



Volume 2 of 2

Project Manual

Camp Hartell CSMS Compressor Replacement
Windsor Locks, CT

Project No.: 25MIL23702

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State of Connecticut
Military Department
Procurement and Contracting
360 Broad Street
Hartford, CT 06105

Project Manual Date: March 6, 2026

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PART 1 – GENERAL

1.1 DEFINITIONS

A. Contractor:

Whenever the term "**Contractor**" is used in these Division 01 General Requirements and the Contract Documents, it may be understood to mean either the **Design-Bid-Build (D-B-B) "General Contractor"** or the **Construction Manager at Risk ("CMR")** as applicable to the specific Project.

B. Subcontractor:

Whenever the term "**Subcontractor**" is used, it may be understood to mean either a **Subcontractor** or a **Supplier**, as applicable to the specific Project.

C. Contract:

Whenever the term "**Contract**" is used in these Division 01 General Requirements and the Contract Documents, it may be understood to mean either the **D-B-B General Contractor's Contract Sum** as stated in their Contract or the **CMR's Contract Sum** as stated in their CMR Agreement, as applicable to the specific Project.

1.2 RELATED DOCUMENTS

- A.** The Contract Documents are defined in the D-B-B and CMR Division 00 General Conditions, as applicable to the specific Project.
- B.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Delivery Method:

- 1. ☒ Design-Bid-Build (DBB);
- 2. ☐ Construction Manager at Risk (CMR)

B. Project Number: 25MIL23702.

C. Project Title: CSMS Compressor Replacement – Camp Hartell

D. Project Location: 542 North Street, Windsor Locks, CT 06069

E. The Project Description:

Removal of two air compressors and replacement with one building air compressor, two breathing air compressors, all associated specialties, and power. Temporary compressor provisions.

- 1. The Authorities Having Jurisdiction for Threshold Projects, Non-Threshold Projects, as defined by the Connecticut General Statutes, are the Connecticut Department of Administrative Services (DAS) / Construction Services (CS) Office of State Building Inspector (OSBI) and Office of State Fire Marshal (OSFM).

F. Owner:

- 1. **Owner's Name:** The Owner is the State of Connecticut, Military Department.
- 2. **Authorized Representative for the Owner: Project Manager Name: James Cavanna.**
 - a. **Military Project Manager's Location:** The Project Manager is located at 360 Broad Street, Hartford, CT, 06105.
 - b. **Phone: 860-548-3222**
 - c. **Email(s): james.cavanna@ct.gov.**
- 3. **Authority:** The Project Manager is the only authorized representative for the Military Department Commissioner to act in matters involving revoking, altering, enlarging or relaxing any requirement of the Contract Documents. **The Project Manager is not empowered to revoke, alter, enlarge, or relax any requirements as detailed within the articles of Division 00 Section 00 72 13 General Conditions of the Contract for Construction for Construction for Construction for Design-Bid-Build OR Division 00 Section 00 72 23 General Conditions of the Contract for Construction for Construction Manager at Risk, as applicable.**

- a. **Related Section: Article 25, All Work Subject To Control of the Commissioner,** Division 00 General Conditions of the Contract for Construction.

G. Agency:

1. **Agency Name:** The Military Department
2. **Agency Representative Name and Title:** Maria Morales-Diaz. The Agency Representative's Title is **Fiscal Administrative Manager.**
 - a. **Agency Representative Location:** The Agency Representative is located at **360 Broad Street, Hartford, CT 06105.**
 - b. **Phone:** 860-524-4946;
 - c. **Email(s):** maria.morales-diaz@ct.gov.
3. **Authority:** The Agency Representative has the administrative authority for the facility and or site where the work is being performed but does not have the authority to change the Contract Documents or direct the Contractor.

H. Architect and Engineer (A/E):

1. **Engineer's Name:** The Engineer representing the firm for this project is Craig Razza, PE – Kohler Ronan, LLC.
 - a. **Engineer's Location:** The Engineer is located at 93 Lake Avenue, Danbury, CT 06810..
 - b. **Phone:** 203-778-1017;
 - c. **Email(s):** crazza@kohlerronan.com.
2. The Architect and Engineer (A/E) or their accredited representative is referred to in the Contract Documents as "Architect" or "Architects" or "Engineer" or "Engineers" or by pronouns which imply them. As information for the Contractor, the Architect's or Engineer's status is defined as follows:
 - a. The Architect and Engineer will not make interpretations or decisions directly to the Contractor. All interpretations or decisions will be conveyed through the Construction Administrator to the Project Manager.
 - b. As the authorized representative of the Department of Administrative Services Commissioner, the Architect and Engineer is responsible for review of shop drawings, materials, and equipment intended for the work, in accordance with the Division 00 "General Conditions" and "Supplementary Conditions".
3. Wherever the Architect or Engineer is mentioned in the documents in connection with an administrative function, it shall include the Construction Administrator in that function except for shop drawings.

I. Construction Administrator (CA):

1. **Construction Administrator Name:** TBD
 - a. **Construction Administrator Location:** The Construction Administrator is located at **[Insert]**,
 - b. **Phone];**
 - c. **Fax:**
 - d. **Email(s):**
2. **Authority:** As information to the Contractor, the Construction Administrator's status is defined as follows:
 - a. The Construction Administrator (CA) is referred to in the Contract Documents as "Construction Administrator" or by pronouns which imply it. All communications concerning the project will be directed through the Construction Administrator or a designated representative(s).
 - b. The Construction Administrator is the Owner's Agent who will, among other things, monitor and analyze the Contractor's performance, scheduling and construction, process shop drawings, material, and equipment submittals, review and process periodic billings, review, analyze, and recommend cost changes.
 - c. **Related Section: Article 26 "Authority of the Construction Administrator"** of Division 00 "General Conditions of the Contract for Construction".
3. The Construction Administrator will process all requests for information, interpretations and decisions regarding the meaning and intent of the Contract Documents, consulting with appropriate parties prior to rendering the interpretations or decisions for the Project Manager to the Contractor. All such requests and replies shall be in writing.

J. Construction Manager (CMR):

1. Construction Manager's Name (CMR): TBD

- a. **Construction Manager's Firm's Location:** The Construction Manager is located at .
- b. **Phone:**;
- c. **Fax:**;
- d. **Email(s):**.

2. Authority: Construction Manager is under direct Contract with the Department of Administrative Services, responsible for performing the Work under the Contract Documents. Whenever the words "Contractor" or "General Contractor" are used it shall be understood to mean Construction Manager.

3. Related Sections:

- a. **Article 1 "Definitions"** of Division 00 "General Conditions of the Contract for Construction for Construction Manager at Risk (CMR)"; and
- b. **Section 2.3 "Construction Phase"** of Article 2 "Construction Manager At Risk Responsibilities", in Section 00 52 23 "Standard Form of Agreement Between Owner and Construction Manager-At-Risk (CMR) For Guaranteed Maximum Price (GMP)".

K. Work: The Work Includes but is not limited to the following:

- 1 Plumbing, Fire Protection, HVAC, and Controls;**
- 2 Electrical and Fire Alarm Systems; and**
- 3 Special Equipment.**

- L.** The Contractor will include in their bid, all items required in order to carry out the intent of the Work as described, shown and implied in the Contract Documents.
- M.** It shall be the Contractor's responsibility upon discovery to immediately notify the Construction Administrator, in writing, of errors, omissions, discrepancies, and instances of noncompliance with applicable codes and regulations within the documents, and of any work which will not fit or properly function if installed as indicated on the Contract Documents. Any additional costs arising from the Contractor's failure to provide such notification shall be borne by the Contractor.
- N.** The Work will be constructed under the Contractor's Contract as applicable to this Project.
- O.** The Work will be performed in accordance with the Connecticut Department of Energy and Environmental Protection's (DEEP) **"General Permit for the Discharge of Stormwater and Dewatering Wastewater from Construction Activities"** (DEEP-WPED-GP-015) and **Stormwater Pollution Control Plan (SPCP)**, including, but not limited to, implementing, maintaining, and updating the SPCP, performing regular inspections, conducting and reporting stormwater monitoring activities, retaining records for the required period of time, and performing all post-construction measures and inspections. See **Section 01 50 00 "Temporary Facilities and Controls"** and **Section 31 20 05 "Sedimentation and Erosion Control"** for additional information.

1.4 CONTRACTOR'S USE OF PREMISES

- A. General:** During the construction period the Contractor shall have full use of the newly constructed premises for construction operations, including use of the site. The Contractor's use of the premises is limited only by the Owner's right to perform work or to retain other contractors on portions of the Project.
- B. Use of the Site:** Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
 - 1. Owner Occupancy:** Allow for Owner occupancy and use by the public of the existing facility.
 - 2.** The Contractor shall confine his operations including storage of materials, supplies, equipment, and apparatus to the areas bounded by the contract limits indicated and as directed in the Contract Documents.
 - 3.** Existing roads, drives, walks, and parking areas which are not within the contract limit line are to be kept free and clear at all times. All deliveries for the project are to enter the **[Insert]** property from **[Insert]**. The Contractor shall check all roadways for accessibility and clearances for deliveries of all large material and equipment. The Contractor shall inform the Construction Administrator at least **seventy-two (72)** hours in advance of these deliveries so they can be coordinated with the Agency so appropriate traffic control, etc. can be provided. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

4. The Contractor shall be responsible for keeping the premises clean and shall pick up rubbish and debris and promptly remove from site.
 5. Parking for the Contractor's employees will be limited to an area designated by the Construction Administrator, and the Contractor may be required to provide identification stickers for all employees' cars.
 6. Special precautions shall be taken to protect all wetland areas designated to remain. Prevent any and all sediment, debris, or other materials from getting into these areas. Should any sediment, debris, or other materials get into these areas or if any damage occurs to the vegetation therein, the Contractor shall immediately contact the Construction Administrator for direction.
 7. The Contractor shall comply with local working hour restrictions, unless specifically approved otherwise in writing by the Owner.
 8. No signs, other than those approved by the Construction Administrator, will be visible on the premises.
- C. **Use of the Existing Building:** Maintain the existing building in a weather-tight condition throughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period. Note: Check with Agency special types of conditions. Contractor personnel are not allowed to use the Cafeteria or vending machines within the existing buildings unless authorized in writing by the agency.

1.8 OCCUPANCY REQUIREMENTS

- A. **Full Agency Occupancy During Construction:** The Owner reserves the right to allow the Agency to occupy the site and existing building during the entire construction period. Cooperate with the Agency during construction operations to minimize conflicts and facilitate Agency usage. Perform the Work so as not to interfere with the Agency's operations.
1. Provide adequate building and fire code egress from the buildings during the renovation process and/or as indicated on the Contract Documents. The Contractor will be responsible to maintain and protect egress ways during the construction sequence as required and/or indicated in the Contract documents. The Contractor shall be responsible for preparing egress plans for Owner approval and for DAS/CS Office of State Building Official and Office of State Fire Marshal for approval if required.

1.11 MISCELLANEOUS PROVISIONS

A. Examination of Site:

1. It is not the intent of the Documents to show all existing conditions. All Contractors and Subcontractors are advised to attend the Pre-Bid Meeting prior to submitting their Bid Proposals. This is the only official opportunity to visit and examine the site with the Owner, Agency, Architect, Engineer and Construction Administrator.
2. The Contractor should investigate and satisfy himself as to the conditions affecting the work, including but not restricted to those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, uncertainties of weather, roads or similar physical conditions of the ground, the character of equipment, and facilities needed preliminary to and during the prosecution of the Work. The Contractor should further satisfy himself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, as well as from information presented by the Contract Documents. Any failure by the Contractor to acquaint himself with the available information shall not relieve him from the responsibility for estimating properly the difficulty and cost of successfully performing the Work.
3. If tests have been done for Asbestos Containing Material (ACM), Lead-Based Paint (LBP) Containing Material, Polychlorinated Biphenyls (PCBs) in Building Materials and/or Mold, then the results are referenced in **Section 00 30 00 Available Information**. See **Section 01 35 16 "Alteration Project Procedures"** for **removal responsibility** and additional information.
4. If tests have been done for Contaminated Soils and/or Contaminated Groundwater, then the results are referenced in **Section 00 30 00 Available Information**. See **Section 01 35 16 "Alteration Project Procedures"** for **removal responsibility** and additional information.
5. If tests have been done for Work Involving Hazardous Materials, Wastes, and Items and Universal Wastes (Including Products Containing Persistent Bioaccumulative Toxic Chemicals" [PBTs] such as PCBs, Di-2-ethylhexyl Phthalate [DEHP], and Mercury), the results are referenced in **Section 00 30 00 Available Information**. See **Section 01 35 16 "Alteration Project Procedures"** for **exposure limits and removal responsibility**.

7. No attempt has been made to locate hazardous material associated with existing site utilities, though it is presumed that at least some asbestos may be discovered associated with underground piping during the course of site and site utilities work. If and when such materials appear, the Contractor shall notify the Owner, who shall direct additional work outside of this Contract to assist in cutting up and disposing of same. The Contractor shall assist the hazardous materials contractor(s) with excavating, heavy lifting, and the like at no additional cost to the Owner.
- B. Pre-Bid Meeting:**
1. A Pre-Bid Meeting and tour of the site will be conducted as scheduled in Division 00 Section 00 11 16 "Invitation to Bid". This scheduled meeting is the only official opportunity for the bidders to tour the site with the Owner, Engineer, Construction Administrator, and Agency.
- C. Project Documents:**
1. The Specifications and Drawings are intended to describe and illustrate the materials and labor necessary for the work of this Project.
 2. Throughout the Technical Specifications, the Connecticut Department of Transportation Standard Specifications for Roads, Bridges, and Incidental Construction Form 818, current edition including any interim and supplemental specifications are referenced. Where so referenced the requirements set forth therein are applicable and made a part hereof. Copies of Form 818 are available from the Connecticut Department of Transportation at a nominal charge.
- D. Site Logistics Plan(s):** Site Logistics Plan(s) for this Project are in the Contract Documents. The Site Logistics Plan(s) describe in detail the proposed use of the Site and Building, both inside and outside the Contract Limit Area.
1. **Related Section:** Section 01 31 00 "Project Management and Coordination", 1.5 Submittals, A, (4).
 2. The **Site Logistics Plan(s)** include, but are not be limited to the following information:
 - a. **Building location**
 - b. **Area of Work**
 - c. **Temporary compressor location**
 - d. **Proposed building access points;**
- E. Scope Review:**
1. Prior to signing a Contract with the State, will conduct a full scope review with the apparent Low Bidder to ensure that all of the requirements have been included within the bid. This scope review will highlight all of the specific requirements of the project, a review of the procedures and all of the Technical sections of the contract documents.
 2. This process will ensure that all of the scope of work included in the contract documents has indeed been included.
- F. Specifications, Drawings, and Electronic Data Storage Devices Furnished:**
1. The Contractor shall receive **one (1) set of Portable Document Format (PDF, latest version) Conformed Bid Documents** (incorporating all Addendum changes made to the Contract Documents during the official Bid Period) on Electronic Data Storage Devices on or about the time of execution of the Contract, free of charge from the Architect. If additional copies are wanted, they will be available at the direct additional cost of their reproduction, to the Contractor.
 2. The Contractor shall receive **one (1) set of AutoCAD compatible (latest version) Conformed Set of Floor Plans** (incorporating all Addendum changes made to the Contract Documents during the official Bid Period) on Electronic Data Storage Devices at no cost on or about the time of execution of the Contract from the Architect. Additional sets of AutoCAD compatible (latest version) Floor Plans on Electronic Data Storage Devices from the Architect shall be available at the cost of their reproduction, to the Contractor.
- G. Construction Responsibility:**
1. The Contractor shall be responsible for his construction means, methods, techniques, sequences, and procedures employed in the performance of his work and shall have full responsibility for his failure to carry out any part of his work in accordance with the Contract Documents.
- H. Overtime Requests:**
1. The Contractor shall request approval from the Owner to work overtime. Said request shall be made **forty eight (48) hours** in advance. All costs for overtime are included in the Contract Sum as stated in Division 00 Section 00 41 00 "Bid Proposal Form."

I. Project Management Software:

1. The Military Department is not using Project Management Software for this project.
2. The Contractor is required to utilize the specified Project Management Software for the duration of this project and shall provide all project information via this Project Management Software. This includes, but is not limited to contracts, applications for payment, change orders, change order proposals, requests for information, etc.
3. The Contractor is required to scan all documents that contain wet (ink) signatures and send a copy of those documents electronically to the Project Manager and the project specific email "file" address. The hard copy of the wet signature documents shall be transmitted as directed by the Project Manager. This includes, but is not limited to all contracts, change orders, applications for payment, closeout documentation, etc.

