamel-finish signs, punched or drilled for mechanical fasteners, with colors, legend, and size appropriate to the application.

G. Exterior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396 inch (1 mm), galvanized-steel backing, with colors, legend, and size appropriate to the application. 1/4 inch (6 mm) grommets in corners for mounting.

H. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.3 TOUCHUP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom, but no less than that required by NEC.

B. Clearances: Coordinate with other trades and/or existing conditions to maintain code required clearances above, below and around electrical equipment.

C. Materials and Components: Install level, plumb, and square to other building systems and components, unless otherwise indicated.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.

B. Dry Locations: Steel materials.

C. Selection of Supports: Comply with manufacturer's written instructions.

D. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200 lb (90 kg) design load.

3.3 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps. Clamps less than 7 feet above the floor shall be one-piece without protruding edges or bolts.

F. Install 1/4 inch (6 mm) diameter or larger threaded steel hanger rods, unless otherwise indicated.

G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2 inch (38 mm) and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports. Support wires shall be dedicated to the support of electrical materials and equipment. Ceiling support equipment and wires are not to be used for the support of electrical equipment.

H. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches (610 mm) from the box.

I. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless

components are mounted directly to structural elements of adequate strength. Field galvanize galvanized members that have been field cut.

J. Install sleeves for raceway penetrations of walls unless core-drilled holes are used. Install sleeves for raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies.

K. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:

1. Wood: Fasten with wood screws or screw-type nails.
2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
3. New Concrete: Concrete inserts with machine screws and bolts.
4. Existing Concrete: Expansion bolts. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
5. Steel: Welded threaded studs or spring-tension clamps on steel. No field welding of supports to structural members will be allowed.
6. Light Steel: Sheet-metal screws. Do not penetrate outer skin of building from within.
7. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.4 IDENTIFICATION MATERIALS AND DEVICES

A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout project.

C. Self-Adhesive Identification Products: Clean surfaces before applying.

D. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches (150 to 200 mm) below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches (400 mm), overall, use a single line marker.

E. Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:

1. Phase A: Black.
2. Phase B: Red.
3. Phase C: Blue.

F. Color-code 480/277-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follow:

1. Phase A: Brown.
2. Phase B: Orange.
3. Phase C: Yellow.

G. Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

H. Install engraved-laminated signs with black letters on white background with minimum 3/8 inch (9 mm) high lettering for equipment designations for switchgear or description of load being fed or controlled in the case of motor control center units or switch board circuit breakers.

I. For existing panelboards in which circuit breakers are added or deleted or for which loads are changed, provide a new directory to indicate installed circuit loads. Use a computer or typewriter to create the directory, handwritten directories are not acceptable.

3.5 FIRESTOPPING

A. Apply firestopping to raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials shall be fire resistant per ASTM E119 fire test conditions and shall be non-combustible when tested per ASTM E136. Melting point shall exceed 2000 degrees F. per ASTM C24. Fireproofing installation for openings in rated floors or partitions shall provide an airtight seal.

3.6 EQUIPMENT AND CONTROL WIRING

A. Wire in and connect every motor and item of equipment furnished as a part of this contract, including those furnished under other Divisions. Provide all required disconnecting means, boxes, conduit, conductors, etc. Motors and equipment furnished under other Divisions will be installed under that Division.

B. Motor starters and variable speed drives will be furnished under the division that the motors being controlled are furnished, and will be installed under Division 26 by the Electrical Contractor unless controllers are integral to the equipment. Installation includes mounting, connection to power and grounding. Where starters and drives are indicated to be mounted in a motor control center, they will be provided under Division 26.

C. Control Wiring: All control wiring and interlock wiring for Division 23 is included in Division 23.

3.7 DEMOLITION

A. Protect existing electrical equipment and installations not indicated to be removed. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, appearance and functionality.

B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches (50 mm) below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

D. Existing Work to Remain: Maintain feed, or provide new feed to equipment and devices that are not being removed. Where existing feeders and branch circuits need to be intercepted outside of the building, routing to devices shall be in an inconspicuous manner approved by the Architect.

E. Remove demolished material from project site.

F. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.8 SEQUENCING AND SCHEDULING

A. Electrical power and system interruptions shall be held to a minimum and will be permitted only at times approved by the Owner. The Owner may require that any interruptions be during nights, weekends, holidays, etc. Provide any required overtime work at no additional cost to Owner.

B. Do not interrupt feed to any service, feeder or branch circuit feeding facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to make temporary provisions where required according to requirements indicated:

1. Notify Owner no fewer than seven (7) days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.
3. Provide all temporary facilities and services, including fire watch, required to maintain operation, security, and life safety.

3.9 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.10 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:

1. Supporting devices for electrical components.
2. Electrical identification.
3. Electrical demolition.
4. Cutting and patching for electrical construction.
5. Touchup painting.

3.11 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint: Paint materials and application requirements are specified in Division 9 Section "Painting."

1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.12 CLEANING AND PROTECTION

A. Upon completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 26 05 19 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

A. Field Quality-Control Test Reports: From Contractor.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70 (2020).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 CONDUCTORS AND CABLES

A. Manufacturers:

1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Senator Wire & Cable Company.
4. Southwire Company.

B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

C. Conductor Material: Copper complying with NEMA WC 5 or 7; stranded or solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.

D. Conductor Insulation Types: Type THHN-THWN, XHHW or USE complying with NEMA WC 5 or 7 as applicable.

2.3 CONNECTORS AND SPLICES

A. Manufacturers:

1. AFC Cable Systems, Inc.
2. AMP Incorporated/Tyco International.
3. Hubbell/Anderson.
4. O-Z/Gedney; EGS Electrical Group LLC.
5. 3M Company; Electrical Products Division.
6. Ideal

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated. Push in splice and insulation displacement type connectors shall not be used.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Service Entrance, Feeders and Branch Circuits: Type THHN-THWN, XHHW or USE single conductors in raceway. Minimum size #12 AWG or larger where required for voltage drop. Where branch circuits exceed 100 feet in length, use minimum #10 AWG.

B. Class 1 Control Circuits: Type THHN-THWN, in raceway. Minimum size #14 AWG.

C. Class 2 Control Circuits: Type THHN-THWN, in raceway or Power-limited cable in raceways. Size as recommended by equipment manufacturer.

3.2 INSTALLATION

A. Run all conductors in raceways unless specifically indicated otherwise.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Seal around cables penetrating fire-rated elements according to Division 7.

E. Identify and color-code conductors and cables according to Division 26 Section, "Basic Electrical Materials and Methods."

F. Provide a separate grounded conductor (neutral) for each 120 volt and 277 volt branch circuit; do not use common neutrals.

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.4 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.

B. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.3 SUBMITTALS

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

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

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 (2020), Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1. Comply with UL 467.

PART 2 - PRODUCTS

2.1 MAUFACTURERS

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

1. Grounding Conductors, Cables, Connections, and Rods:
   a. Apache Grounding/Erico Inc.
   b. Chance/Hubbell
   c. Copperweld Corp.
   d. Erico Inc.; Electrical Products Group
   e. Ideal Industries, Inc.
   f. ILSCO
   g. Kearney/Cooper Power Systems
   h. O-Z/Gedney Co.; a business of the EGS Electrical Group
   i. Raco, Inc.; Division of Hubbell
   j. Thomas and Betts, Electrical

2.2 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 26 Section, "Conductors and Cables."

B. Material: Copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Bare Copper Conductors: Comply with the following:

1. Solid Conductors: ASTM B 3.

2.3 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

C. Twist-on Connectors: Plastic body with coiled copper alloy wire forming threads.

D. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

E. Underground Mechanical Connectors: Bolted-pressure type or compression type, listed for underground application.

PART 3 - EXECUTION

3.1 APPLICATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. In raceways, use insulated equipment grounding conductors.

C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections except these at test wells.

D. Equipment Grounding Conductor Terminations: Use bolted clamp type or compression connectors for conductors larger than 10 AWG. Use Plastic body twist-on connectors for 10AWG and smaller.

3.2 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and circuits.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

3.4 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

END OF SECTION

SECTION 26 05 33 - RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Division 26 Section, "Basic Electrical Materials and Methods," for supports, anchors, and identification products.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. GRC: Galvanized Rigid Conduit.

D. IMC: Intermediate metal conduit.

E. LFMC: Liquidtight flexible metal conduit.

F. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: Show fabrication and installation details of components for raceways, fittings, boxes, enclosures, and cabinets.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70 (2020).

1.6 COORDINATION

A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 Articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 METAL CONDUIT AND TUBING AND RACEWAY SYSTEMS

A. Manufacturers:

1. Anamet Electrical, Inc.; Anaconda Metal Hose.
2. Electri-Flex Co.
3. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
4. LTV Steel Tubular Products Company.
5. Manhattan/CDT/Cole-Flex.
6. O-Z Gedney; Unit of General Signal.
7. Wheatland Tube Co.

B. Rigid Steel Conduit: ANSI C80.1. U. L. 6. Threaded with threaded fittings.

C. IMC: ANSI C80.6. U.L. 1242.

D. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.

E. Plastic-Coated IMC and Fittings: NEMA RN 1.

F. EMT and Fittings: ANSI C80.3. U.L. 797.
1. Fittings, 2 Inch Diameter and Larger: Steel (not die cast) set-screw or compression type.
2. Fittings, Smaller than 2 Inches Diameter: Compression type.