J. Subcontractor Performance Evaluations:

1. Pursuant to C.G.S. Sec. 4a-101, the Contractor shall compile evaluation information during the performance of the contract on each of its subcontractors who are performing work with a value in excess of one million dollars (\$1,000,000.00). The Contractor shall complete and submit to evaluations of each such subcontractor upon fifty percent (50%) completion of the project and upon Substantial Completion of the project. The Contractor acknowledges that its failure to complete and submit these evaluations in a timely manner may, by statute, result in a delay in project funding and, consequently, payment to the Contractor. The Contractor agrees to indemnify and hold the State harmless from any loss, damage, or expense that results from or is caused by the Contractor's failure to complete and submit the evaluations to in accordance with this provision.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 11 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for handling requests for equals and substitutions made after award of the Contract.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 01 Section 01 33 00 "Submittal Procedures" specifies requirements for submitting the Contractor's Construction Schedule and the Submittal Schedule.
 - 2. Division 01 Section 01 42 20 "Reference Standards and Definitions" specifies the applicability of industry standards to products specified.
 - 3. Division 01 Section 01 60 00 "Product Requirements" specifies requirements governing the Contractor's selection of products and product options.

1.3 DEFINITIONS

- A. Definitions in this Article do not change or modify the meaning of other terms used in the Contract Documents.
- B. **Equals or Substitutions General:** Changes in products, materials, equipment, and methods of construction required by the Contract Documents proposed by the Contractor after award of the Contract.

1.4 SUBMITTALS

- A. **Equals and Substitution Request Submittals:** The Owner will consider requests for equals or substitutions if made prior to the Receipt of the Competitive Bid. The information on all materials shall be consistent with the information herein. After the contract award, substitutions will be considered for materials or systems specified that are no longer available. It will not be considered if the product was not purchased in a reasonable time after award. The Contractor shall submit all equal and substitutions requests on the **"Equal or Substitute Product Request (Form 7001)"**, an example of which is shown at the end of this Section. The Form is available from the Construction Administrator (CA). See Article 15 in the General Conditions for further refinement and information.
- B. The Contractor is required to prepare and submit three (3) copies of the required data for the first manufacturer listed or procedure listed in the specifications section with reference to all of the following areas: the substance and function considering quality, workmanship, economy of operation, durability and suitability for purposes intended including the size, rating performance, LEED® compliance, and cost. All submissions must include all the required data for the first listed manufacturer or procedure as specified, as well as the required data for the proposed Equal or Substitution. This will enable the Owner and Architect to determine that the proposed Equal or Substitution is or is not substantially equal to the first listed manufacturer or procedure.
 - 1. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers.
 - 2. Provide complete documentation showing compliance with the requirements for equals or substitutions, and the following information, as appropriate:
 - a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate contractors that will be necessary to accommodate the proposed Equal or Substitution.
 - b. A detailed comparison chart of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements, such as performance, weight, size, durability, and visual effect.
 - c. Product Data, including Shop Drawings and descriptions of products and fabrication and installation procedures.
 - d. Samples, where applicable or requested.
 - e. A statement indicating the effect on the Contractor's Construction Schedule or CPM Schedule compared to the schedule without approval of the Equal or Substitution. Indicate the effect on overall Contract Time.

- f. Cost information, broken down, including a proposal of the net change, if any in the Contract Sum.
 - g. The Contractor's certification that the proposed Equal or Substitution conforms to requirements in the Contract Documents in every respect and is appropriate for the applications indicated.
 - h. The Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the Equal or Substitution to perform adequately.
3. **Architect's Action:** If necessary, the Architect will request additional information or documentation for evaluation within **seven (7) days** of receipt of the original request for equal or substitution request. The Architect will notify the Construction Administrator who will notify the Owner of recommended acceptance or rejection of the proposed equal or substitution, within **fourteen (14) days** of receipt of the request, or **seven (7) days** of receipt of additional information or documentation, whichever is later. The Construction Administrator will give final acceptance or rejection by the Owner not less than **seven (7) days** after notification.
- a. Any request deemed an "Equal" and accepted by the Construction Administrator, Architect, Owner, and Agency will result in written notification to the Contractor and will not be in the form of a change order for an "Equal".
 - b. Any request deemed a "Substitution" and rejected or approved by Construction Administrator, Architect, and Owner may result in written notification to the Contractor and may be in the form of a change order if the "Substitution" is approved.

PART 2 - PRODUCTS

2.1 EQUAL OR SUBSTITUTIONS

- A. **Conditions:** The Architect will consider the Contractor's request for Equal or Substitution of a product or method of construction when one or more of the following conditions are satisfied, as determined by the Architect. If the following conditions are not satisfied, the Architect will return the requests to the Construction Administrator without action except to record noncompliance with these requirements.
- 1. The proposed request does not require extensive revisions to the Contract Documents.
 - 2. The proposed request is in accordance with the general intent of the Contract Documents.
 - 3. The proposed request is timely, fully documented, and/or properly submitted.
 - 4. The proposed request can be provided within the Contract Time. However, the Architect will not consider the proposed request if it is a result of the Contractor's failure to pursue the Work promptly or coordinate activities properly.
 - 5. The proposed request will offer the Owner a substantial advantage, in cost, time, energy conservation, or other considerations, after deducting additional responsibilities the Owner must assume. However, if the proposed request requires the Owner to incur additional responsibilities, including but not limited to, additional compensation to the Architect for redesign and evaluation services, increased cost of other construction by the Owner or similar considerations, then the Owner will have just cause to reject the request for Equal or Substitution.
 - 6. The proposed request can receive the necessary approvals, in a timely manner, required by governing authorities having jurisdiction.
 - 7. The proposed request can be provided in a manner that is compatible with the Work as certified by the Contractor.
 - 8. The proposed request can be coordinated with the Work as certified by the Contractor.
 - 9. The proposed request can uphold the warranties required by the Contract Documents as certified by the Contractor.
- B. The Contractor's submission and the Architect's review of Submittals, including but not limited to, Samples, Manufacturer's Data, Shop Drawings, or other such items, which are not clearly identified as a request for an Equal or Substitution, will not be considered or accepted as a valid request for an Equal or Substitution, nor does it constitute an approval.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 25 00



7001
Equal or Substitute
Product Request

Page 1 of 2

Request Phase: Pre-Bid <input type="checkbox"/> Post Bid <input type="checkbox"/> (See Article 15 Materials: Standards, General Conditions)	
(If Pre-bid only) Current Bid Due Date: <input type="text"/>	Request No.: <input type="text"/> Dated: <input type="text"/>
To: State of Connecticut Department of Administrative Services, Construction Services	DAS Project No.: <input type="text"/>
	Project Name / Location: <input type="text"/>

References: Specification(s):	Section(s): <input type="text"/>	Paragraph(s): <input type="text"/>
Drawing(s):	Drawing(s) No(s): <input type="text"/>	Detail(s) No(s): <input type="text"/>
Contractually Specified Product:	<input type="text"/>	
Contractor Proposed Product:	<input type="text"/>	
Proposed Product is:	Equal: <input type="checkbox"/>	Substitute: <input type="checkbox"/> Model No.: <input type="text"/>

IMPORTANT:
See Attached Data For Both Specified And Proposed Products
As Required By Article 15 General Conditions.

Data attached:	Drawings: <input type="checkbox"/>	Product Data: <input type="checkbox"/>	Reports: <input type="checkbox"/>	Samples: <input type="checkbox"/>
	Tests: <input type="checkbox"/>	Other: <input type="text"/>		

Reason(s) for not providing the Specified Product:

Similar Installation:	
Project Name: <input type="text"/>	Architect's Name: <input type="text"/>
Project Location: <input type="text"/>	Owner's Name: <input type="text"/>
	Date Installed: <input type="text"/>



7001
Equal or Substitute
Product Request

Page 2 of 2

Will proposed substitution impact other parts of the Work?	No	<input type="checkbox"/>	Yes	<input type="checkbox"/>	If Yes Attach An Explanation.
Will proposed substitution increase Contract Time?	No	<input type="checkbox"/>	Yes	<input type="checkbox"/>	By Number Of Calendar Days <input style="width: 50px;" type="text"/>
Actual Dollar Savings to the State of Connecticut if substitution is accepted: \$ <input style="width: 150px;" type="text"/>					
The Undersigned Certifies: That The Proposed Request For An Equal Or Substitute Product Conforms To All Of The Requirements Of Division 01 General Requirements, Section 01 25 00 Substitution Procedures.					
Request Submitted By General Contractor / CMR: <input style="width: 300px;" type="text"/> <div style="text-align: right; font-size: small;">(Firm's Typed Name)</div>					
By:	<input style="width: 100px;" type="text"/>	<input style="width: 100px;" type="text"/>	<input style="width: 100px;" type="text"/>	<input style="width: 100px;" type="text"/>	
	(Typed Name)	(Title)	(Signature)	(Date)	
Contractor / CMR Send copies to : DAS PM: <input type="checkbox"/> CA: <input type="checkbox"/>					

Consultant's Request Received on (Date): <input style="width: 100px;" type="text"/>	
Consultant's Review – This Substitution Request is:	
<input type="checkbox"/>	Approved: <i>(Submittal(s) in accordance with Div. 01 General Requirements, Section 01 33 00 Submittal Procedures.)</i>
<input type="checkbox"/>	Approved as Noted: <i>(Submittals in accordance with Div. 01 General Requirements, Section 01 33 00 Submittal Procedures.)</i>
<input type="checkbox"/>	Rejected: Use Specified Materials.
<input type="checkbox"/>	Rejected: Request Not Received Within Specified Time Period - Use Specified Materials.
Reviewed Issued By:	
Name:	<input style="width: 250px;" type="text"/> <div style="text-align: center; font-size: x-small;">(Typed Name)</div>
Title:	<input style="width: 250px;" type="text"/>
Signature:	<input style="width: 150px;" type="text"/> <input style="width: 100px;" type="text"/> <div style="display: flex; justify-content: space-between; font-size: x-small;"> (Signature) (Date) </div>

CONSULTANT Send copies to:	DAS PM	<input type="checkbox"/>	CA	<input type="checkbox"/>	Chief Architect	<input type="checkbox"/>	Chief Engineer	<input type="checkbox"/>
If Approved: As noted by Consultant, DAS Chief Architect: <input style="width: 200px;" type="text"/> <input style="width: 100px;" type="text"/> <div style="display: flex; justify-content: space-between; font-size: x-small;"> (Signature) (Date) </div>								

Copies:	Project File	Red R2	
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END

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing contract modifications.
- B. The Project Manager is not empowered to revoke, alter, enlarge, or relax any requirements as detailed within the articles of Division 00 Section 00 72 13 General Conditions Of The Contract for Construction for Design-Bid-Build OR Division 00 Section 00 72 23 General Conditions Of The Contract for Construction for Construction Manager At Risk, as applicable.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. "Article 13 - Compensation for Changes in the Work", Division 00 Section 00 72 13 General Conditions Of The Contract for Construction for Design-Bid-Build OR Division 00 Section 00 72 23 General Conditions Of The Contract for Construction for Construction Manager At Risk, as applicable.
 - 2. "Article 14 – Deleted Work", Division 00 Section 00 72 13 General Conditions Of The Contract for Construction for Design-Bid-Build OR Division 00 Section 00 72 23 General Conditions Of The Contract for Construction for Construction Manager At Risk, as applicable.
 - 3. Division 01 Section 01 25 00 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after award of the Contract.
 - 4. Division 01 Section 01 29 76 "Progress Payment Procedures" for administrative procedures governing Applications for Payment.
 - 5. Division 01 Section 01 32 16 "Construction Progress Schedules" for requirements for construction scheduling and reporting progress of work.
- D. All Forms referenced in this Section are available for download from the DAS website (<https://portal.ct.gov/das>)> Doing Business With The State > State Building Construction > Publications and Forms > DAS Construction Services Library > 7000 Series - Construction Phase Forms.

1.3 REQUESTS FOR INFORMATION

- A. In the event that the Contractor or subcontractor, at any tier, determines that some portion of the drawings, specifications, or other contract documents requires clarification or interpretation by the Architect, the Contractor shall submit a "Request for Information" utilizing the specified Agency form to the Architect via the Construction Administrator. "Requests for Information" may only be submitted by the Contractor and shall only be submitted on the "Request for Information" forms as required by the Owner.
 - 1. In the "Request for Information", the Contractor shall clearly and concisely set forth the issue for which clarification or interpretation is sought and why a response is needed from the Architect.
 - 2. In the "Request for Information", the Contractor shall set forth an interpretation or understanding of the requirement along with reasons why such an understanding was reached.
 - 3. The Owner acknowledges that this is a complex project. Based upon the owner's past experience with projects of similar complexity, the Owner anticipates that there will probably be some "Requests for Information" on this project.
 - 4. The Architect will review all "Requests for Information" to determine whether they are valid "Requests for Information". If it is determined that the document is not a valid "Request for Information", it will be returned to the Contractor, unreviewed as to content, for resubmittal on the proper form and in the proper manner.
 - 5. A "Request for Information Response" shall be issued within seven (7) days of receipt of the request from the Contractor unless the Owner determines that a longer time is necessary to provide an adequate response. If a longer time is determined necessary by the Owner, the Owner will, within seven (7) days of receipt of the request, notify the Contractor of the anticipated response time. If the Contractor submits a "Request for Information" on an activity with seven (7) days or less of float on the current project schedule, the Contractor shall not be entitled to any time extension due to the time it takes the Architect to respond to the request provided that the Architect responds within the seven (7) days set forth above.

6. A "Request for Information Response" from the Architect will not change any requirement of the Contract Documents. In the event the Contractor believes that the "Request for Information Response" will cause a change to the requirements of the Contract Documents, the Contractor shall within five (5) days give written notice to the Construction Administrator stating that the Contractor believes the "Request for Information Response" will result in a "Change Order" and the Contractor intends to submit a "Change Order Proposal" request. Failure to give such written notice within five (5) days shall waive the Contractor's right to seek additional time or cost under the requirement these Requirements.

1.4 MINOR CHANGES IN THE WORK

- A. The Architect, through the Construction Administrator, will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or Contract Time, on the "Supplemental Instructions" form as required by the Owner.

1.5 PROPOSAL REQUEST

- A. Architect/Owner-Initiated Requests For Proposals: The Architect or Owner will issue a detailed description of proposed changes in the Work via the Construction Administrator that will require adjustment to the Contract Sum or Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications. Such requests shall be on a "Proposal Request" form as required by the Owner.
 1. "Proposal Request" is issued for information only. Do not consider them as an instruction either to stop work in progress or to execute the proposed change.
 2. Within **(14) days** of receipt of a "Proposal Request", submit a "Change Order Proposal" with the required information necessary to execute the change to the Construction Administrator for the Architect's/Owner's review.
 - a. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time.
 - d. The Agency is tax exempt. All Contractor and Subcontractor services provided under your Contract with the State of Connecticut may not be exempt from taxes. The Department of Revenue Services can guide you as to which services are exempt and which are not. Please contact the State of Connecticut, Department of Revenue Services at 1-800-382-9463 or 860-541-3280.
 - e. Dollar values shown on the Schedule of Values shall not be the governing (or deciding) final amounts for change orders involving either additional charges or deletions.

1.6 CHANGE ORDER PROPOSAL

- A. When either a "Request for Information" from the Contractor or a "Proposal Request" from the Architect or Owner results in conditions that may require modifications to the Contract, the Contractor may propose changes by submitting a request for a "Change Order Proposal" to the Architect via the Construction Administrator on forms as required by the Owner. These forms shall also include "Change Order Proposal Workbook(s)" as required by the Owner.
 1. Include statements outlining the reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and Contract Time.
 2. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities as directed by Article 13 of the General Conditions of the Contract for Construction.
 3. Indicate applicable delivery charges, equipment rental, and amounts of trade discounts.
 4. Comply with requirements in Division 01 Section 01 25 00 "Substitution Procedures" if the proposed change requires an equal or substitution of one product or system for a product or system specified.
 5. The State of Connecticut construction contract has the following tax exemptions:
 - a. Purchasing of materials which will be physically incorporated and become a permanent part of the project.
 - b. Tools, supplies and equipment used in fulfilling the construction contract are not exempt.

- c. Services that are resold by the Contractor are exempt, i.e. if a Contractor hires a plumber, carpenter or electrician, a resale certificate may be issued to the subcontractor because these services are considered to be integral and inseparable component parts of the building contract
- C. "Change Order Request" Forms: Use "Change Order Proposal" and "Change Order Proposal Worksheets" forms as required by Owner.
- D. A "Change Order Proposal" cannot be submitted without either prior submission of a "Request for Information" from the Contractor or as a response to a "Proposal Request" submitted by the Architect or Owner.
- E. Any "Change Order Request" submitted without a prior submittal of a "Request for Information" or as a response to a "Proposal Request" will be immediately rejected and returned to the Contractor.

1.7 CONSTRUCTION CHANGE DIRECTIVE

A. "Construction Change Directive":

When the Owner and the Contractor disagree on the terms of a "Change Order Proposal" resulting from either a "Request for Information" or "Proposal Request", then the Architect through the Construction Administrator may issue a "Construction Change Directive" on a "Construction Change Directive" form as authorized by the Owner. The "Construction Change Directive" instructs the Contractor to proceed with a change in the Work, for subsequent inclusion in a "Change Order".

- 1. The "Construction Change Directive" contains a complete description of the change in the Work. It also designates the method to be followed to determine change in the Contract Sum or Contract Time.
- 2. Contractor must proceed with the Work once a "Construction Change Directive" is issued.
- 3. The change in the Contract Sum and Contract Time resulting from the issuance of a "Construction Change Directive" will be based on "Time & Material" or "Unit Prices".
- 4. Issuance of "Construction Change Directive" does not guarantee payment for the Work described in the "Construction Change Directive".
- B. Documentation: The Contractor shall maintain detailed records on a time and material basis of work required by the "Construction Change Directive".
 - 1. After completion of the change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.
 - 2. The final value shall be negotiated based on the supporting data to determine the value of the work.