G. FMC: Zinc-coated steel.

H. LFMC: Flexible steel conduit with PVC jacket.

I. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers:

1. American International.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corp.
4. Cantex Inc.
5. Certainteed Corp.; Pipe & Plastics Group.
6. Condux International.
7. ElecSYS, Inc.
8. Lamson & Sessions; Carlon Electrical Products.
9. Manhattan/CDT/Cole-Flex.
10. RACO; Division of Hubbell, Inc.
11. Thomas & Betts Corporation.

B. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.

C. RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

2.4 METAL WIREWAYS

A. Manufacturers:

1. Hoffman.
2. Square D.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

E. Wireway Covers: Screw-cover type.

F. Finish: Manufacturer's standard enamel finish.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. Emerson/General Signal; Appleton Electric Company.
3. Erickson Electrical Equipment Co.
4. Hoffman.
5. Hubbell, Inc.; Killark Electric Manufacturing Co.
6. O-Z/Gedney; Unit of General Signal.

7. RACO; Division of Hubbell, Inc.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet-PLM Division.
10. Spring City Electrical Manufacturing Co.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

G. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.6 FACTORY FINISHES

A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard paint applied to factory-assembled raceways, enclosures, and cabinets before shipping.

B. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Use the following raceways for outdoor installations:

1. Exposed: GRC or IMC.
2. Concealed: GRC or IMC.
3. Underground, Single Run: GRC or RNC.
4. Underground, Grouped: GRC or RNC.
5. Connection to Vibrating Equipment: LFMC.
6. Boxes and Enclosures: NEMA 250, Type 3R or Type 4.

B. Use the following raceways for indoor installations:

1. Exposed in Unfinished Areas: EMT. Use IMC or GRC for locations subject to mechanical damage.
2. Exposed in finished areas: Surface metal raceway where concealment is impossible. Limit use to the least possible. The impossibility of concealment is in the opinion of the Architect.
3. Concealed: EMT.
4. Connection to Vibrating Equipment: FMC; except in wet or damp locations, use LFMC.
5. Damp or Wet Locations: GRC or IMC.
6. Boxes and Enclosures: NEMA 250, Type 1, unless otherwise indicated.

C. Minimum Raceway Size: 1/2-inch trade size (DN 14) unless noted. 3/8-inch factory assembled, flexible steel "fixture whips," a maximum of 60 inches long, may be used to feed individual lay-in fluorescent lighting fixtures.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

3.2 INSTALLATION

A. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

B. Do not support electrical equipment or raceways from ceiling grid or ceiling grid supports. Independently support all equipment and raceways directly from structural elements.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section, "Basic Electrical Materials and Methods."

E. Install temporary closures to prevent foreign matter from entering raceways.

F. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

H. Conceal raceways within finished walls, ceilings, and floors unless concealment is impossible or where otherwise indicated.

1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

I. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.

1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2. Space raceways laterally to prevent voids in concrete.
3. Run conduit larger than 1 inch trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
4. Change from nonmetallic tubing to rigid steel conduit or IMC before rising above the floor.

J. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.

1. Run parallel or banked raceways together on common supports.
2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

K. Join raceways with fittings designed and approved for that purpose and make joints tight.

1. Use insulating bushings to protect conductors.

L. Tighten set screws of threadless fittings with suitable tools.

M. Terminations:

1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200 lb (90 kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

O. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches (150 mm) above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

P. Flexible Connections: Use maximum of 60 inches (1725 mm) of flexible conduit for recessed and semirecessed lighting fixtures. Use maximum of 12 inches (35 mm) of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

Q. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.4 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Ground-fault circuit interrupter devices.
   2. Device wall plates.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. TVSS: Transient voltage surge suppressor.

C. EMI: Electromagnetic interference.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70 (2011).

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following (for each type of wiring device):
   1. Duplex, Weather-Resistant GFCI Receptacles, 125V-1ϕ-20A:
      a. Hubbell #GFRWR20I
      b. Leviton #GFWR2-I
      c. P & S #2097TRWRI

2. Weatherproof Vertical Metallic In-Use Covers:
    a. Hubbell #WP2GE
    b. Leviton #IUM1V-GY
    c. P & S #WIUCAST1

2.2 DEVICE PLATES

A. Single and combination types to match corresponding wiring devices.
    1. Plate-Securing Screws: Metal with head color to match plate finish.
    2. Material for Finished Spaces: smooth, high-impact thermoplastic.
    3. Material for Unfinished Spaces: Galvanized steel.
    4. Material for Wet Locations: See above.

2.3 FINISHES

A. Color:
    1. Wiring Devices Connected to Normal Power System and Associated Device Plates: Ivory, unless otherwise required by Architect or required by NFPA 70.
    2. Wiring Devices Connected to Emergency Power System and Associated Device Plates: Red.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies level, plumb, and square with building lines.

B. Install wall dimmers to achieve indicated rating after derating for ganging according to manufacturer's written instructions. Where switches are mounted adjacent to dimmers, switch shall be that dimmer manufacturer's companion device, matching dimmer style.

C. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' written instructions.

D. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates. Provide dimmer manufacturer's custom companion plates where dimmers and switches are mounted together.

E. Remove wall plates and protect devices and assemblies during painting.

F. Provide carpet flange or carpet trim for floor boxes as required for the floor covering.

3.2 MOUNTING HEIGHTS

A. Mount toggle switches at 48 inches above finished floor to center of toggle handle.

B. Mount receptacles, telephone outlets and data outlets 18 inches above finished floor to center of receptacle unless specifically noted otherwise.

C. Mount devices above counters at 2 inches from bottom of device to top of counter, or counter backsplash.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section “Grounding and Bonding."

B. Connect wiring according to Division 26 Section "Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

D. Do not connect stranded wire to devices using back wired push-in feature.

E. When terminating stranded conductors on devices, ends of strands shall be contained by insulation so that all strands must be held by screw.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
   2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION

SECTION 26 32 13 - PACKAGED ENGINE GENERATOR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes packaged engine-generator sets for emergency standby power supply with the following features:
   1. Natural gas engine.
   2. Unit-mounted cooling system.
   3. Unit-mounted control and monitoring.
   4. Outdoor enclosure.
   5. Remote annunciator.

B. Related Sections include the following:
   1. Division 26 Section, "Transfer Switches," for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
   1. Thermal damage curve for generator.
   2. Time-current characteristic curves and manufacturer recommended settings for generator protective device.
   3. List of all factor settings of relays; provide rely-setting and calibration instructions, including software, where applicable.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified, showing recommended clearances on all sides of unit.
   2. Wiring Diagrams: Power, signal, and control wiring.

C. Qualification Data: For manufacturer.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
   1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

F. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with ASME B15.1.

E. Comply with NFPA 37.

F. Comply with NFPA 70.

G. Comply with NFPA 110 requirements for Level 1 emergency power supply system.

H. Comply with UL 2200.

I. Engine Exhaust Emissions: Comply with applicable federal, state, and local government requirements.

J. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

K. Noise Emission: Company with applicable state and local government requirements due to sound emitted by generator set including engine, engine exhaust, engine colling0air intake and discharge, and other components of installation.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Using Agency or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
   1. Notify Engineer and Using Agency in advance of proposed interruption of electrical service.
   2. Do not proceed with interruption of electrical service without Architect's written permission.

3. Refer to Division 26 Section, "Basic Electrical Materials and Methods," for additional requirements.

B. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
1. Ambient Temperature: Minus 15 to plus 40 degrees C.
2. Relative Humidity: 0 to 95 percent.
3. Altitude: Sea level to 1000 feet (300 meters).

1.7 COORDINATION

A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
1. Warranty Period: 5 years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Caterpillar.
2. Cummins.
3. Generac Power Systems.

4. MTU.

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and -tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
   1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

C. Capacities and Characteristics:
   1. Power Output Ratings: Nominal ratings as indicated.
   2. Output Connections: Three-phase, 4 wire.
   3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

D. Generator-Set Performance:
   1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
   2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
   3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
   4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
   5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
   6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
   7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
   8. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

A. Fuel: Natural gas.

B. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).

C. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

E. Governor: Adjustable isochronous, with speed sensing.

F. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition with vertical discharge from unit.
3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
    a. Rating: 50 psig (345 kPa) maximum working pressure with coolant at 180 degrees F (82 degrees C), and noncollapsible under vacuum.
    b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

G. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Sound level measured at a distance of 10 feet (3 meters) from exhaust discharge after installation is complete shall be 85 dBA or less.

H. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

I. Starting System: 12-V electric, with negative ground.
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: As required by NFPA 110 for system level specified.

4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35 A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 degrees C to plus 60 degrees C to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
    e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
    f. Enclosure and Mounting: NEMA 250, Type 1, mount inside generator weather-proof housing.
    g. Omissions: Unit shall comply with all applicable federal, state, and local standards and regulations.

2.4 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

D. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
1. AC voltmeter.
2. AC ammeter.
3. AC frequency meter.
4. DC voltmeter (alternator battery charging).
5. Engine-coolant temperature gage.
6. Engine lubricating-oil pressure gage.
7. Running-time meter.
8. Ammeter-voltmeter, phase-selector switch(es).
9. Generator-voltage adjusting rheostat.
10. Start-stop switch.
11. Overspeed shutdown device.
12. Coolant high-temperature shutdown device.
13. Coolant low-level shutdown device.
14. Oil low-pressure shutdown device.
15. Generator overload.
16. Generator No. 3 not connected to building.

E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

F. Common Remote Audible Alarm: Company with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.

G. Remote Alarm Annunciator: Comply with NFPA 110. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition, including “Generator No. 3 not connected to building.” Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

2.5 GENERATOR OVERCURRENT PROTECTION

A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.
1. Tripping Characteristic: Designed specifically for generator protection.
2. Trip Rating: Matched to generator rating.