1.8 CHANGE ORDER PROCEDURES

- A. Upon the Owner's approval of a Contractor's "Change Order Proposal", the Construction Administrator will issue a "Change Order" for signatures of the Architect, Owner and the Contractor on a "Change Order" form as required by the Owner.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 26 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies procedures for preparation and submittal of the Contractor's Applications for Payment.
- B. Related Sections: The following Sections contain requirements that relate to this Section.
 - 1. Notice to Bidders: Article 10
 - 2. General Conditions: Articles: 27 "Schedule of Values, Application for Payment"; 28 "Partial Payments"; 31 "Final Payment"; and 32 "Owner's Right to Withhold Payments".
 - 3. Division 01 Section 01 32 16 "Construction Progress Schedules" for requirements for construction scheduling and reporting progress of work.
 - 4. Division 01 Section 01 33 00 "Submittal Procedures".
 - 5. Division 01 Section 01 77 00 "Closeout Procedures" for requirements for Final Payment.

1.3 SCHEDULE OF VALUES

- A. **Coordination:** Coordinate preparation of the "Schedule of Values" with preparation of the CPM Schedule or Construction Schedule. Use "Schedule of Values" form as required by the Owner
 - 1. Submit the "Schedule of Values" to the Construction Administrator at the earliest possible date but no later than **twenty-one (21)** days after Contract Start Date.
 - 2. **Sub-schedules:** Where Work is separated into phases requiring separately phased payments, provide sub-schedules showing values correlated with each phase of payment.
- B. **Format and Content:** Use the Project Manual Table of Contents as a guide to establish the format for the "Schedule of Values". Provide at least one line item for each Specification Section on electronic media printout.
 - 1. **Identification:** Project identification on the Schedule of Values shall include, but not be limited to, the following:
 - a. **Owner**
 - b. **Project Number**
 - c. **Project Name**
 - d. **Project Location**
 - e. **Contractor's name and address.**
 - 2. Arrange the "Schedule of Values" in tabular format as required by the Owner, containing separate columns including, but not limited to, the following Items:
 - a. **Item Number.**
 - b. **Description of Work with Related Specification Section or Division Number.**
 - c. **Scheduled Values broken down by description number, type material, units of each material.**
 - 1) **Include break down of General Condition requirements, i.e. bonds, insurance premiums, taxes, job mobilization, temporary facilities, field supervision and layout, operation and maintenance manuals, punch list activities, project record documents, demonstration and training, overhead, and profit as separate line items.**
 - d. **Name of subcontractor.**
 - e. **Name of manufacturer or fabricator.**
 - f. **Name of supplier.**
 - g. **Retainage.**
 - h. **Contract sum in sufficient detail.**
 - 3. Percentage of Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

4. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual Table of Contents. Break principal subcontract amounts down into several line items. In addition, the following items listed below must be included.
 - a. **Site Logistics Plan (01 31 00):** a lump sum at 1/20 of one percent of the base bid total project cost at the time of submission of this plan.
 - b. **Coordination Drawings (01 31 00):** a lump sum of this cost for payment at the submittal of this product a minimum cost of 1/10th of one percent of the base bid total project cost or \$5,000 whichever is greater.
 - c. **Photographic Documentation (01 32 33):** a monthly cost of \$1,000 per month to be paid each month upon receipt of the photographs or forfeit of that month's payment.
 - d. **Submittal Schedule (01 33 00):** a lump sum payment calculated at 1/20th of 1% of the base bid total project cost upon receipt of the schedule
 - e. **Waste Collection & Cleaning (01 50 00):** a monthly cost. A minimum payment of \$1,000 to \$3,000 (based on size & complexity of the project) with forfeit of that monthly payment if not done.
 - f. **As-Built Updates (01 31 00):** a monthly cost, a minimum payment of \$1,000 with forfeit of that monthly payment if not done.
 - g. **Start-up and Adjusting (01 75 00):** a lump sum cost upon completion. (to be determined by the Project Manager (PM) with Architect/Engineer and Construction Administrator (CA) advice)
 - h. **Schedule (01 32 16):** For the Base Schedule a lump sum payment or 40% of the total schedule budget, with the remainder paid on an even payment over the duration of the project.
5. Round amounts to nearest whole dollar; the total shall equal the Contract Sum.
6. **Unit-Cost Allowances:** Show the line-item value of unit-cost allowances, as a product of the unit cost, multiplied by the measured quantity. Estimate quantities from the best indication in the Contract Documents.
7. **General Conditions:** Show line items for indirect costs and margins on actual costs only when such items are listed individually in Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be complete. Include the total cost and proportionate share of general overhead and profit margin for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at the Contractor's option.

1.4 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by the Architect and Construction Administrator and paid for by the Owner.
 1. The initial "Application for Payment", the "Application for Payment" at time of "Substantial Completion", and the final "Application for Payment", involve additional requirements.
- B. **Payment-Application Terms:** The Owner will process monthly progress payments. The Contractor may submit applications for payment on a monthly basis.
- C. **Payment-Application Forms:** Use the "Application for Payment" form as required by the Owner. Present the required information on electronic media printout or Owner approved form; multiple pages should be used if required.
 1. For each item, provide a column including but not limited to the following items:
 - a. Item Number.
 - b. Description of Work and Related Specification Section or Division.
 - c. Scheduled Value, break down by units of material and units of labor.
 - d. Work Completed from previous application.
 - e. Work Completed this period.
 - f. Materials presently stored.
 - g. Total Completed and stored to date of application.
 - h. Percentage of Completion.

- i. Balance to Finish.
- j. Retainage.
- D. **Application Preparation:** Complete every entry on the Application form. At the time of Final Payment only, include an executed Application form by a person authorized to sign legal documents on behalf of the Contractor. The Construction Administrator will return incomplete Applications without action.
 - 1. Entries shall match data on the "Schedule of Values".
 - 2. Include amounts of Change Orders issued prior to the last day of the construction period covered by the application.
- E. **Transmittal:** Except for final payment, submit to the Construction Administrator by a method ensuring receipt within **forty-eight (48)** hours. **One (1)** complete, signed and notarized original of each Application for Payment, including lien waivers and similar attachments when required, along with **six (6)** copies. For Final Payment, **nine (9)** complete, signed and notarized copies shall be submitted.
 - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information related to the application, in a manner acceptable to the Architect.
- F. **Applications for Payment:** Administrative actions and submittals, that must precede or coincide with submittal of the first Application for Payment and all subsequent Application for Payments including, but not limited to, the following items:
 - 1. List of subcontractors and suppliers' name, FEIN/Social Security numbers, and Connecticut Tax Registration Numbers.
 - 2. List of principal suppliers and fabricators.
 - 3. Schedule of Values.
 - 4. Contractor's Construction Schedule (preliminary if not final).
 - 5. Schedule of principal products.
 - 6. Submittal Schedule (preliminary if not final).
 - 7. List of Contractor's staff assignments.
 - 8. List of Contractor's principal consultants.
 - 9. Copies of all applicable permits.
 - 10. Copies of authorizations and licenses from governing authorities for performance of the Work.
 - 11. Proof that subcontractors have been paid amounts included on the Contractor's Application for Payment within thirty (30) days after the Owner has paid the Contractor for the particular Application for Payment in accordance with Connecticut General Statute § 49-41a (a)(1).
 - 12. Releases of Lien from subcontractors with amounts included on the Contractor's Application for Payment when Contractor has been paid by the Owner for the particular Application for Payment but the subcontractors have not been paid.
 - 13. Proof that as-built documents are updated as required by Section 01 77 00 "Closeout Procedures.
 - 14. Initial as-built survey and damage report, if required.
 - 15. Update the "Contractor's Master Subcontract Agreement List" and submit copies all recently executed Subcontract Agreements in accordance with CGS § 4b-96.
 - 15.1. The "Contractor's Master Subcontract Agreement List" shall list all Subcontract Agreements in order of Contract Sum magnitude (from high to low) in the following format:

Contractor's Master Subcontract Agreement List				
Subcontractor Name	Minority Or Small Business Designation	Trade	Address	Contract Sum

- 16. In accordance with CGS § 42-158j (b):
Each payment requisition submitted shall include a statement showing the status of all pending construction change orders, other pending change directives and approved changes to the original contract or subcontract. Such statement shall identify the pending construction change orders and other pending change directives, and shall include the date such change orders and directives were initiated,

the costs associated with their performance and a description of any work completed. As used in this section, "pending construction change order" or "other pending change directive" **means an authorized directive for extra work that has been issued to a contractor or a subcontractor and identified by an official Change Order Number or Construction Change Directive Number assigned by the State of Connecticut.**

- G. Application for Payment at Substantial Completion:** Following issuance of the Certificate of Substantial Completion submit an Application for Payment form; use the form as required by the Owner. Present the required information on electronic media printout as applicable that include, but are not limited, to the following:
1. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
 2. Administrative actions and submittals that shall precede or coincide with this application include, but are not limited to, the following:
 - 2.1 Occupancy permits and similar approvals.
 - 2.2 Warranties (guarantees) and maintenance agreements.
 - 2.3 Test/adjust/balance records.
 - 2.4 Maintenance instructions.
 - 2.5 Meter readings.
 - 2.6 Startup performance reports.
 - 2.7 Changeover information related to Owner's occupancy, use, operation, and maintenance.
 - 2.8 Final cleaning.
 - 2.9 Application for reduction of retainage and consent of surety.
 - 2.10 Advice on shifting insurance coverage.
 - 2.11 Final progress photographs.
 - 2.12 List of incomplete Work, recognized as exceptions to Architect's Certificate of Substantial Completion.
- H. Final Payment Application:** Administrative actions and submittals that must precede or coincide with submittal of the final Application for Payment include, but are not limited, to the following:
1. Completion of Project Closeout requirements.
 2. Completion of list of items remaining to be completed as indicated on the attachment to the Certificate of Substantial Completion.
 3. Ensure that unsettled claims will be settled.
 4. Ensure that incomplete Work is not accepted and will be completed in accordance with a schedule prepared by the Contractor which is acceptable to the Owner.
 5. Transmittal of required Project construction records to the Owner (including as-built documents specified in Section 01 77 00 "Closeout Procedures").
 6. Certified property survey.
 7. Proof that taxes, fees, and similar obligations were paid.
 8. Removal of temporary facilities and services.
 9. Removal of surplus materials, rubbish, and similar elements (Reference Section 01 74 19 "Construction Waste Management & Disposal").
 10. Change of door locks to Owner's access.
 11. The requirements of the General Conditions and Supplementary Conditions for Final Acceptance, Final Completion, Final Inspection, and Final Payment.
 12. Asbestos, lead or other hazardous material manifests.
 13. Completion of "Building Contractor Reporting Form" as supplied by the Department, for all Contractors, Subcontractors, Vendors, Suppliers, etc. who work on the Contract. The form includes the following information:
 - a. Contractor/Subcontractor name.

- b. FEIN/Social Security Numbers
- c. Connecticut Tax Registration Numbers
- d. Type of work
- e. Name of business and address
- f. Remittance address.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 29 76

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and supervisory requirements necessary for coordinating construction operations including, but not necessarily limited to, the following:
 - 1. General project coordination procedures.
 - 2. Conservation.
 - 3. Coordination Drawings, including Site Logistics Plans.
 - 4. Administrative and supervisory personnel.
 - 5. Cleaning and protection.
- B. **Related Sections:** The following Sections contain requirements that relate to this Section:
 - 1. Division 01 Section 01 29 76 "Progress Payment Procedures" for Schedule of Values items
 - 2. Division 01 Section 01 31 19 "Project Meetings" for progress meetings, coordination meetings, and pre-installation conferences.
 - 3. Division 01 Section 01 32 16 "Construction Progress Schedules" for requirements for construction scheduling and reporting progress of work.
 - 4. Division 01 Section 01 50 00 "Temporary Facilities and Controls".
 - 5. Division 01 Section 01 60 00 "Product Requirements" for coordinating general installation.
 - 6. Division 01 Section 01 77 00 "Closeout Procedures" for coordinating contract closeout.
 - 7. Division 01 Section 01 91 00 "Commissioning" defines the commissioning process.

1.3 CONSTRUCTION ADMINISTRATOR

A. Construction Administrator:

- 1. The Construction Administrator is identified in Division 01 Section 01 11 00 "Summary of Work".
- 2. **Construction Mobilization:**
 - a. Cooperate with the Construction Administrator in the allocation of mobilization areas of the site, for field offices and sheds, for agency facility access, traffic, and parking facilities.
 - b. During Construction, coordinate use of site and facilities through the Construction Administrator.
 - c. Comply with Construction Administrator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
 - d. Comply with instructions of the Construction Administrator for use of temporary utilities and construction facilities.
 - e. Coordinate field engineering layout as specified in Division 01 Section 01 71 23 "Field Engineering" for work under the instructions of the Construction Administrator.

1.4 COORDINATION

- A. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
 - 3. Make provisions to accommodate items scheduled for later installation.

- B. Where necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.
 - 1. Prepare similar memoranda for the Construction Administrator, Owner and separate contractors where coordination of their work is required.
- C. **Administrative Procedures:** Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and assure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of schedules.
 - 2. Installation and removal of temporary facilities.
 - 3. Delivery and processing of submittals.
 - 4. Progress meetings.
 - 5. Project closeout activities.
 - 6. As-Built - coordinate monthly meetings to assure up-dates being performed.

1.5 SUBMITTALS

- A. **Coordination Drawings:** Prepare coordination drawings to complete detailed coordination of systems and components and to integrate information about fabrication and installation.
 - 1. Thoroughly prepare coordination drawings, as further stipulated in Part 3 "Execution", reviewing all contract documents and consulting with all entities contributing to or involved with each portion of the work under consideration.
 - a. Show the relationship of all components shown on any separate Shop Drawings.
 - b. Indicate required desired installation sequences.
 - c. Comply with requirements contained in Division 01 Section 01 33 00 "Submittal Procedures".
 - 2. Prepare coordination drawings for installation of all products and materials fabricated by separate entities.
 - 3. Prepare coordination drawings where limited space availability necessitates maximum utilization of space for efficient installation of different components, including but not limited to: all site-utility entry points; all ceiling and roof cavities in all areas; all electrical, telecommunications and mechanical rooms and their support facilities; and all such other conditions required to coordinate the work.
 - 4. **Prepare a Site Logistics Plan(s) showing:** The entire project area and limits; all routes into and out of site; all staging and stockpiling and lay-down areas; all aspects of phasing/staging; all parking, paving and fencing; and all specific provisions to satisfy requirements of Division 01 Sections, including but not limited to Field Engineering and Temporary Facilities and Controls. The Site Logistics Plan shall coincide with and complement the general staging plans and site plans outlined in the contract bidding documents. It is intended that the Contractor shall present this refined plan for approval by the Construction Administrator. The fencing shown on this plan is required for all phases. Exact placement and timing of installations and removals will be reviewed and approved by the Construction Administrator prior to implementation. An additional allotment of various fencing is specified in Division 32, which the Contractor shall provide, install, and relocate at various intervals, for installation and removal by the Contractor per the direction of the project's Construction Administrator. This staging and logistics plan will require refinement and change for each phase/stage of the project. The Site Logistics Plan(s) shall be drawn at a scale no smaller than 1"=40' and shall be submitted as stipulated in Division 01 Section 01 29 76 "Progress Payment Procedures", but in no case later than (30) days after Notice to Proceed.
 - 5. Prepare coordination drawings showing locations of surface recesses and voids, as well as offsets and breaks, requiring filling and/or feathering, both those initially visible and those discovered during the course of work. Review with Owner and Architect to obtain direction for filling and feathering. Revise drawing(s) to record directions for same for field and record purposes.
- B. **Staff Names:** Prior to the contract start date, submit a list of the Contractor's principal staff assignments, including the superintendent, project safety officer, and other personnel in attendance at the Project Site. Identify individuals and their duties and responsibilities. List their addresses and telephone numbers.
 - 1. Post copies of the list in the Project meeting room, the temporary field office, and at each temporary telephone.
 - 2. Provide resumes of each staff member proposed for the Project. This shall include the Project Manager, Project Superintendent and Safety Officer.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 GENERAL COORDINATION PROVISIONS

- A. Inspection of Conditions:** The Contractor shall require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed and coordinate such inspections with the Construction Administrator and authorities having jurisdictions. If unsatisfactory conditions exist notify the Construction Administrator immediately. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
- B.** The Contractor shall coordinate temporary enclosures with required inspections and tests to minimize the necessity of uncovering completed construction for that purpose.
- C. Coordination Drawings:** Before construction work can begin, the Contractor shall submit to the Architect coordination drawings in the form of CAD files of the coordination drawings or electronic transfer. Such drawings will be required throughout all areas for trades as described below. These drawings shall show resolutions of trade conflicts in congested areas. The Architect will supply base drawings (with the title blocks removed), including floor plans, reflected ceiling plans, and structural framing plans, in the form of electronic CAD/Revit files, using the AutoCAD/Revit release edition specified with the files, to the Contractor for distribution to the trades for use in developing the coordination drawings. Each trade contractor shall create separate layers within the CAD files to show the work of their trade. Prepare coordination drawings as follows:
1. The HVAC subcontractor shall initiate 1/4-inch scale drawings done on AutoCAD/Revit (latest version) showing ducts and piping in plan and section. Sheet metal shop drawings must be approved prior to starting coordination drawings.
 2. The Sprinkler subcontractor shall then add layers to superimpose his piping layout on the coordination drawings.
 3. The Electrical subcontractor shall then add layers to superimpose all the electrical information on the coordination drawings. Said information is to include but not necessarily be limited to cable trays, equipment, lighting, conduits, bus duct, etc. Show space allowances reserved for work under other contracts, such as audio-visual wiring and equipment.
 4. The Plumbing subcontractor shall then add layers to complete the coordination drawing by drawing his piping (including pitch) on the coordination drawings.
 5. Subcontractors for specialties, furnishings, equipment and special construction shall add layers to show their work to assure full coordination of all systems.
 6. The Construction Administrator shall review the completed coordination drawings for general compliance and then submit them to the Architect for his review. All subcontractors shall rework the drawings until all systems are properly coordinated.
 7. The Ceiling subcontractor shall utilize the drawings to prepare acoustic panel ceiling drawings and any other suspended ceiling drawings, and shall indicate areas of conflict with the work of other trades by drafting the location of grids, panels and tiles.
 8. The Contractor shall indicate Architectural/Structural conflicts or obstacles and coordinate to suit the overall construction schedule. The Contractor shall locate all precut and prefabricated holes and openings in structural steel on the CAD coordination drawing files as required for HVAC, plumbing, fire protection and electrical work. The Contractor shall coordinate these holes and openings with the structural steel fabricator during the structural steel shop drawing development phase. Coordination to take place on schedule so as to permit shop fabrication of all structural steel holes and openings. The Owner will not be held responsible for the costs associated with field fabrication of structural openings resulting from the lack of timely and thorough coordination.
 9. The Contractor shall expedite all drawing work and coordinate to suit the construction schedule. The Contractor shall then review these drawings and compare them with the Architectural, Structural, Equipment, and other drawings and determine that all of the work can be installed without undue interference. Prior to the submittal to the Architect, areas of potential conflict shall be brought to the attention of the Contractor who shall convene a coordination meeting of all parties involved, for the purpose of resolving all utility conflicts. The Contractor shall supervise and direct corrective measures and have all trades sign acceptance of the drawings. Submit one (1) hard copy of each drawing to the Architect and one (1) copy to the Construction Administrator for the record, and only after all conflicts have been accommodated.

10. If the coordination meeting fails to resolve coordination conflicts, the Contractor shall indicate the nature of such conflicts in a detailed RFI, proposing the most economical solution.
 11. The Contractor shall not permit work by trades to proceed in a given bay or area until all trade foremen agree on the exact arrangements for each room or area. If a given trade proceeds prior to trades approval, then if necessary, that trade shall revise their work, if necessary, at no extra cost, in order to permit other trades to proceed.
 12. Submit all coordination drawings via electronic transfer.
- D. The Construction Administrator will meet with the Contractor on all major items of coordination.

3.2 CLEANING AND PROTECTION

- A. Clean and protect construction in progress and adjoining materials in place, during handling and installation. Apply protective covering, where required, to assure protection from damage or deterioration.
- B. Clean and provide maintenance on completed construction as construction per manufacturers requirements through the remainder of the construction period. Adjust and lubricate operable components to assure operability without damaging effects.
- C. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:
 1. Excessive static or dynamic loading.
 2. Excessive internal or external pressures.
 3. Excessively high or low temperatures.
 4. Thermal shock.
 5. Excessively high or low humidity.
 6. Air contamination or pollution.
 7. Water or ice.
 8. Solvents.
 9. Chemicals.
 10. Light.
 11. Radiation.
 12. Puncture.
 13. Abrasion.
 14. Heavy traffic.
 15. Soiling, staining, and corrosion.
 16. Bacteria.
 17. Rodent and insect infestation.
 18. Combustion.
 19. Electrical current.
 20. High-speed operation.
 21. Improper lubrication.
 22. Unusual wear or other misuse.
 23. Contact between incompatible materials.
 24. Destructive testing.
 25. Misalignment.
 26. Excessive weathering.
 27. Unprotected storage.
 28. Improper shipping or handling.
 29. Theft.
 30. Vandalism.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 31 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for project meetings, including, but not limited to, the following:
 - 1. **Start Date meeting (establishes start date)**
 - 2. **Pre-construction conferences.**
 - 3. **Pre-installation conferences.**
 - 4. **Progress meetings.**
 - 5. **Safety**
 - 6. **Coordination**
 - 7. **As-built drawings review**
 - 8. **And as required**
- B. **Related Sections:** The following Sections contain requirements that relate to this Section:
 - 1. Division 01 Section 01 31 00 "Project Management and Coordination" for procedures for coordinating project meetings with other construction activities.
 - 2. Division 01 Section 01 32 16 "Construction Progress Schedules" for requirements for construction scheduling and reporting progress of work.
 - 3. Division 01 Section 01 33 00 "Submittal Procedures" for submitting the Construction Schedule or CPM Schedule.
 - 4. Division 01 Section 01 35 26 "Government Safety Requirements specifies the requirements for safety plans, reports, and investigation submittals.

1.3 PRE-CONSTRUCTION CONFERENCE

- A. The Contractor will attend a pre-construction conference before starting construction, as scheduled by the Construction Administrator convenient to the Owner, the Construction Administrator, Architect, and Contractor. This meeting will take place at least **fourteen (14)** days prior to official Start Date. Hold the conference at the Project Site or another convenient location as directed by the Construction Administrator. The Construction Administrator shall conduct the Pre-construction Conference to review the Contractor and Subcontractor responsibilities and personnel assignments.
- B. **Attendees:** Authorized representatives of the Construction Administrator, Owner, Architect, and their consultants; the Contractor and its superintendent; major subcontractors; agency; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.
- C. **Agenda:** Discuss items of significance that could affect progress, including the following:
 - 1. **Tentative construction schedule.**
 - 2. **Critical work sequencing.**
 - 3. **Progress meeting schedule.**
 - 4. **Designation of responsible personnel.**
 - 5. **Procedures for processing field decisions and Change Orders.**
 - 6. **Procedures for processing Applications for Payment.**
 - 7. **Distribution of Contract Documents.**
 - 8. **Submittal of Shop Drawings, Product Data, and Samples.**
 - 9. **Preparation of record documents.**

10. Use of the premises.
11. Parking availability.
12. Office, work, and storage areas.
13. Equipment deliveries and priorities.
14. Safety procedures.
15. First aid.
16. Security.
17. Housekeeping.
18. Working hours.

1.4 PRE-INSTALLATION/CONSTRUCTION CONFERENCES

- A. The Contractor will schedule a pre-installation conference(s) at the Project Site before each construction activity that requires coordination with other construction. The Contractor shall be responsible to notify in writing the Construction Administrator and the appropriate Subcontractor(s), etc., of the date and time of all Pre-installation/Construction Conferences. Notification shall be at least seven (7) days, prior to the Conference. The Contractor shall be responsible for coordination and attendance of all Subcontractors, etc., involved in or affected by the installation for all Pre-installation/Construction Conferences.
- B. **Attendees:** The Construction Administrator, Contractor, Subcontractors, Owner and Architect, the installer and representatives of manufacturers and fabricators involved in or affected by the installation, and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. The Contractor shall advise all attendees of the scheduled Pre-installation/Construction Conferences dates.
- C. **Agenda:** Review the progress of other construction activities and preparations for the particular activity under consideration at each Pre-installation/Construction Conference, including but not limited to the following requirements:
 1. Contract Documents.
 2. Options.
 3. Related Change Orders.
 4. Purchases.
 5. Deliveries.
 6. Shop Drawings, Product Data, and quality-control samples.
 7. Review of mockups.
 8. Possible conflicts.
 9. Compatibility problems.
 10. Time schedules.
 11. Weather limitations.
 12. Manufacturer's recommendations.
 13. Warranty requirements.
 14. Compatibility of materials.
 15. Acceptability of substrates.
 16. Temporary facilities.
 17. Space and access limitations.
 18. Governing regulations.
 19. Safety.
 20. Inspecting and testing requirements.
 21. Required performance results.

22. Recording requirements.

23. Protection.

- D. The Construction Administrator will record significant discussions and agreements and disagreements of each Pre-installation/Construction Conference, and the approved schedule. The Construction Administrator will promptly distribute the record of the Pre-installation/Construction Conference to all attendees.
- E. The Contractor shall not proceed with the installation/construction if the conference cannot be successfully concluded. The Contractor shall be responsible to initiate whatever actions are necessary to resolve impediments to performance of Work and schedule and reconvene another Pre-installation/Construction Conference at the earliest feasible date. Failure of the contractor to resolve impediments to the performance of the work will not result in an extension of days.

1.5 PROGRESS MEETINGS

- A. The Construction Administrator will conduct progress meetings, bi-weekly, at the Project Site or at regular intervals as agreed upon at the Pre-construction Conference. The Construction Administrator will notify the Owner, the Architect, and the Contractor of the scheduled Progress Meeting dates. Coordinate dates of Progress Meetings with preparation of Application for Payment requests.
- B. **Attendees:** In addition to representatives of the Contractor, Construction Administrator, Owner and the Architect, subcontractor, supplier, or other entity concerned with current progress or involved in planning, coordination, or performance of future activities may be requested to attend these meetings on an as needed basis. All participants at the meeting shall be familiar with the Project and authorized to conclude matters relating to the Work. The Contractor shall include the site superintendent as a minimum.
- C. **Agenda:** Progress Meetings shall review and correct or approve minutes of the previous Progress Meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the status of the Project.
 - 1. **Construction Schedule or CPM Schedule:** Review progress since the last Progress Meeting. Determine where each activity is in relation to the required Contractor's "Construction Schedule" or "CPM Schedule" and whether each activity is on time or ahead or behind Schedule. Determine how Work that is behind Schedule will be expedited; secure commitments from parties involved to do so. Discuss whether Schedule revisions are required to insure that current and subsequent activities will be completed within the Contract Time.
 - 2. Review the present and future needs of each entity present, including the following:
 - a. **Interface requirements.**
 - b. **Time.**
 - c. **Sequences.**
 - d. **Status of submittals.**
 - e. **Deliveries.**
 - f. **Off-site fabrication problems.**
 - g. **Access.**
 - h. **Site utilization.**
 - i. **Temporary facilities and services.**
 - j. **Hours of work.**
 - k. **Hazards and risks.**
 - l. **Housekeeping.**
 - m. **Quality and work standards.**
 - n. **Change Orders.**
 - o. **Documentation of information for payment requests.**
- D. **Reporting:** The Construction Administrator will distribute minutes of the meeting to each party present, promptly and before the next scheduled meeting, and to parties who should have been present.

1.6 SUBCONTRACTOR/COORDINATION/SAFETY MEETINGS

- A.** The Contractor shall conduct Subcontractor/coordination meetings.
- B.** The Contractor shall conduct a separate safety meeting after the safety plan is submitted. The Contractor shall take meeting minutes. These minutes shall be made available upon request. The Contractor shall notify the Construction Administrator of the times and dates of these meetings, who may elect to attend these meetings as an observer when necessary. A minimum of one safety meeting will be held per month.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 31 19

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for the preparation, submittal, and updating of the Contractor's construction schedules and reporting progress of the Work.
 - 1. Refer to the General Conditions and the Agreement for definitions and specific dates of Contract Time.
- B. This Section includes the following:
 - 1. Format.
 - 2. Content.
 - 3. Revisions to schedules.
 - 4. Submittals.
 - 5. Distribution.
- C. **Related Sections:** The following Sections contain requirements that relate to this Section:
 - 1. Division 01 Section 01 29 76 "Progress Payment Procedures" specifies requirements for submitting Schedule of Values and Application for Payments.
 - 2. Division 01 Section 01 31 19 "Project Meetings" specifies requirements for submitting and distributing meeting and conference minutes.
 - 3. Division 01 Section 01 33 00 "Submittal Procedures" specifies requirements for submitting the Submittal Schedule.
 - 4. Division 01 Section 01 45 00 "Quality Control" specifies requirements for submitting inspection and test reports.
 - 5. Division 01 Section 01 60 00 "Product Requirements" specifies requirements for submitting the list of products.

1.3 DEFINITIONS

- A. **Construction Schedule:** A method of planning and scheduling a construction project utilizing a horizontal bar chart with a separate bar for each major portion of the Work or operation to make the schedule an effective tool for planning and monitoring the progress of the work.

1.4 QUALITY ASSURANCE

- A. **The Contractor's Consultant:** Retain a consultant to provide planning, evaluating, and reporting by CPM scheduling.
 - 1. **In-House Option:** The Owner may waive the requirement to retain a consultant if the Contractor can demonstrate that:
 - a. The Contractor has the computer equipment required to produce construction schedules.
 - b. The Contractor employs skilled personnel with experience in construction scheduling and reporting techniques.
 - 2. **Program:** Use **Microsoft Project** latest version.
 - 3. **Standards:** Comply with procedures contained in AGC's "Construction Planning & Scheduling."

1.5 PRELIMINARY SCHEDULE

- A. Preliminary Gantt schedule is to be prepared by the Contractor and submitted to the Construction Administrator within **seven (7)** days of award of contract. This schedule is to cover all items of Work from the start of the project up to the completion of the project. This schedule must be revised when the actual schedule of significant items varies more than one week from the proposed schedule.

1.6 CONSTRUCTION SCHEDULE FORMAT

1. **Format:** Utilize a horizontal bar chart (Gantt) with a separate bar for each major portion of the Work or operation, identifying first work day of each week.
2. **Program:** Use **Microsoft Project**, latest version.
3. **Sequence of Listings:** Utilize the Table of Contents of this Project Manual and the chronological order of the start of each item of work.
4. **Scale and Spacing:** Provide space for notations and revisions.
5. **Sheet Size:** To be coordinated with Construction Administrator.
6. **Weather Days Allowance:** The Contractor shall include as a separate identifiable activity on the Critical Path of the Construction Schedule, and activity labeled "Weather Days Allowance." Insert this activity immediately prior to the substantial completion milestone.
 - 6.1 The Contractor shall be fully responsible for determining the number of weather delay days to be included in the Construction Schedule. This determination shall be based on the normal anticipated weather for the project location and the nature of the project work. The Construction Schedule shall be based on the contractor's determined weather delay allowance. The weather delay activity shall be included in the construction schedule immediately prior to the Substantial Completion milestone.
 - 6.2 The minimal allowed duration of the Weather Days Allowance shall be calculated as follows (decimals rounded to nearest whole number):

$$\frac{\text{Contract Time (Calendar Days)}}{365} \text{ multiplied by } 7 \text{ equals Weather Days Allowance (Calendar Days)}$$
 - 6.3 The Contractor shall insert an activity in the Critical Path of the Construction Schedule to reflect weather day occurrences when weather days are experienced and accepted by the Owner. Identify this activity as a weather delay.
 - 6.4 The Contractor shall reduce duration of Weather Days Allowance activity as weather delays are experienced and inserted into the schedule. Remaining weather days in Weather Day Allowance at completion of project is considered float. Weather delay, when justified, are considered allowable, non compensable.

1.7 CONTENT

- A. Show complete sequence of construction by activity, with dates beginning and completion of each element of construction.
- B. Identify each item by specification section numbers.
- C. Identify work of separate phases and other logically grouped activities.
- D. Show accumulated percentages of completion of each item, and total percentage of Work completed, as of the **first** day of each month.
- E. Provide separate schedule of submittal dates for shop drawings, product data, and samples, Owner/Agency furnished products and any products identified as under Allowances, and dates reviewed submittals will be required from Architect/Engineer. Indicate decision dates for selection of finishes.
- F. Indicate delivery dates for Owner/Agency furnished products and any products identified as under Allowances.
- G. Indicate critical path with original baseline indicated.
- H. Coordinate content with Schedule of Values specified in Section 01 29 76 "Progress Payment Procedures."

1.8 SUBMITTALS AND REVISIONS TO SCHEDULES

- A. An initial bar graph schedule is to be prepared by the Contractor and submitted to the Construction Administrator. Refer to Article 1.5.
- B. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
- C. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
- D. Provide narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect.

- E. Schedules must be revised monthly and when the actual schedule of significant items varies more than **seven (7) days** from the proposed schedule.
- F. Submit revised Construction Schedules for each Application for Payment.
- G. Submit **one (1)** copy of the Construction Schedule to the Construction Administrator.

1.9 DISTRIBUTION

- A. Distribute copies of the Construction Schedules to Construction Administrator, Architect, Owner, Subcontractors, suppliers, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problem anticipated by projections indicated in schedules.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 32 16

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for construction photographs.
- B. **Related Sections:** The following Section contains requirements that relate to construction photographs:
 - 1. Division 01 Section 01 33 00 "Submittal Procedures" specifies general requirements for submitting digital construction photographs.