3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

B. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:
1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

2.6 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Dripproof.

G. Instrument Transformers: Mounted within generator enclosure.

H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

2.7 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, weatherproof, sound attenuated steel housing, wind resistant up to 100 mph (160 km/h). Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure. Vertical exhaust discharge.

B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
   1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
   2. Vertical discharge.

2.8 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

2.9 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.10 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
   1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Install packaged engine generator with elastomeric isolator pads on 4-inch- (100-mm-) high concrete base. Secure sets to anchor bolts installed in concrete bases. Concrete base construction is specified in Division 16 Sections.

D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Division 25 Sections. Drawings indicate general arrangement of piping and specialties.

B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.

C. Connect engine exhaust pipe to engine with flexible connector.

D. Connect fuel piping to engines with a gate valve and union and flexible connector.

E. Ground equipment according to Division 26 Section 260526, "Grounding and Bonding."

F. Connect wiring according to Division 26 Section 260519, "Conductors and Cables."

3.4 IDENTIFICATION

A. Identify system components according to Division 26 Section 260500, "Basic Electrical Materials and Methods."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:
   1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.

D. Coordinate tests with tests for transfer switches and run them concurrently.

E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Remove and replace malfunctioning units and retest and reinspect as specified above.

I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION

SECTION 26 36 00 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provision, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this section.

1.2 SUMMARY

A. Section includes automatic transfer switches rated 600 V and less.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

C. Field quality-control reports.

D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA ICS 1.

C. Comply with NFPA 70.

D. Comply with NFPA 110.

E. Comply with UL 1008 unless requirements of these Specifications are stricter.

F. Comply with NFPA 70 (2020).

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Transfer Switches Using Molded-Case Switches or Circuit Breakers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Caterpillar
      b. Eaton Corp

c. Generac Power Systems
d. Thomson Power Systems

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
   1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
   1. Switch Action: Double throw; mechanically held in both directions.
   2. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

G. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.

H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

I. Battery Charger: For generator starting batteries.
   1. Float type rated 10 A.
   2. Ammeter to display charging current.
   3. Fused ac inputs and dc outputs.

J. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 MOLDED CASE TYPE AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

D. Transfer Switches Based on Molded-Case-Switch Components: Comply with NEMA AB 1, UL 489, and UL 869A.

E. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase.

F. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer.

G. Automatic Transfer-Switch Features:
   1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
   2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
   3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
   4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
   5. Test Switch: Simulate normal-source failure.
   6. Switch-Position Pilot Lights: Indicate source to which load is connected.
   7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
      a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
      b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
   8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
   9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
   10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
   11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
   12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is not available.

2.4 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Floor-Mounting Switch: Anchor to floor by bolting.
    1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Section 16073 "Hangers and Supports for Electrical Systems."

B. Identify components according to Division 26 Section "Basic Electrical Materials and Methods."

C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding."

B. Connect wiring according to Division 26 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections:
    1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
    2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
    a. Check for electrical continuity of circuits and for short circuits.
    b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    c. Verify that manual transfer warnings are properly placed.
    d. Perform manual transfer operation.
4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    c. Verify time-delay settings.
    d. Verify pickup and dropout voltages by data readout or inspection of control settings.
    e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
    f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
    a. Verify grounding connections and locations and ratings of sensors.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Remove and replace malfunctioning units and retest as specified above.

F. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Section 01820 "Demonstration and Training."

B. Coordinate this training with that for generator equipment.

END OF SECTION

SECTION 26 36 10 - GENERATOR DOCKING SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes generator docking switches rated 600 V and less, including the following:

1. Generator docking switches.

B. Related Sections include the following:

1. Division 26 Section “Packaged Engine Generator.”
2. Division 26 Section “Transfer Switches”

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1. Single-Line Diagram: Show connections between transfer switch, power sources, and load.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control test reports.

1. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: The manufacturer shall have produced and sold UL1008 listed generator docking switches as standard product for a minimum of three (3) years.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NEMA ICS 1.

D. Comply with NFPA 70 (2020).

E. Comply with UL 1008.

1.5 PROJECT CONDITIONS

A. Environmental Conditions: Shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: 5 to 45 deg C.
2. Relative Humidity: 0 to 95 percent.
3. Altitude: Sea level to 1000 feet (300 m).

1.6 COORDINATION

A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of generator docking switch and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or an approved equal:

1. ESL Power Systems.
2. Eaton Corp.

2.2 GENERAL

A. Switches shall be molded case device type as indicated on the drawings. Knife switch or fused switches are not acceptable. Standard mechanical conductor terminals shall be provided for both the on-site generator and the portable generator.

B. Contractor shall be responsible for the equipment until it has been installed and is finally inspected, tested and accepted in accordance with the requirements of this Specification.

2.3 MOLDED CASE GENERATOR DOCKING SWITCH

A. Generator docking switch shall consist of (2) two mechanically-interlocked molded case devices; kirk-locks are not acceptable, connectors, power distribution block and grounding terminals, all housed within a padlockable enclosure.