1.3 SUBMITTALS

- A. **Photographs:** Provide a digital camera to take **twenty-four (24)** or more photos each time. Deliver **one (1)** set of photos through electronic media to the Construction Administrator for the Department.
- B. **Extra Sets:** When requested by the Owner, the photographer shall prepare extra sets of prints or electronic media. The photographer shall distribute these directly to the designated parties who will pay the costs for the extra sets directly to the photographer.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC COPIES

- A. On the date the work is begun and every **thirty (30) days** thereafter (until the work is at least 95 percent complete), the Contractor shall have digital photographs of the construction taken by a professional photographer.
- B. **Identification:** Label each File with project name and date the photographs were taken. With each submittal provide an applied label, rubber-stamped or index sheet with the following information:
 - 1. **Name of the Project.**
 - 2. **Name and address of the photographer.**
 - 3. **Name of the Architect.**
 - 4. **Name of the Contractor.**
 - 5. **Date the photographs were taken.**
 - 6. **Vantage Point: Description of vantage point, in terms of location, direction (by compass point), and elevation or story of construction.**

PART 3 – EXECUTION

3.1 PRECONSTRUCTION PHOTOGRAPHS

- A. Before starting construction, take digital photos of the site and surrounding properties from different points of view, as selected by the Construction Administrator.
 - 1. Take digital photos in sufficient number to show existing site conditions before starting Work.
 - 2. Take digital photos of adjacent existing buildings either on or adjoining the property in sufficient detail to record accurately the physical conditions at the start of construction.

3.2 PHOTOGRAPHIC REQUIREMENTS

- A. Take **twenty-four (24)** or more digital photographs monthly, coinciding with the cutoff date associated with each Application for Payment. The Construction Administrator shall select the vantage points for each shot to best show the status of construction and progress since the last photos were taken.
- B. As the digital photographs are a record of the work progress, they shall be taken each month, whether or not they show work done during the preceding month. Deliver the file within **ten (10) days** of their taking.

- C. Provide and coordinate the use of photographic software to assure that the photos are viewable by all interested parties.

D. PART 2 - PRODUCTS (Not Applicable)

E. PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 32 33

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submittals required for performance of the Work, including but not limited to the following:
 - 1. **Submittal schedule.**
 - 2. **Shop Drawings.**
 - 3. **Product Data.**
 - 4. **Quality assurance submittals.**
 - 5. **Proposed "Substitutions/Equals".**
 - 6. **Warrantee samples.**
 - 7. **Coordination Drawings.**
 - 8. **O & M Manuals**
- B. Administrative Submittals: Refer to other Division 01 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to, the following:
 - 1. **Permits.**
 - 2. **Applications for Payment.**
 - 3. **Performance and payment bonds.**
 - 4. **Contractor's construction schedule.**
 - 5. **Daily construction reports.**
 - 6. **Construction Photographs.**
 - 7. **Insurance certificates.**
 - 8. **List of subcontractors.**
 - 9. **Subcontractors/Suppliers FEIN number's and Connecticut tax registration number.**
- C. **Related Sections:** The following Sections contain requirements that relate to this Section:
 - 1. Division 01 Section 01 25 00 "Substitution Procedures" specifies requirements for submittal of requests for equals and substitutions.
 - 2. Division 01 Section 01 29 76 "Progress Payment Procedures" specifies requirements for submittal of the Schedule of Values.
 - 3. Division 01 Section 01 31 00 "Project Management and Coordination" specifies requirements governing preparation and submittal of required Coordination Drawings.
 - 4. Division 01 Section 01 31 19 "Project Meetings" specifies requirements for submittal and distribution of meeting and conference minutes.
 - 5. Division 01 Section 01 32 16 "Construction Progress Schedules" for requirements for construction scheduling and reporting progress of work.
 - 6. Division 01 Section 01 32 33 "Photographic Documentation" specifies requirements for submittal of periodic construction photographs.
 - 7. Division 01 Section 01 35 26 "Government Safety Requirements" specifies the requirements for safety plans, reports, and investigation submittals.
 - 8. Division 01 Section 01 45 00 "Quality Control" specifies requirements for submittal of inspection and test reports and mockups.
 - 9. Division 01 Section 01 77 00 "Closeout Procedures" specifies requirements for submittal of Project Record Documents and warranties at project closeout.

- 10. Division 01 Section 01 78 30 "Warranties and Bonds".
- 11. Division 01 Section 01 91 00 "Commissioning" specifies requirements for submittal of quality assurance documentation related to commissioning.

1.3 DEFINITIONS

- A. Coordination Drawings show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or to function as intended and as identified in the Specification Divisions 02 through 49.
 - 1. Preparation of Coordination Drawings is specified in Division 01 Section 01 31 00 "Project Management and Coordination" and may include components previously shown in detail on Shop Drawings or Product Data.
- B. Field samples are full-size physical examples erected on-site to illustrate finishes, coatings, or finish materials. Field samples are used to establish the standard by which the Work will be judged.
- C. Mockups are full-size assemblies for review of construction, coordination, testing, or operation; they are not Samples.

1.4 SUBMITTAL PROCEDURES

- A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.
 - a. The Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received.
 - b. The Architect reserves the right to reject incomplete submitted packages.
 - 3. Processing: To avoid the need to delay installation as a result of the time required to process submittals, allow sufficient time for submittal review, including time for re-submittals.
 - a. Allow **fourteen (14) days** for initial review. Allow additional time if the Architect must delay processing to permit coordination with subsequent submittals.
 - b. If an intermediate submittal is necessary, process the same as the initial submittal.
 - c. Allow **fourteen (14) days** for reprocessing each submittal.
 - d. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the Work to permit processing.
- B. If a non-named manufacturer is intended to be submitted, the Contractor shall adhere to the Substitution request procedure. No product will be considered approved without the Substitute documentation.
- C. **Submittal Preparation:** Place a permanent label, title block or **8-1/2 inches x 11 inches** cover page approved by the Architect, on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.
 - 1. The minimum number of copies required for each submittal shall be **seven (7)** or as determined otherwise at the pre-construction conference or by the Construction Administrator.
 - 2. Provide a space approximately **4 inches by 5 inches** on the label, beside the title block or on the cover page on Shop Drawings to record the Contractor's review and approval markings and the action taken.
 - 3. Include the following information on the label for processing and recording action taken.
 - a. **Project Name and State of Connecticut Project Number.**
 - b. **Date.**
 - c. **Name and address of the Architect, Construction Administrator, and Owner Representative.**
 - d. **Name and address of the Contractor.**
 - e. **Name and address of the subcontractor.**
 - f. **Name and address of the supplier.**
 - g. **Name of the manufacturer.**

- h. **Number and title of appropriate Specification Section.**
 - i. **Drawing number and detail references, as appropriate.**
 - j. **Indicate either initial or resubmittal.**
 - k. **Indicate deviations from Contract Documents.**
 - l. **Indicate if "equal" or "substitution".**
- D. **Submittal Transmittal:** Package each submittal appropriately for transmittal and handling. Transmit each submittal from the Contractor to the Architect using a transmittal form. Copy the Construction Administrator on the transmittal. The Architect will return all submittals to the Contractor after action is taken with a complete copy of the submittal package and one complete copy of the submittal package. The Architect will not accept submittals received from sources other than the Contractor.
 - 1. On the transmittal, record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

1.6 SUBMITTAL SCHEDULE

- A. After development and review by the Owner and Architect acceptance of the Contractor's Construction or CPM schedule prepare a complete schedule of submittals. Submit the schedule to the Construction Administrator within **thirty (30)** days of Contract Award.
 - 1. Coordinate Submittal Schedule with the list of subcontracts, Schedule of Values, and the list of products as well as the Contractor's Construction or CPM Schedule.
 - 2. Prepare the schedule in chronological order. Provide the following information:
 - a. Schedule date for the initial submittal.
 - b. Related section number.
 - c. Submittal category (Shop Drawings, Product Data, or Samples).
 - d. Name of Subcontractor.
 - e. Description of the part of Work covered.
 - f. Scheduled date for resubmittal.
 - g. Scheduled date for the Architect's final release of approval.
- B. **Submittal Schedule:** Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the Architect and additional time for handling and reviewing submittals required by those corrections.
 - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's Construction or CPM Schedule.
 - 2. **Initial Submittal:** Submit concurrently with start-up construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - 3. **Final Submittal:** Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
- C. **Coordination:** Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each specification section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by the same specification section as separate packages under separate transmittals.
 - 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

- a. Architect and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- D. **Processing Time:** Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. **Initial Review:** Allow ten business days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Construction Manager will advise Contractor when a submittal being processed must be delayed for coordination with related submittals not yet received. Additional time will be required if processing must be delayed to permit review of related subsequent submittals.
 - 2. **Intermediate Review:** If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. **Resubmittal Review:** Allow ten business days for review of each resubmittal.
 - 4. **Mass Submittals:** Six (6) or more submittals in one (1) day or twenty (20) or more submittals in one (1) week. If "Mass Submittals" are received, Architect's review time stated above may be extended as necessary to perform proper review. Architect will review "Mass Submittals based upon priority determined by Architect after consultation with Owner and Contractor.
- E. **Distribution:** Following response to the initial submittal, print and distribute copies to the Construction Administrator, Architect, Owner, subcontractors, and other parties required to comply with submittal dates indicated. Post copies in the Project meeting room and field office.
 - 1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.
- A. **Schedule Updating:** Revise the schedule after each meeting or activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting.

1.7 DAILY CONSTRUCTION REPORTS

- A. Prepare a daily construction report recording the following information concerning events at the site, and submit duplicate copies to the Construction Administrator at weekly intervals:
 - 1. List of subcontractors at the site.
 - 2. Approximate count of personnel at the site.
 - 3. High and low temperatures, general weather conditions.
 - 4. Accidents and unusual events.
 - 5. Meetings and significant decisions.
 - 6. Stoppages, delays, shortages, and losses.
 - 7. Meter readings and similar recordings.
 - 8. List of equipment on site and identify if idle or in use.
 - 9. Orders and requests of governing authorities.
 - 10. Change Orders received, start and end dates.
 - 11. Services connected, disconnected.
 - 12. Equipment or system tests and startups.
 - 13. Partial Completion's, occupancies.
 - 14. Substantial Completion's authorized.
 - 15. Equals or Substitutions approved or rejected.

1.8 SHOP DRAWINGS

- A. Submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing.

- B. Shop Drawings include fabrication and installation Drawings, setting diagrams, schedules, patterns, templates and similar Drawings. Include the following information:
 - 1. Dimensions.
 - 2. Identification of products and materials included by sheet and detail number.
 - 3. Compliance with specified standards.
 - 4. Notation of coordination requirements.
 - 5. Notation of dimensions established by field measurement.
 - 6. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least **8-1/2 by 11 inches** but no larger than **36 by 48 inches**.
 - 7. Submit **one (1)** reproducible media and **seven (7)** prints as directed by the Construction Administrator. The Contractor's submittal shall identify the specification section and/or drawing number applicable to the submittal.
 - 8. Details shall be large scale and/or full size.
- C. The Contractor shall review the Shop Drawings, stamp with this approval, and submit them with reasonable promptness and in orderly sequence so as to cause no delay in his Work or in the Work of any subcontractor. Shop Drawings shall be properly identified as specified for item, material, workmanship, and project number. At the submission, the Contractor shall inform the Architect, in writing of any deviation in the shop drawings from the requirements of the Contract Documents.
- D. The Architect will review and comment on shop drawings with reasonable promptness so as to cause no delay, but only for conformance with the design concept of the project and with the information given in the Contract Documents. Refer to Article 5 of the General Conditions. Shop Drawings received by the Architect that indicate insufficient study of drawings and specifications, illegible portions or gross errors, will be rejected outright. Such rejections shall not constitute an acceptable reason for granting the Contractor additional time to perform the work.
- E. The Contractor shall make any corrections required by the Architect and shall resubmit the required number of corrected copies of Shop Drawings until fully reviewed.
- F. Upon final review submit **four (4)** additional prints, same as submitted, for use by the Construction Administrator.
- G. The Architect's review and comments on Shop Drawings shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents.
- H. Only final reviewed Shop Drawings are to be used on the Project site.
- I. The Work installed shall be reviewed in accordance with the Shop Drawings and the drawings and specifications. Final Review of the Shop Drawings by the Architect shall constitute acceptance by the State and the Architect of a variation or departure that is **clearly identified**. If the contractor believes notations made by the A/E increases the value or scope of the CD's, the contractor must provide written notice to the CA within **seven (7)** days of this issue. Final reviewed Shop Drawings shall not replace or be used as a vehicle to issue or incorporate change orders or substitutions. Substitutions shall be submitted in accordance with Division 01 Section 01 25 00 "Substitution Procedures".

1.9 SHOP DRAWINGS FOR FIRE PROTECTION SYSTEMS:

- A. During product submittals and shop drawing review for fire protection systems shall comply with all of the requirements in the section above "Shop Drawings". The Consultant shall verify the FM Global requirements are satisfied for all relevant components. The PM and Construction Administrator for the Project shall submit the Contractor's fire protection system product information and shop drawings to the Consultant and FM Global. In addition, Sprinkler system shop drawings and hydraulic calculations must be stamped by a professional engineer licensed in the state of Connecticut and must include the project number. Electronic sets of information [as noted in this Section 01 33 00 "Submittal Procedures"] shall be submitted to the State's Insurance Carrier (SIC), and **electronic** set shall be submitted to the Office of the State Fire Marshal (OSFM)(threshold buildings only):
 - 1. **Office of State Fire Marshal:**
CT Department of Administrative Services
Construction Services
Office of State Fire Marshal
450 Columbus Boulevard, Suite 1304
Hartford, Connecticut 06103

Phone: (860) 713-5750

2. State Insurance Carrier (SIC):

FM Global Boston Operations
Plan Review
1175 Boston-Providence Turnpike
PO Box 9102
Norwood, MA 02062
Tel: (781) 440-8241 or FAX (781) 440-8742
bostonleadengineer@fmglobal.com

- B.** Before the shop drawings are submitted to SIC or OSFM, the A/E's fire protection consultant must review the sprinkler design for compliance with the code, OSFM, and FM Global requirements.
- C.** The State Insurance Carrier requires **two (2)** weeks prior notice of a sprinkler system acceptance test. Contractor shall coordinate with their Submittal Schedule and Baseline Schedules.

1.10 SHOP DRAWINGS FOR ROOFING SYSTEMS:

- A. Construction Phase Requirements:** During product submittals and shop drawing review for Roofing Systems the Consultant shall verify FM Global requirements are satisfied for all relevant components. The PM and Construction Administer for the Project shall submit the Contractor's roofing systems product information and shop drawings to the Consultant and FM Global. Shop drawings for roofing systems shall comply with all of the requirements in the section above "Shop Drawings". **Electronic** set of information [as noted in this Section 01 33 00 "Submittal Procedures"] shall be submitted to the State's Insurance Carrier (SIC):

1. State Insurance Carrier (SIC):

FM Global Boston Operations
Plan Review
1175 Boston-Providence Turnpike
PO Box 9102
Norwood, MA 02062
Tel: (781) 440-8241 or FAX (781) 440-8742
bostonleadengineer@fmglobal.com

- B.** The State Insurance Carrier requires **two (2)** weeks prior notice of roofing system shop drawing reviews. Contractor shall coordinate with their Submittal Schedule and Baseline Schedules.
- C.** See Section **00 30 60 General Statement For FM Global Checklist For Roofing Systems** and **Section 50 60 00 FM Global Checklist for Roofing Systems**.

1.11 PRODUCT DATA

- A.** Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, schedules, such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.
 - 1.** Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products that are not required, mark copies to indicate the applicable information. Include the following information:
 - a. Manufacturer's printed recommendations.
 - b. Compliance with trade association standards.
 - c. Compliance with recognized testing agency standards.
 - d. Application of testing agency labels and seals.
 - e. Notation of dimensions verified by field measurement.
 - f. Notation of coordination requirements.
 - 2.** Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.
 - 3. Preliminary Submittal:** Submit a preliminary single copy of Product Data where selection of options is required.
 - 4. Submittals:** Submit **electronic** copies of each required submittal. The electronic copy shall be searchable and include navigable section indexes.

- a. For Operation and Maintenance (O&M) Manuals, submit an electronic copy for approval. Include, at a minimum, a complete list of equipment supplied, including model numbers, serial numbers, ranges and other pertinent data. The operating details, maintenance instructions and troubleshooting guide shall be separate sections. Provide the local supplier contact information as well as manufacturer information. The Architect will mark the electronic copy with action taken and corrections or modifications required. Once approved, provide five (5) hard copies to Agency.
 - b. Unless noncompliance with Contract Document provisions is observed, the approved electronic copy of the submittal will serve as the final submittal.
- 5. **Distribution:** Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.
 - a. Do not proceed with installation until a copy of Product Data is in the Installer's possession.
 - b. Do not permit use of unmarked copies of Product Data in connection with construction.

1.12 SAMPLES

- A. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.
 - 1. Store, mount or display Samples on site in the manner to facilitate review of qualities indicated. Prepare Samples to match the Architect's sample. Include the following:
 - a. Specification Section number and reference.
 - b. Generic description of the Sample.
 - c. Sample source.
 - d. Product name or name of the manufacturer.
 - e. Compliance with recognized standards.
 - f. Availability and delivery time.
 - 2. Submit Samples for review of size, kind, color, pattern, and texture. Submit Samples for a final check of these characteristics with other elements and a comparison of these characteristics between the final submittal and the actual component as delivered and installed.
 - a. Where variation in color, pattern, texture, or other characteristic is inherent in the material or product represented, submit at least **three (3)** multiple units that show approximate limits of the variations.
 - b. Refer to other Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
 - c. Refer to other Sections for Samples to be returned to the Contractor for incorporation in the Work. Such Samples must be undamaged at time of use. On the transmittal, indicate special requests regarding disposition of Sample submittals.
 - d. Samples not incorporated into the Work, or otherwise designated as the Owner's property, are the property of the Contractor and shall be removed from the site prior to Substantial Completion.
 - 3. **Preliminary Submittals:** Submit a full set of choices where Samples are submitted for selection of color, pattern, texture, or similar characteristics from a range of standard choices, unless otherwise noted in specification section.
 - a. The Architect will review and return preliminary submittals with the Architects notation, indicating selection and other action.
 - 4. **Submittals:** Except for Samples illustrating assembly details, workmanship, fabrication techniques, connections, operation, and similar characteristics, submit **electronic** set. The Architect will return **electronic** set marked with the action taken.
 - 5. Maintain sets of Samples, as returned, at the Project Site, for quality comparisons throughout the course of construction.
 - a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
 - b. Sample sets may be used to obtain final acceptance of the construction associated with each set.

- B. Distribution of Samples:** Prepare and distribute additional sets to subcontractors, manufacturers, fabricators, suppliers, installers, and others as required for performance of the Work. Show distribution on transmittal forms.
1. Field samples are full-size examples erected on-site to illustrate finishes, coatings, or finish materials and to establish the Project standard.
 - a. Comply with submittal requirements to the fullest extent possible. Process transmittal forms to provide a record of activity.

1.13 QUALITY ASSURANCE SUBMITTALS

- A.** Submit quality-control submittals, including design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals as required under other Sections of the Specifications.
- B. Certifications:** Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a notarized certification from the manufacturer certifying compliance with specified requirements.
1. **Signature:** Certification shall be signed by an officer of the manufacturer or other individual authorized to sign documents on behalf of the company.
- C. Inspection and Test Reports:** Requirements for submittal of inspection and test reports from independent testing agencies are specified in Division 01 Section 01 45 00 "Quality Control."

1.14 ARCHITECT'S ACTION

- A.** Except for submittals for the record or information; or an incomplete submission by the Contractor, where action and return is required, the Architect will review each submittal, mark to indicate action taken, and return promptly.
1. Compliance with specified characteristics is the Contractor's responsibility.
- B. Informational Submittals:** The Architect will stamp each submittal with a uniform, action stamp. The Architect will mark the stamp appropriately to indicate the action taken, as follows:
1. **Accepted for Record:** When received for documentation purposes and is acknowledged as received and no further revision is required. Comments may be noted using this action.
 2. **Revise for Record:** When received for documentation purposes and there is notations and comments requiring a resubmittal of the package. Comments will be noted using this action.
- C. Action Stamp:** The Architect will stamp each submittal with a uniform, action stamp. The Architect will mark the stamp appropriately to indicate the action taken, as follows:
1. **Approved:** When the Architect marks a submittal "Approved," the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.
 2. **Approved as Noted:** When the Architect marks a submittal "Approved as Noted," the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents and can be released. Submit corrected copies for record. Final payment depends on that compliance.
 3. **Revise and Resubmit:** When the Architect marks a submittal "Revise and Resubmit," do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark.
 4. **Rejected:** When the Architect marks a submittal "Rejected" submit in accordance with the Contract Documents. The submittal contains non specified items or does not meet the requirements of the Contract Documents.
 5. Do not use, or allow others to use, submittals marked "Rejected", or "Revise and Resubmit" at the Project Site or elsewhere where Work is in progress.
- D. Unsolicited Submittals:** The Architect will "Return Without Action" unsolicited submittals.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 33 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 00 General Conditions of the Contract for Construction for Design-Bid-Build and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for performing alteration and renovation Work.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 00 Section 00 30 00 "General Statements for Available Information" for information that is available in addition to the Bidding Documents for review by bidders. Such information may include an existing conditions survey, contaminated soil reports, contaminated groundwater reports, hazardous building material reports, geotechnical data, etc.
 - 2. Division 01 Section 01 31 00 "Project Management and Coordination" for procedures for coordinating cutting and patching with other construction activities.
 - 3. Division 01 Section 01 73 29 "Cutting and Patching" for procedures for cutting and patching.
 - 4. Division 01 Section 01 74 19 "Construction Waste Management & Disposal" for the requirements for waste management goals, waste management plan and waste management plan implementation.
 - 5. Refer to other Sections for specific requirements and limitations applicable to performing alteration Work with individual parts of the Work.
 - 6. Requirements of this Section apply to mechanical and electrical installations. Refer to Division 22, 23 and 26 Sections for other requirements and limitations applicable to renovation Work by mechanical and electrical installations.

PART 2 - PRODUCTS

2.1 PRODUCTS FOR PATCHING AND EXTENDING WORK

- A. New materials: As specified in product sections; match existing Products and Work for patching and extending Work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing Products where necessary, referring to existing Work as a standard.

PART 3 - EXECUTION

3.1 INSPECTION

A. General:

- 1. Observe all existing conditions prior to submitting a bid. Include in the bid, existing conditions and their impact, particularly to cost and health and safety of workers and occupants, and proper function and operation of the facility. Be aware of other work being performed. Failure to visit the site shall in no way provide relief from the necessity of furnishing materials or performing any work that may be required to complete the work in accordance with the Contract Documents without additional cost to the Owner. All site visits shall be scheduled with the Owner.
- 2. The quantities, locations and the extent of work indicated are best estimates, which are limited by the physical constraints imposed by occupancy of the facility. Consider all aspects of the substrates within the identified plan area. Material information and quantities were obtained from site surveys. Accordingly, variations (plus or minus 10 percent) in quantities within the limits of the work area are considered as having no impact on contract sum and contract performance period. Where additional abatement work is required beyond the above variations, the contract sum and contract performance period shall be adjusted under provisions of Division 01 of the Specifications.
- 3. Verify that demolition is complete and areas are ready for installation of new Work.
- 4. Beginning of restoration Work means acceptance of existing conditions.

3.2 PREPARATION

- A. Cut, move, or remove items as are necessary for access to alteration and renovation Work. Replace and restore at completion.
- B. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.
- C. Remove debris and abandoned items from area and from concealed spaces.
- D. Prepare surface and remove surface finishes to provide for proper installation of new Work and finishes.
- E. Close openings in exterior surfaces to protect existing Work **[and salvageable items]** from weather and extremes of temperature and humidity. Insulate ductwork and piping to prevent condensation in exposed areas.

3.3 INSTALLATION

- A. Coordinate alteration and renovation Work to expedite completion, and if required sequence Work to accommodate Owner occupancy.
- B. Remove, cut and patch Work in a manner to minimize damage and to provide restoring products and finishes to original and or specified condition in accordance with **Section 01 73 29 "Cutting and Patching"**.
- C. Refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with neat transition to adjacent finishes in accordance with **Section 01 73 29 "Cutting and Patching"**.
- D. In addition to specified replacement of equipment, restore existing plumbing, heating, ventilation, air conditioning, and electrical systems to full operational condition.
- E. Recover and refinish Work that exposes mechanical and electrical Work exposed accidentally during the Work.
- F. Install products as specified in individual specification sections.

3.4 TRANSITIONS

- A. Where new Work abuts or aligns with existing, perform a smooth and even transition. Patch work to match existing adjacent Work in texture and appearance.
- B. When finished surfaces are cut so that a smooth transition with new Work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect/Engineer.

3.5 ADJUSTMENTS

- A. Where removal of partitions or walls result in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
- B. Where a change of plane of 1/4-inch in (12) inches or more occurs, request recommendation from Architect/Engineer for providing a smooth transition.
- C. Trim existing doors as necessary to clear new floor finish. Refinish trim as required.
- D. Fit Work at penetrations of surfaces as specified in **Section 01 73 29 "Cutting and Patching"**.

3.6 REPAIR OF DAMAGED SURFACES

- A. Patch or replace portions of existing surfaces that are damaged, lifted, discolored, or showing imperfections.
- B. Repair substrate prior to patching finishes.

3.7 FINISHES

- A. Finish surfaces as specified in individual product specification sections.
- B. Finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

3.8 CLEANING

- A. In addition to cleaning specified in **Section 01 50 00 "Temporary Facilities and Controls"**, clean Agency occupied areas of Work.

END OF SECTION 01 35 16

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This guide specification covers construction safety requirements and requirements for the protection of people, property, and resources. It is intended for use in construction, renovation, and demolition projects for the State of Connecticut Military Department.
- B. **Related Sections:** The following Sections contain requirements that relate to this Section:
1. Division 01 Section 01 33 00 Submittal Procedures specifies the requirements for submittal requirements;
 2. Division 01 Section 01 31 19 "Project Meetings" specifies requirements for submittal and distribution of meeting and conference minutes.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE) www.asse.org/publications/	
ASSE/SAFE A10.32	(2004) Fall Protection
ASSE/SAFE A10.34	(2001; R 2005) Protection of the Public on or Adjacent to Construction Sites
ASSE/SAFE Z359.1	(2007) Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components
AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) www.asme.org/Codes/	
ASME B30.22	(2005) Articulating Boom Cranes
ASME B30.3	(2004) Construction Tower Cranes
ASME B30.5	(2004) Mobile and Locomotive Cranes
ASME B30.8	(2004) Floating Cranes and Floating Derricks
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) www.nfpa.org/	
NFPA 10	(2007) Portable Fire Extinguishers
NFPA 51B	(2009) Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 241	(2004) Safeguarding Construction, Alteration, and Demolition Operations
NFPA 70	(2008) National Electrical Code
NFPA 70E	Standard for Electrical Safety in the Workplace
CODE OF FEDERAL REGULATIONS (CFR) www.archives.gov/federal-register/cfr/	
10 CFR	Standards for Protection Against Radiation
29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.28	Safety Requirements For Scaffolding.
29 CFR 1910.146	Permit-required Confined Spaces
29 CFR 1910.147	Control Of Hazardous Energy (Lockout/Tagout)
29 CFR 1910.178	Powered industrial trucks.
29 CFR 1915	Confined and Enclosed Spaces and Other
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.500	Fall Protection
29 CFR 1926.550	Cranes and Derricks
US Army Core of Engineers (USACE)	

www.iwr.usace.army.mil	
EM 385-1-1	Safety, and Health Requirements Manual (2008),

1.3 SUBMITTALS

- A. An "O" followed by "A" indicates that the Owner acceptance; submittals not having an "O" designation are for Contractor Quality Control approval.
- B. **Submittal Procedures:**
1. **Preconstruction Submittals:**
 - a. Accident Prevention Plan (APP); "O, A";
 - b. Activity Hazard Analysis (AHA); "O, A";
 - c. Crane Critical Lift Plan; "O, A";
 - d. Proof of qualification for Crane Operators; O, A.
 2. **Test Reports:** Submit reports as their incidence occurs, in accordance with the requirements of the paragraph entitled, "Reports."
 - a. Accident Reports;
 - b. Monthly Exposure Reports;
 - c. Crane Reports;
 - d. Regulatory Citations and Violations;
 - e. Gas Protection.
 3. **Certificates:**
 - a. Confined Space Entry Permit;
 - b. Hot work permit;
 - c. License Certificates.
 - d. Certificate of Compliance – Crane

1.4 DEFINITIONS

- A. **Competent Person.** A competent person is one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.
- B. **Competent Person for Fall Protection.** A person who is capable of identifying hazardous or dangerous conditions in the personal fall arrest system or any component thereof, as well as their application and use with related equipment, and has the authority to take prompt corrective measures to eliminate the hazards of falling.
- C. **Confined Space:** A space which by design has limited openings for entry and exit, unfavorable natural ventilation which could contain or produce dangerous air contaminants, and which is not intended for continuous employee occupancy. Confined spaces include, but are not limited to storage tanks, process vessels, pits, silos, vats, degreasers, reaction vessels, boilers, ventilation and exhaust ducts, sewers, tunnels, underground utility vaults, and pipelines.
- D. **High Visibility Accident:** Any mishap which may generate publicity and/or high visibility.
- E. **Medical Treatment;** Medical treatment includes treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even though provided by a physician or registered personnel.
- F. **Operating Envelope:** The area surrounding any crane. Inside this "envelope" is the crane, the operator, riggers and crane walkers, rigging gear between the hook and the load, the load and the crane's supporting structure (ground, rail, etc.).
- G. **Qualified Person for Fall Protection:** A person with a recognized degree or professional certificate and with extensive knowledge, training and experience in the field of fall protection; who is capable of performing design, analysis, and evaluation of fall protection systems and equipment.
- H. **Recordable Injuries or Illnesses:** Any work-related injury or illness that results in:
1. Death, regardless of the time between the injury and death, or the length of the illness;
 2. Days away from work (any time lost after day of injury/illness onset);
 3. Restricted work;
 4. Transfer to another job;

5. Medical treatment beyond first aid;
6. Loss of consciousness; or
7. A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.

I. **Weight Handling Equipment (WHE) Accident:** A WHE accident occurs when any one or more of the six elements in the operating envelope fails to perform correctly during operation, including operation during maintenance or testing resulting in personnel injury or death; material or equipment damage; dropped load; derailment; two-blocking; overload; and/or collision, including unplanned contact between the load, crane, and/or other objects. A dropped load, derailment, two-blocking, overload and collision are considered an accident even though no material damage or injury occurs. A component failure (e.g., motor burnout, gear tooth failure, bearing failure) is not considered an accident solely due to material or equipment damage unless the component failure results in damage to other components (e.g., dropped boom, dropped load, roll over, etc.).]

1.5 REGULATORY REQUIREMENTS

A. In addition to the detailed requirements included in the provisions of this Section see, **Division 01, Section 01 42 20 "Reference Standards and Definitions"** for other state laws, criteria, rules and regulations. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, regulations, and referenced documents vary, the most stringent requirements govern.

1.6 SITE QUALIFICATIONS, DUTIES, AND MEETINGS

A. **Personnel Qualifications:**

B. **Site Safety and Health Officer (SSHO):**

1. Provide a Site Safety and Health Officer (SSHO) at the work site at all times to perform safety and occupational health management, surveillance, inspections, and safety enforcement for the Contractor. The Contractor Quality Control (QC) person can be the SSHO on this project. Meet the following requirements within the SSHO:

Level 3: A minimum of **five (5) years** safety work on similar projects. 30-hour OSHA construction safety class or equivalent within the last **five (5) years**. An average of at least 24 hours of formal safety training each year for the past 5 years. Competent person training as needed.

E. **Crane Operators:**

Meet the Crane Operators and Crane Operation requirements of the Connecticut Bureau of License and Permits – Cranes, Department of Administrative Services, Office of State Fire Marshal pursuant to C.G.S § 29-221 through 29-230. Provide proof of current license and qualification. For more information visit the DAS website (www.ct.gov/DAS) > Licensing, Certification, Permitting and Codes > Cranes, or call (860) 713-5580 or (860) 713-5529.

F. **Personnel Duties:**

1. **Site Safety and Health Officer (SSHO):**

- a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Attach safety inspection logs to the Contractors' daily production report.
- b. Conduct mishap investigations and complete required reports. Maintain the **OSHA Form 300 and Daily Production** reports for prime and sub-contractors. For more information visit the OSHA website at www.osha.gov > Employers > Recordkeeping Requirements and Forms.
- c. Maintain applicable safety reference material on the job site.
- d. Attend the pre-construction conference, pre-work meetings including preparatory inspection meeting, and periodic in-progress meetings.
- e. Implement and enforce accepted APPS and AHAs.
- f. Maintain a safety and health deficiency tracking system that monitors outstanding deficiencies until resolution. Post a list of unresolved safety and health deficiencies on the safety bulletin board.
- g. Ensure sub-contractor compliance with safety and health requirements.

Failure to perform the above duties will result in dismissal of the superintendent and/or SSSH, and a project work stoppage. The project work stoppage will remain in effect pending approval of a suitable replacement.

G. Meetings:

1. Preconstruction Conference:

- a. Contractor representatives who have a responsibility or significant role in accident prevention on the project shall attend the preconstruction conference. This includes the project superintendent, site safety and health officer, quality control supervisor, or any other assigned safety and health professionals who participated in the development of the **Accident Prevention Plan (APP)**; (including the **Activity Hazard Analyses (AHAs)**, and special plans, program and procedures associated with it).
- b. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the Owner's Representative(s) as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.
- c. Deficiencies in the submitted APP will be brought to the attention of the Contractor at the preconstruction conference, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted APP.

2. Safety Meetings:

Safety meetings shall be conducted to review past activities, plan for new or changed operations, review pertinent aspects of appropriate AHA (by trade), establish safe working procedures for anticipated hazards, and provide pertinent safety and health training and motivation.

- a. Meetings shall be conducted at least once a month for all supervisors on the project location and at least once a week for all workers by supervisors or foremen.
- b. Meetings shall be documented, including the date, persons in attendance, subjects discussed, and names of individual(s) who conducted the meeting. Documentation shall be maintained and copies furnished to the Construction Administrator (CA) on request.
- c. The Construction Administrator (CA) shall be informed of all scheduled meetings in advance and be invited to attend.