B. Generator docking switch enclosure shall be NEMA 250 Type 3R construction, constructed of continuous seam-welded, powder coated galvanneal steel. The main access shall be through an interlocked, hinged door that extends the full height of the enclosure. Access for portable generator cables terminals shall be via a) drawn flange cable entry openings in the bottom of enclosure for wall mount units, or b) hinged lower door for pad mount units. A hinged flap door shall be provided to cover the cable openings when cables are not connected; the hinged flap door shall allow cable entry only after the main access door has been opened. Enclosure shall be powder coated after fabrication.

C. None of the portable generator conductor terminals shall be accessible unless both molded case circuit breakers are in the "OFF" position and the main access door is open.

D. A power distribution block shall be provided for load-side field wiring. The power distribution block shall be factory wired to the molded case devices.

E. Molded case devices shall be UL Listed and the short circuit interrupt rating shall be a minimum of 65kAIC at 480VAC. Trip rating of the molded case devices shall be as shown on the drawings. One molded case devices shall be fed from utility power; the other molded case devices shall be fed from the cam-style male connectors to supply power from a portable generator. Both molded case devices shall include UL Listed door-mounted operating mechanisms (with provisions for a locking device), preventing the opening of the main access door unless both breakers are in the "OFF" position. Both molded case devices shall be mounted behind a deadfront panel. The load-side of the molded case devices shall not be energizable unless the main access door is closed and one of the molded case devices is in the "ON" position. The (2) molded case devices shall be safety interlocked by mechanical means to ensure that only one device can be closed at any given time.

F. Generator docking switch shall be suitable for use as service equipment in the USA as defined by the NEC.

G. Generator docking switch shall include permanently affixed operation instructions.

2.4 ACCESSORIES

A. Accessories shall include:

1. Phase rotation monitors.
2. Auxiliary contacts to indicate that Generator No. 3 is not connected to building.

2.5 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prior to installation of generator docking switches, Contractor shall examine the areas and conditions under which the manual transfer switch is to be installed and notify the Engineer in writing if unsatisfactory conditions exist.

B. Generator docking switch shall be installed as shown on the drawings and per the manufacturer's written instructions. In addition, the installation shall meet the requirements of local codes, the National Electrical Code and National Electrical Contractors Association's "Standard of Installation".

C. Conduit entry into the generator docking switch shall be by Contractor; Contractor shall furnish and install UL listed watertight conduit hubs, as manufactured by MYERS, T&B or other for each conduit entry where required on the manual transfer switch. The incoming hub size shall match the conduit size for feeders and ground as shown on the drawings. The outgoing hub size shall match the conduit size for loads and ground as shown on the drawings.

D. Any conduit penetrations that are above live parts must be properly sealed to prevent moisture intrusion from the conduit. A UL Listed or Classified expanding foam sealant (such as Rainbow Quick Seal 79547), or other sealing product meeting local codes and NEC requirements should be used to seal the interior of the conduit around the cables. The product selected must be able to permanently seal around all wires and the conduit (common 'Duct Seal" is not acceptable for this application). The sealing shall be done at the entry into the enclosure so the seal can be verified and inspected from inside the enclosure. Failure to seal may allow water to drip on live parts and will void warranty. Hubs shall be properly installed and tightened to maintain Type 3R integrity of the manual transfer switch enclosure.

E. Contractor shall terminate feeder conductors, load conductors and ground per the manufacturer's instructions. All field wiring terminations shall be torqued as required per the instructions on the manual transfer switch's power distribution block, circuit breaker & ground lug.

F. Connect wiring according to Division 26 Section "Conductors and Cables."

3.2 FIELD TESTING

A. Prior to energizing manual transfer switch, the Contractor shall perform the following checks and tests as a minimum.

1. Verify mounting and connections are complete and secure.
2. Verify internal components and wiring are secure.
3. Perform continuity check of all circuits.
4. Perform 1,000 VDC megger test on feeder, load and ground cables.
5. Verify deadfront is secure.
6. With the manual transfer switch deadfront in place and the main access door closed and properly latched, actuate both Operator Mechanisms; verify only (1) breaker at a time can be turned to the "ON" position
7. Confirm operation of the manual transfer switch ground receptacle by attaching a plug to the manual transfer switch ground receptacle and then verify that the plug is grounded to the facility ground.
8. Once utility power has been applied, confirm operation of manual transfer switch by following directions on main access door.

END OF SECTION

SECTION 26 43 12 - SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes UL Type 1, 100Ka/phase surge protective device.

1.3 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. SVR: Suppressed voltage rating.

C. TVSS: Transient voltage surge suppressor.

D. SPD: Surge Protective Devices (SPD's).

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating weights, operating characteristics, furnished specialties, and accessories.

B. Product Certificates: For SPD's, signed by product manufacturer certifying compliance with the following standards:

1. UL 1283.
2. UL 1449, 5th Edition.

C. Operation and Maintenance Data: For SPD's to include in emergency, operation, and maintenance manuals.

D. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain SPD's and accessories through one source from a single manufacturer.

B. Product Options: Drawings indicate size, dimensional requirements, and electrical performance of SPD's and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NEMA LS 1, "Low Voltage Surge Protection Devices."

1.6 PROJECT CONDITIONS

A. Service Conditions: Rate surge protection devices for continuous operation under the following conditions, unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: 30 to 120 degrees F (0 to 50 degrees C).
3. Humidity: 0 to 85 percent, noncondensing.
4. Altitude: Less than 20,000 feet (6090 meters) above sea level.

1.7 COORDINATION

A. Coordinate location of SPD's to allow adequate clearances for maintenance.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within one year from date of Final Inspection.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the specified.

2.2 UL Type 1, 100KA/Phase Service Entrance Surge Protective Devices

A. Surge Protection Device Description: Non-modular type with the following features and accessories:

1. LED indicator lights for power and protection status.
2. NEMA 4 or 4x enclosure
3. Audible alarm and form C relay alarm relay

B. Surge Current Capacity Per Phase: 100KA (min)

C. Nominal Discharge Current: 20KA (min)

D. Short-Circuit Rating: 200KA

E. Connection Method: Permanently wired.

F. 480Y/277V SURGE PROTECTIVE DEVICES:
   1. ABB OVRHTP1002773YPUO
   2. Eaton SPC 100480Y5P
   3. Siemens TPS4C111OD
   4. Square D HWB41

G. 208Y/120V SURGE PROTECTIVE DEVICES:
   1. ABB OVRHTP1001203YPUO
   2. Eaton SPC100208Y5P
   3. Siemens TPS4C111OD
   4. Square D HWB21

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTION DEVICES

A. Install devices where indicated on drawings near the end of underground branch circuits extending beyond the building, with ground lead bonded to branch circuit ground.

B. Install devices at each exterior item of mechanical equipment having a hermetic compressor. Connect on line side of local disconnect, with ground lead bonded to branch circuit ground.

C. Make SPD leads as short as possible and keep radius of bends in wire as large as is practical.

3.2 PLACING SYSTEM INTO SERVICE

A. Do not energize or connect service entrance or HVAC equipment to their sources until SPD's are installed and connected.

END OF SECTION

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Lighting fixtures mounted on exterior building surfaces.
   2. Accessories.

1.3 DEFINITIONS

A. BF: Ballast factor. Ratio of light output of a given lamp(s) operated by the subject ballast to the light output of the same lamp(s) when operated on an ANSI reference circuit.

B. Correlated Color Temperature (CCT) – a visible light characteristic of comparing a light source to a theoretical, heating black body radiator (measured in degrees kelvin).

C. CRI: Color rendering index.

D. CU: Coefficient of utilization.

E. Effective Projected Area (EPA) – the wind loading of the fixture.

F. International Protection (IP) Rating – delineates the level at which foreign objects and water can intrude inside a device.

G. Restriction of Hazardous Substances (RoHS) – products that are RoHS-compliant do not contain any of the following materials: lead (Pb), mercury (Hg), cadmium (Cd), hexavalent

H. Useful Life – the operating hours before reaching 70% of the initial rated lumen output point with no catastrophic failures under normal conditions.

I. LER: Luminaire efficiency rating, which is calculated according to NEMA LE 5. This value can be estimated from photometric data using the following formula:
   1. LER is equal to the product of total rated lamp lumens times BF times luminaire efficiency, divided by input watts.

J. RCR: Room cavity ratio.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
   1. Physical description of fixture, including dimensions and verification of indicated parameters.
   2. Emergency lighting unit battery and charger.

3. Fluorescent and high-intensity-discharge ballasts.
4. Lamps.

B. Wiring Diagrams: Power, signal, and control wiring.

C. IESNA LM-79 report on manufacturer's standard production model luminaire to include:
1. Testing agency, report number, date, manufacturer's name, catalog number, LED driver, drive current, ambient temperature.
2. Luminaire efficacy (lumens/watt), minimum light output, zonal lumen density.
3. Color qualities (CCT, CRI, chromaticity).
4. ANSI C78.377 Duv.
5. Electrical measurements (input voltage, input current, input power).
6. Spectral distribution over visible wavelengths (mW/nm).
7. Absolute intensity candlepower (cd) summary table.
8. Isocandela plot
9. Photometric file, including BUG rating.

D. IESNA LM-80 report on LED package, array, or module, to include:
1. Testing agency, report number, date, type of equipment, and LED light source being tested.
2. All data required by IESNA LM-80.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, include the following:
1. Catalog data for each fixture. Include the diffuser, ballast, and lamps installed in that fixture.

G. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70 (2020).