1.7 ACCIDENT PREVENTION PLAN (APP):

A. Use a qualified person to prepare the written site-specific APP.

1. Prepare the APP in accordance with the format and requirements of US Army Core of Engineers (USACE), Safety, and Health Requirements Manual, EM 385-1-1, or as approved by the CA and as supplemented herein. Cover all paragraphs and subparagraph elements in **USACE EM 385-1-1, Appendix A, "Minimum Basic Outline for Accident Prevention Plan"** or as approved by the CA. The USACE Safety, and Health Requirements Manual, EM 385-1-1 is available at the USACE Website www.iwr.usace.army.mil.
2. Specific requirements for some of the APP elements are described in "**B**" below. The APP shall be job-specific and address any unusual or unique aspects of the project or activity for which it is written.

B. The APP shall interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and made site-specific. The Owner considers the Prime General Contractor to be the "controlling authority" for all work site safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP shall be signed by the person and firm (senior person) preparing the APP, the Contractor, the on-site superintendent, the designated site safety and health officer and any designated Certified Safety Professional (CSP) and/or Certified Industrial Hygienist (CIH).

C. Submit the APP to the Project Manager and Construction Administrator **Fourteen (14) Calendar Days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP. Once accepted by the Project Manager and Construction Administrator, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping work, at the discretion of the Project Manager and Construction Administrator, until the matter has been rectified. Once work begins, changes to the accepted APP shall**

be made with the knowledge and concurrence of the Project Manager and Construction Administrator, project superintendent, Site Safety and Health Officer (SSHO) and quality control manager. Should any hazard become evident, stop work in the area, secure the area, and develop a plan to remove the hazard. Notify the Project Manager and Construction Administrator within **Twenty (24)** hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by **American Society of Safety Engineers, ASSE/SAFE A10.34 - Protection of the Public on or Adjacent to Construction Sites, see www.asse.org**) and the environment.

Copies of the accepted plan will be maintained at the Construction Administrator's office at the job site. Continuously reviewed and amended the APP, as necessary, throughout the life of the contract. Incorporate unusual or high-hazard activities not identified in the original APP as they are discovered.

D. APP Contents:

The contents of the Accident Prevention Plan (APP) shall be in accordance with **Appendix A** of the US Army Corps of Engineers, **EM 385-1-1 Safety and Health Requirements Manual**, Appendix A, Minimum Basic Outline for Accident Prevention Plans or as approved by the CA. For more information visit the USACE Website at www.usace.army.mil/Library.

- 1.8 ACTIVITY HAZARD ANALYSIS (AHA):** Activity Hazard Analyses (AHAs) define the activities being performed and identify the sequences of work, the specific hazards anticipated, site conditions, equipment, materials, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level of risk. The Activity Hazard Analysis (AHA) format shall be in accordance with US Army Corps of Engineers, **EM 385-1-1 Safety and Health Requirements Manual** or as approved by the CA.

A. Submittals:

1. Submit initial AHA to CA for review at least 15 Calendar Days prior to the start of each phase. Format subsequent AHAs as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.
2. The AHA list will be reviewed monthly at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change. Develop the activity hazard analyses using the project schedule as the basis for the activities performed. Any activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier or subcontractor and provided to the prime contractor for submittal to the CA.

1.9 DISPLAY OF SAFETY INFORMATION

Within **one (1) Calendar Days** after commencement of work, erect a safety bulletin board at the job site. Include and maintain information on safety bulletin board as required by US Army Corps of Engineers, **EM 385-1-1 Safety and Health Requirements Manual**, Section 01.A.06 or as approved by the CA. Additional items required to be posted include:

- A.** Confined space entry permit.
- B.** Hot work permit.
- C.** Crane permit
- D.** Others (as required)

1.10 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in the article "References." Maintain applicable equipment manufacturer's manuals.

1.11 EMERGENCY MEDICAL TREATMENT

Contractors will arrange for their own emergency medical treatment. The Owner has no responsibility to provide emergency medical treatment.

1.12 REPORTS

A. Accident Reports

1. Conduct an accident investigation for recordable injuries and illnesses, and property damage accidents resulting in at least Two Thousand Dollars (\$2,000) in damages, to establish the root cause(s) of the accident, complete "Accident Report Form" approved by the CA. Provide the report to the CA within **five (5) Calendar Days** of the accident.

B. Accident Notification

Notify the CA as soon as practical, but not later than **four hours (4)**, after any accident meeting the definition of Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than \$2,000, or any weight handling equipment accident.

1. Within notification include the following:
 - a. contractor name;
 - b. contract title;
 - c. type of contract;
 - d. name of activity,
 - e. installation or location where accident occurred;
 - f. date and time of accident;
 - g. names of personnel injured;
 - h. extent of property damage, if any; extent of injury, if known, and brief description of accident to include type of construction equipment used, Personal Protective Equipment (PPE) used, etc.. Preserve the conditions and evidence on the accident site until the U.S. Department of Labor, Occupational Safety and Health Administration (USDOL-OSHA) investigation team arrives on-site and USDOL-OSHA investigation is conducted.

C. Monthly Exposure Reports

Monthly exposure reporting to the CA is required to be attached to the monthly Application for Payment request. This report is a compilation of employee-hours worked each month for all site workers, both prime and subcontractor. Provide on a form approved by the CA.

D. Crane Reports

Submit crane inspection reports on a form approved by the CA and as specified herein with Daily Reports of Inspections.

E. HOT WORK

Hot Work shall only be performed in accordance with the requirements of **NFPA 51B "Fire Prevention During Welding, Cutting and Other Hot Work Standard"**.

1. Definitions:

- a. **Hot Work:** Work involving burning, welding, or a similar operation that is capable of initiating fires or explosions. Examples listed by NFPA include arc welding, oxygen- fuel gas welding, open-flame soldering, brazing, thermal spraying, oxygen cutting, and arc cutting.
 - b. **Permit Authorizing Individual (PAI).** Means the individual designated by the General Contractor to authorize hot work. The PAI is permitted to be, among others, the General Contractor's project executive, supervisor, foreperson, or designated safety administrator. The PAI CANNOT be the hot work operator, except as permitted in **NFPA 51B**. The PAI is aware of the fire hazards involved and is familiar with the provisions of this standard.
2. **Permit:** Submit and obtain a written permit from the PAI prior to performing "Hot Work" (welding, cutting, etc.) or operating other flame-producing/spark producing devices, from the PAI. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. The General Contractor will provide at least **two (2)** twenty (20) pound 4A:20 BC rated extinguishers for normal "Hot Work". All extinguishers shall be current inspection tagged, approved safety pin and tamper resistant seal.
 3. **Fire Watch:** It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch shall be trained in accordance with **NFPA 51B Standard for Fire Prevention During Welding, Cutting, and Other Hot Work** and remain on-site for a minimum of 30 minutes after completion of the task or as specified on the hot work permit. When starting work in the facility, require personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the local fire department emergency phone number(s). ANY FIRE, NO MATTER HOW SMALL, SHALL BE REPORTED TO THE LOCAL FIRE DEPARTMENT, GENERAL CONTRACTOR'S AUTHORIZED REPRESENTATIVE, AND OWNER'S CA IMMEDIATELY.

1.13 FACILITY OCCUPANCY CLOSURE

Streets, walks, and other facilities occupied and used by the state User Agency shall not be closed or obstructed without written permission from the CA.

1.14 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor must:

- A. Secure outside equipment and materials and place materials that could be damaged in protected areas.

- B. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.
- C. Ensure that temporary erosion controls are adequate.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

3.1 CONSTRUCTION AND/OR OTHER WORK

Comply with the Connecticut State Building and Fire Safety Codes, OSHA regulations, and other references regulations. The most stringent standard prevails.

3.1.2 HAZARDOUS MATERIAL EXCLUSIONS

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with **USACE EM 385-1-1** such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocyanates, lead-based paint are prohibited. The CA, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials.

3.1.3 UNFORESEEN HAZARDOUS MATERIAL

- A. Related Section: Division 01, Section 01 35 16, Alteration Project Procedures.

3.2 PRE-OUTAGE COORDINATION MEETING

Contractors are required to apply for utility outages at least **fifteen (15) Calendar Days** in advance. As a minimum, the request should include the location of the outage, utilities being affected, duration of outage and any necessary sketches. Special requirements for electrical outage requests are contained elsewhere in this specification section. Once approved, and prior to beginning work on the utility system requiring shut down, attend a pre-outage coordination meeting with the CA, User Agency Representative, and Public Utilities representative to review the scope of work and the lock-out/tag-out procedures for worker protection. No work will be performed on energized electrical circuits unless proof is provided that no other means exist.

3.3 SAFETY LOCKOUT/TAGOUT PROCEDURES

- A. The General Contractor shall ensure that each employee is familiar with and complies with these procedures and **OSHA 29 CFR 1910.147 Control Of Hazardous Energy (Lockout/Tagout)**.
 - 1. The General Contractor's "Authorized Employee" shall apply lockout/tagout tags and take other actions that, because of experience and knowledge, are known to be necessary to make the particular equipment safe to work on.
 - 2. No person, regardless of position or authority, shall operate any switch, valve, or equipment that has an official lockout/tagout tag attached to it, nor shall such tag be removed except as provided in this section.
 - 3. No person shall work on any equipment that requires a lockout/tagout tag unless he, his immediate supervisor, project leader, or a subordinate has in his possession the stubs of the required lockout/tagout tags. Only qualified personnel shall perform work on electrical circuits.
 - 4. A supervisor who is required to enter an area protected by a lockout/tagout tag will be considered a member of the protected group provided he notifies the holder of the tag stub each time he enters and departs from the protected area.
 - 5. Identification markings on building light and power distribution circuits shall not be relied on for established safe work conditions.
 - 6. Before clearance will be given on any equipment other than electrical (generally referred to as mechanical apparatus), the apparatus, valves, or systems shall be secured in a passive condition with the appropriate vents, pins, and locks. Pressurized or vacuum systems shall be vented to relieve differential pressure completely. Vent valves shall be tagged open during the course of the work. Where dangerous gas or fluid systems are involved, or in areas where the environment may be oxygen deficient, system or areas shall be purged, ventilated, or otherwise made safe prior to entry.
- B. **Tag Placement**

Lockout/tagout tags shall be completed in accordance with the regulations printed on the back thereof and attached to any device which, if operated, could cause an unsafe condition to exist. If more than one group is to work on any circuit or equipment, the employee in charge of each group shall have a separate

set of lockout/tagout tags completed and properly attached. When it is required that certain equipment be tagged, the State of Connecticut Authority Having Jurisdiction will review the characteristics of the various systems involved that affect the safety of the operations and the work to be done; take the necessary actions, including voltage and pressure checks, grounding, and venting, to make the system and equipment safe to work on; and apply such lockout/tagout tags to those switches, valves, vents, or other mechanical devices needed to preserve the safety provided. This operation is referred to as "Providing Safety Clearance."

C. Tag Removal

When any individual or group has completed its part of the work and is clear of the circuits or equipment, the supervisor, project leader, or individual for whom the equipment was tagged shall turn in his signed lockout/tagout tag stub to the Contractor. That group's or individual's lockout/tagout tags on equipment may then be removed on authorization by the Contractor.

3.4 FALL HAZARD PROTECTION AND PREVENTION PROGRAM

Establish a fall protection and prevention program, for the protection of all employees exposed to fall hazards. Within the program include company policy, identify responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures.

A. Training

Institute a fall protection training program. As part of the Fall Hazard Protection and Prevention Program, provide training for each employee who might be exposed to fall hazards. Provide training by a competent person for fall protection in accordance with **USACE EM 385-1-1, Section 21.A.16.**

B. Fall Protection Equipment and Systems

Enforce use of the fall protection equipment and systems designated for each specific work activity in the Fall Protection and Prevention Plan and/or AHA at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in **USACE EM 385-1-1, section 21.** In addition to the required fall protection systems, safety skiff, personal floatation devices, life rings etc., are required when working above or next to water in accordance with **USACE EM 385-1-1, paragraphs 05.H. and 05.I.** Personal fall arrest systems are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall arrest systems are required when operating other equipment such as scissor lifts if the work platform is capable of being positioned outside the wheelbase. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, or travel. Fall protection must comply with **OSHA 29 CFR 1926.500, Fall Protection, Subpart M, and ASSE/SAFE A10.32, Fall Protection.**

1. Personal Fall Arrest Equipment

Personal fall arrest equipment, systems, subsystems, and components shall meet **ASSE/SAFE Z359.1, Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components.** Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. Body belts may only be used as a positioning device system (for uses such as steel reinforcing assembly and in addition to an approved fall arrest system). Harnesses shall have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Only locking snap hooks and carabiners shall be used. Webbing, straps, and ropes shall be made of synthetic fiber. The maximum free fall distance when using fall arrest equipment shall not exceed 1.8 m 6 feet. The total fall distance and any swinging of the worker (pendulum-like motion) that can occur during a fall shall always be taken

2. Fall Protection for Roofing Work

Implement fall protection controls based on the type of roof being constructed and work being performed. Evaluate the roof area to be accessed for its structural integrity including weight-bearing capabilities for the projected loading.

a. Low Sloped Roofs:

- (i)** For work within 6 feet (6 feet (1.8 m) of an edge, on low-slope roofs, Protect personnel from falling by use of personal fall arrest systems, guardrails, or safety nets.
- (ii)** For work greater than (6 feet (1.8 m) from an edge, erect and install warning lines in accordance with **OSHA 29 CFR 1926.500, Fall Protection.**

- b. Steep-Sloped Roofs:** Work on steep-sloped roofs requires a personal fall arrest system, guardrails with toe-boards, or safety nets. This requirement also includes residential or housing type construction.

3. **Existing Anchorage**

Certified (or re-certified) by a qualified person for fall protection existing anchorages, to be used for attachment of personal fall arrest equipment in accordance with **ASSE/SAFE Z359.1, Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components**. Existing horizontal lifeline anchorages must be certified (or re-certified) by a registered professional engineer with experience in designing horizontal lifeline systems.

4. **Horizontal Lifelines**

Design, install, certify and use under the supervision of a qualified person horizontal lifelines for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (**OSHA 29 CFR 1926.500 Fall Protection**).

5. **Guardrails and Safety Nets**

Design, install and use guardrails and safety nets in accordance with **29 CFR 1926, Safety and Health Regulations for Construction Subpart M**.

6. **Rescue and Evacuation Procedures**

When personal fall arrest systems are used, the contractor must ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. Prepare a Rescue and Evacuation Plan and include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. Include the Rescue and Evacuation Plan within the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP).

3.5 **SCAFFOLDING**

A. The Contractor shall provide all employees with a safe means of access to the work area on the scaffold in accordance with **OSHA 29 CFR 1910.28 Safety Requirements For Scaffolding** and as contained in this section.

1. Climbing of any scaffold braces or supports not specifically designed for access is prohibited.
2. Access scaffold platforms greater than 20 feet (6 m) maximum in height by use of a scaffold stair system.
3. Do not use vertical ladders commonly provided by scaffold system manufacturers for accessing scaffold platforms greater than 20 feet (6 m) maximum in height.
4. The use of an adequate gate is required.
5. Ensure that employees are qualified to perform scaffold erection and dismantling.
6. Do not use scaffold without the capability of supporting at least four times the maximum intended load or without appropriate fall protection as delineated in the accepted fall protection and prevention plan.
7. Stationary scaffolds must be attached to structural building components to safeguard against tipping forward or backward.
8. Give special care to ensure scaffold systems are not overloaded. Side brackets used to extend scaffold platforms on self-supported scaffold systems for the storage of material are prohibited.
9. The first tie-in shall be at the height equal to 4 times the width of the smallest dimension of the scaffold base. Place work platforms on mud sills. Scaffold or work platform erectors shall have fall protection during the erection and dismantling of scaffolding or work platforms that are more than six feet. Delineate fall protection requirements when working above six feet or above dangerous operations in the Fall Protection and Prevention (FP&P) Plan and Activity Hazard Analysis (AHA) for the phase of work.

B. **Stilts**

The use of stilts for gaining additional height in construction, renovation, repair or maintenance work is **PROHIBITED**.

3.6 EQUIPMENT

A. Material Handling Equipment

Material Handling Equipment shall be in accordance with **OSHA 29 CFR 1910.178 Powered Industrial Trucks** and as contained in this section.

1. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions.
2. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions.
3. Operators of forklifts or power industrial trucks shall be licensed in accordance with OSHA.