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

A. SPECIAL WARRANTY FOR LED LUMINAIRES
   1. The LED manufacturer shall provide a written five-year on-site replacement "finish" warranty for luminaires. Finish warranty shall include warranty against failure or substantial deterioration such as blistering, cracking, peeling, chalking, or fading.
   2. The LED manufacturer shall provide a written five-year on-site replacement warranty for defective or non-starting power supply units and LED source assemblies, which include, but are not limited to, LED packages, LED arrays, LED modules, LED dies, encapsulates, and phosphors.
   3. The LED manufacturer shall provide a written five-year on-site replacement warranty for any LED source assembly, package, array, or module, which does not include the power supply, against 10% or more of the individual LEDs in that assembly, package, array, or module failing to illuminate.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. As specified on the drawings or with approval prior to the bid. Approval granted prior to bid is subject, after the bid, to comparison with the specified equipment and to compliance with the plans, specifications and space limitation requirements.

2.2 FIXTURES AND COMPONENTS, GENERAL

A. LED Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A. Provide luminaires complete with LED light source and power supply unit. Details, shapes, and dimensions are indicative of the general type desired but are not intended to restrict selection to luminaires of a particular manufacturer. Luminaires of similar design, light distribution and brightness characteristics, and of equal finish and quality will be acceptable.
   1. Luminaries shall produce a minimum efficacy of 100 lumens per watt.
   2. Luminaires shall incorporate modular electrical connections and be constructed to allow replacement of all or part of the optics, heat sinks, power supply units, and electrical components using only a simple tool, such as a screw driver.
   3. Luminaires shall bear a nameplate inscribed with the manufacturer's name, address, model number, date of manufacture, and serial number, securely affixed in a conspicuous place. The nameplate of the distributing agent will not be acceptable.
   4. Luminaires surge protection to meet "C low" waveforms as defined in ANSI/IEEE C62.41.2, scenario 1 Location C.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to

prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

E. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.
   4. Laminated Silver Metallized Film: 90 percent.

F. Plastic Diffusers, Covers, and Globes:
   1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
      a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless different thickness is scheduled.
      b. UV stabilized.
   2. Glass: Annealed crystal glass, unless otherwise indicated.

2.3 LIGHTING FIXTURES

A. Fixtures: As scheduled on the Contract Drawings.
   1. Suspended fixtures shall be balanced to hang straight and level.
   2. Continuous rows of fixtures shall be run straight and level; fixture design shall not be susceptible to misalignment after incidental contact.

2.4 LED POWER SUPPLY UNITS

A. Efficiency: 85%.

B. Maximum drive current: 525 mA.

C. Operating temperature: -30°C to +40°C.

D. Operating voltage: 120V to 277V nominal. Fluctuations in line voltage up to 15% shall have no visible effect on the luminous output.

E. Operating frequency: 50/60 Hz.

F. Power factor (PF) $\geq$ 0.90.

G. Total current harmonic distortion (THD) for current: $\leq$ 20%.

H. Comply with FCC 47 CFR Section 15, Class B, non-consumer RFI/EMI standards.

I. Reduction of hazardous substances- (RoHS-) compliant.

J. Luminaires under a covered structure shall be UL-listed Class P with a sound rating of “A.”

K. Driver shall be dimmable and compatible with a standard dimming control circuits.

L. Driver shall be protected against damage due to either an open-circuit or short-circuit fault condition on the driver output. The driver shall resume normal operation when the fault is removed.

M. Over-temperature protection shall be provided to cut off output power if temperature limit is exceeded. The driver shall resume normal operation when within normal operating temperature.

2.5 LED LIGHT SOURCE

A. Correlated color temperature (CCT) shall be in accordance with ANSI C78.377.
1. Nominal CCT: 3000 K: 3045 $\pm$ 175 K.
2. Nominal CCT: 4000 K: 3985 $\pm$ 275 K
3. Nominal CCT: 5000 K: 5028 $\pm$ 283 K.
4. Nominal CCT: 6500 K: 6530 $\pm$ 510 K.

B. Color Rendering Index (CRI) shall be:
1. $\geq$ 80 for 3000 K – 3500 K
2. $\geq$ 70 for 4000 K – 6500 K

C. Thermal management shall be passive by design and shall consist of heat sinks with no fans, pumps, or liquids.

2.6 FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Basic Electrical Materials and Methods," for channel- and angle-iron supports and nonmetallic channel and angle supports.

2.7 FINISHES

A. Fixtures: Manufacturers' standard, unless otherwise indicated.
1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
2. Metallic Finish: Corrosion resistant.

2.8 SOURCE QUALITY CONTROL

A. Provide services of a qualified, independent testing and inspecting agency to factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.

B. Factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures: Set level, plumb, and square with walls.

B. Adjust aimable fixtures to provide required light intensities.

3.2 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Verify normal operation of each fixture after installation.

C. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal.

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

E. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

END OF SECTION