B. Weight Handling Equipment

1. Equip cranes and derricks as specified in **ASME B30.5** or **ASME B30.22** or **ASME B30.8** as applicable.
2. Comply with the crane manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Perform erection under the supervision of a designated person (as defined in **ASME B30.5**). Perform all testing in accordance with the manufacturer's recommended procedures.
3. Comply with **ASME B30.5** for mobile and locomotive cranes, **ASME B30.22** for articulating boom cranes, **ASME B30.3** for construction tower cranes, and **ASME B30.8** for floating cranes and floating derricks.
4. Under no circumstance shall a Contractor make a lift at or above 90% of the cranes rated capacity in any configuration.
5. When operating in the vicinity of overhead transmission lines, operators and riggers shall be alert to this special hazard and follow the requirements of **ASME B30.5** or **ASME B30.22** as applicable.
6. Do not crane suspended personnel work platforms (baskets) unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Do not lift personnel with a line hoist or friction crane.
7. Inspect, maintain, and recharge portable fire extinguishers as specified in **NFPA 10, Standard for Portable Fire Extinguishers**.
8. All employees must keep clear of loads about to be lifted and of suspended loads.
9. Use cribbing when performing lifts on outriggers.
10. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.
11. A physical barricade must be positioned to prevent personnel from entering the counterweight swing (tail swing) area of the crane.
12. Certification records which include the date of inspection, signature of the person performing the inspection, and the serial number or other identifier of the crane that was inspected shall always be available for review by CA.
13. Written reports listing the load test procedures used along with any repairs or alterations performed on the crane shall be available for review by CA.
14. Certify that all crane operators have been trained in proper use of all safety devices (e.g. anti-two block devices).

C. USE OF EXPLOSIVES

Explosives shall not be used or brought to the project site without prior written approval from the CA. Such approval shall not relieve the Contractor of responsibility for injury to persons or for damage to property due to blasting operations. Storage of explosives, when permitted on State property, shall be only where directed and in approved storage facilities. These facilities shall be kept locked at all times except for inspection, delivery, and withdrawal of explosives. Explosive work shall be performed in accordance with the requirements of C.G.S. § 29-343 through 29-355 and as required by the Office of State Fire Marshal, CT Department of Construction Services.

3.7 EXCAVATIONS

A. Perform soil classification by a competent person in accordance with **29 CFR 1926 Safety and Health Regulations for Construction.**

1. Utility Locations

All underground utilities in the work area must be positively identified by and coordinated in accordance with **Division 00, General Conditions, Article 18 Surveys, Permits, And Regulations.** All underground utilities in the work area must be positively identified by a private utility locating service and coordinated with the public utility company. Any markings made during the utility investigation must be maintained by the General Contractor throughout the contract.

2. Utility Location Verification

The Contractor must physically verify underground utility locations by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within three feet of the underground system. Digging within **Two (2) feet (610 mm)** of a known utility must not be performed by means of mechanical equipment; hand digging shall be used. If construction is parallel to an existing utility expose the utility by hand digging every **100 feet (30.5 m)** if parallel within **Five (5) feet (1.5 m)** of the excavation.

3. Shoring Systems

Trench and shoring systems must be identified in the accepted safety plan and AHA. Manufacture tabulated data and specifications or registered engineer tabulated data for shoring or benching systems shall be readily available on-site for review. Job-made shoring or shielding must have the registered professional engineer stamp, specifications, and tabulated data. Extreme care must be used when excavating near direct burial electric underground cables.

4. Trenching Machinery

Operate trenching machines with digging chain drives only when the spotters/laborers are in plain view of the operator. Provide operator and spotters/laborers training on the hazards of the digging chain drives with emphasis on the distance that needs to be maintained when the digging chain is operating. Keep documentation of the training on file at the project site.

3.8 UTILITIES WITHIN CONCRETE SLABS

A. Utilities located within concrete slabs or pier structures, bridges, and the like, are extremely difficult to identify due to the reinforcing steel used in the construction of these structures. Whenever contract work involves concrete chipping, saw cutting, or core drilling, the existing utility location must be coordinated with utility company in addition to a private locating service. Outages to isolate utility systems must be used in circumstances where utilities are unable to be positively identified. The use of historical drawings does not alleviate the contractor from meeting this requirement.

3.9 ELECTRICAL

A. Conduct of Electrical Work

Underground electrical spaces must be certified safe for entry before entering to conduct work. Cables that will be cut must be positively identified and de-energized prior to performing each cut. Positive cable identification must be made prior to submitting any outage request for electrical systems. Arrangements are to be coordinated with the CA and utility company for identification. The CA will not accept an outage request until the Contractor satisfactorily documents that the circuits have been clearly identified. Perform all high voltage cable cutting remotely using hydraulic cutting tool. When racking in or live switching of circuit breakers, no additional person other than the switch operator will be allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method. When working in energized substations, only qualified electrical workers will be permitted to enter. When work requires Contractor to work near energized circuits as defined by the **NFPA 70**, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves with leather protective sleeves, fire retarding shirts, coveralls, face shields, and safety glasses. In addition, provide electrical arc flash protection for personnel as required by **NFPA 70E**. Insulating blankets, hearing protection, and switching suits may also be required, depending on the specific job and as delineated in the Contractor's AHA.

B. Portable Extension Cords

Size portable extension cords in accordance with manufacturer ratings for the tool to be powered and protected from damage. Immediately remove from service all damaged extension cords. Portable extension cords shall meet the requirements of **NFPA 70**.

3.10 WORK IN CONFINED SPACES

A. Comply with the requirements in **OSHA 29 CFR 1910.146** and **OSHA 29 CFR 1926.21(b) (6)**. Any potential for a hazard in the confined space requires a permit system to be used.

- 1.** Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. All hazards pertaining to the space shall be reviewed with each employee during review of the AHA.
- 2.** Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained to ensure exposure to any hazardous atmosphere is kept below its' action level.
- 3.** Sewer wet wells require continuous atmosphere monitoring with audible alarm for toxic gas detection.

END OF SECTION 01 35 26

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. **General:** Basic contract definitions are included in the General Conditions of the Contract for Construction.
- B. **"Indicated":** The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, or other paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the reader locate the reference. Location is not limited to this term.
- C. **"Directed":** Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by the Architect, requested by the Architect, and similar phrases.
- D. **"Approved":** The term "approved," when used in conjunction with the Architect's action on the Contractor's submittals, applications, and requests, is limited to the Architect's duties and responsibilities as stated in the Conditions of the Contract.
- E. **"Regulations":** The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. **"Furnish":** The term "furnish" means supply and deliver to the Project Site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. **"Install":** The term "install" describes operations at the Project Site including the actual unloading, unpacking, assembly, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. **"Provide":** The term "provide" means to furnish and install, complete and ready for the intended use.
- I. **"Installer":** An installer is the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, or similar operations. Installers are required to be experienced in the operations they are engaged to perform.
 - 1. The term **"experienced,"** when used with the term **"installer,"** means having a minimum of **five (5)** previous projects similar in size and scope to this Project, being familiar with the special requirements indicated, and having complied with requirements of authorities having jurisdiction.
 - 2. **Trades:** Using terms such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.
- J. **"Project Site"** is the space available to the Contractor for performing construction activities, either exclusively or in conjunction, with others performing other Work as part of the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land on which the project is to be built.
- K. **"Testing Agencies":** A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.3 SPECIFICATION FORMAT AND CONTENT EXPLANATION

- A. **Specification Format:** These Specifications are organized into Divisions and Sections based on CSI's "MasterFormat" 49-Division format and numbering system.
- B. **Specification Content:** This Specification uses certain conventions regarding the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:
 - 1. **Abbreviated Language:** Language used in Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be

interpolated, as the sense requires. Singular words will be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.

2. **Streamlined Language:** The Specifications generally use the imperative mood and streamlined language. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the Text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by the Contractor or by others when so noted.

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

1.4 INDUSTRY STANDARDS

- A. **Applicability of Standards:** Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. **Publication Dates:** Comply with the standards in effect as of the date of the Contract Documents unless a specific date is indicated in the Contract Documents or the governing regulations cited herein.
- C. **Conflicting Requirements:** Where compliance with **two (2)** or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent and highest quality requirement. Request a decision from the Architect before proceeding on requirements that are different but apparently equal, and where it is uncertain which requirement is the most stringent.
 1. **Minimum Quantity or Quality Levels:** The quantity or quality level shown or specified shall be the minimum acceptable. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Request a clarification from the Architect regarding uncertainties before proceeding.
- D. **Copies of Standards:** Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 1. Where copies of standards are needed to perform a required construction activity, the Contractor shall obtain copies directly from the publication source.
- E. **Abbreviations and Names:** Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards-generating organization, authorities having jurisdiction, or other entity applicable to the context of the text provision. Refer to Thompson Gale's "Encyclopedia of Associations," available in most libraries.

1.5 GOVERNING REGULATIONS AND AUTHORITIES

- A. **Copies of Regulations:** Obtain copies of the "**latest applicable State Codes**" and the following regulations and retain at the Project Site to be available for reference by parties who have a reasonable need during submittals, planning, and progress of the Work, until Substantial Completion.
 1. Connecticut State Building Code
 - 1.1 CT Supplement
 - 1.2 CT Amendments
 - 1.3 International Building Code.
 - 1.4 International Existing Building Code
 - 1.5 International Mechanical Code.
 - 1.6 International Plumbing Code
 - 1.7 International Energy Conservation Code
 - 1.8 National Electric Code (NFPA 70)
 - 1.9 ICC/ANSI A117.1-Accessible and Usable Buildings and Facilities
 2. Connecticut Fire Safety Code
 - 2.1 CT Supplement
 - 2.2 CT Amendments

- 2.3 International Fire Safety Code.
- 2.4 NFPA 101
- 3. Connecticut Fire Prevention Code.
 - 3.1 NFPA 1.
- 4. Occupational Safety and Health Administration (OSHA)
 - 4.1 OSHA 29 CFR Part 1910 Occupational Safety and Health Regulations.
 - 4.2 OSHA 29 CFR Part 1926 Occupational Safety and Health Regulations for Construction.
- B. The “**latest applicable State Codes**” are available for download from the DAS website (www.ct.gov/das) > Doing Business With The State > State Building Construction > Publications and Forms > Office of State Building Inspector *and* Office of State Fire Marshal. Also visit the www.ctdol.state.ct.us Connecticut Department of Labor website.

1.6 SUBMITTALS

- A. **Permits, Licenses, and Certificates:** For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION 01 42 20

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for quality-control services.
- B. Quality-Control services include fire alarm acceptance testing, inspections, tests, and related actions, including reports performed by Contractor, by independent agencies, and by governing authorities. They do not include contract enforcement activities performed by the Owner.
- C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements.
- D. Requirements of this Section relate to customized fabrication and installation procedures, not production of standard products.
 - 1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified inspections, tests, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- E. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 01 Section 01 33 00 "Submittal Procedures" specifies requirements for development of a schedule of required tests and inspections.
 - 2. Division 01 Section 01 73 29 "Cutting and Patching" specifies requirements for repair and restoration of construction disturbed by inspection and testing activities.
 - 3. Division 01 Section 01 77 00 "Closeout Procedures", specific requirements for contract closeout procedures.

1.3 RESPONSIBILITIES

- A. Contractor Responsibilities: Unless otherwise indicated as the responsibility of another identified entity, the Owner, through the Construction Administrator, shall provide inspections, tests, and other quality-control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction. All tests required by the individual specification sections are required to be scheduled and notification given to the Construction Administrator **24/48** hours in advance of the test/inspection as applicable. Costs for these services are not included in the Contract Sum.
 - 1. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Contractor's responsibility, the Contractor shall employ and pay a qualified independent testing agency to perform quality-control services. Costs for these services are included in the Contract Sum.
 - 2. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Owner's responsibility, the Owner will employ and pay a qualified independent testing agency to perform those services.
 - a) Such services include Special Inspections as required by the latest edition of the "Connecticut State Building Code".
 - b) Where the Owner has engaged a testing agency for testing and inspecting part of the Work, and the Contractor is also required to engage an entity for the same or related element, the Contractor shall not employ the entity engaged by the Owner. The Owner will engage the services of a qualified Special Inspector for this project. The Special Inspector, as a representative of the Owner, shall document and confirm compliance with the provisions of the Connecticut State Building Code for Special Inspections.

- c) Materials and assemblies for this project will be tested and construction operations inspected as the work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such defect is discovered nor shall it obligate the State for final acceptance.
 - d) The Owner's use of testing and inspection services shall in no way relieve the Contractor of the responsibility to furnish materials and finished construction in full compliance with the Contract Documents and the Connecticut State Building Code.
- B. Retesting: The Contractor is responsible for retesting where results of inspections, tests, or other quality-control services prove unsatisfactory and indicate noncompliance with Contract Document requirements, regardless of whether the original test was Contractor's responsibility.
 - 1. The cost of retesting construction, revised or replaced by the Contractor, is the Contractor's responsibility where required tests performed on original construction indicated non-compliance with Contract Document requirements.
 - 2. The Owner will issue a credit change order to cover all costs incurred related to all re-tests/re-inspections due to non-compliance to the Contract Documents, including but not limited to the Owner's costs and the Consultant's costs.
- C. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Notify the Agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to, the following:
 - 1. Provide access to the Work.
 - 2. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
 - 3. Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
 - 4. Provide facilities for storage and curing of test samples.
 - 5. Deliver samples to testing laboratories.
 - 6. Provide an approved design mix proposed for use for material mixes that require control by the testing agency.
 - 7. Provide security and protection of samples and test equipment at the Project Site.
- D. Duties of the Testing Agency: The independent testing agency engaged to perform inspections, sampling, and testing of materials and construction specified in individual Sections shall cooperate with the Construction Administrator, Architect and the Contractor in performance of the testing agency's duties. The testing agency shall provide qualified personnel to perform required inspections and tests.
 - 1. The testing agency shall notify the Construction Administrator and the Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. The testing agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.
 - 3. The testing agency shall not perform any duties of the Contractor.
- E. Owner will pay for the services of an independent testing agency laboratory to perform inspections, tests and other services required by the Specifications except as noted below, listed for which the Owner will issue a deduct change order to cover the cost associated with these tests:
 - 1. When the Contractor notifies the Construction Administrator and/or Testing Agency less than 24 hours before the expected time of testing.
 - 2. When the Contractor requires testing for his own convenience.
 - 3. When the Contractor schedules a test and is not ready for the required test.
- F. Submit reports of tests that are part of the submittal requirements which indicate compliance or non-compliance with the specified standard.
- G. See also General Conditions Article 16 "Inspections & Tests".
- H. **Fire Alarm/Acceptance Testing Procedures:**
 - 1. For **all** buildings (exceeding the threshold limit and not exceeding the threshold limit), the fire alarm testing shall be as the authority having jurisdiction shall dictate. This will be as determined by the Office of the State Fire Marshal (OSFM), and shall include, but not be limited to, the requirements as set below:

- a. Protective Signaling Systems: All protective signaling systems shall meet with acceptance testing requirements of the applicable standards listed in NFPA 101 and NFPA 13 currently adopted editions].
- b. Prior Test Notification: At least five (5) working days prior to testing, the Fire Alarm Contractor shall notify (in writing) the following people of the proposed date the acceptance tests are to be performed (Also, see Part 2 of Certificate of Compliance).
 - Department of Administrative Services – OSFM Representative
 - General Contractor
 - Engineer of Record
 - Equipment Supplier Representative
 - Sprinkler Contractor
- c. **Certificates of Compliance:**
 - 1) A Fire Alarm System Inspection and Testing Certification and Description form shall be prepared for each system (See NFPA 72].
 - 2) Parts 1 and 3 through 9, shall be completed after the system is installed and the installation of the wiring has been checked. Every alarm device must also be pre-tested to ensure proper operation and correct annunciation at each remote annunciator and control panel. Part 1 of the form (Certification of System Installation) shall be signed by the fire alarm contractor. The signed and completed preliminary copies of the Certification form shall be forwarded to all parties along with the Prior Test Notification.
 - 3) Part 2, of each applicable form, shall be completed after the operational tests have been completed.
 - 4) After the completion of the operational acceptance tests and sign-off of test witness (with stipulations noted), final copies of the Certificates shall be forwarded to the Department of Construction Services Representatives.
- d. **Tests:**
 - 1) All tests shall be conducted in accordance with the Manufacturer's Testing Recommendations.
 - 2) All testing equipment, apparatus (i.e. sound level decibel meter, 2-way radio communication, test devices, ladders, tools, lighting, etc.) and personnel shall be supplied by the Fire Alarm Contractor and Sprinkler Contractor.
- e. **System Documentation:** Every system shall include the following documentation, which shall be delivered to the Department of Construction Services Representatives upon final acceptance of the system. An owner's manual or manufacturer's installation instructions covering all system equipment, including the following:
 - 1) A detailed narrative description of the system inputs, evacuation signaling, ancillary functions, annunciation, intended sequence of operations, expansion capability, application considerations, and limitations.
 - 2) Operator's instructions for basic systems operations including alarm acknowledgment, system reset, interpreting system output (LED's CRT display, and printout), operation of manual evacuation signaling and ancillary function controls, changing printer paper, etc.
 - 3) A detailed description of routine maintenance and testing as required and recommended and as would be provided under a maintenance contract, including testing and maintenance instructions for each type of device installed. This information should include:
 - (a) A listing of individual system components that require periodic testing and maintenance.
 - (b) Step by step instructions detailing the requisite testing and maintenance procedures and the intervals at which those procedures should be performed.
 - (c) A schedule that correlates the testing and maintenance procedures required by paragraph (2) above and with the listing required by paragraph (1) above.
 - 4) Detailed troubleshooting instructions for each type of trouble condition recognized by the system, including opens, grounds, parity errors, "loop failures," etc. These instructions should include a

list of all trouble signals, and step by step instructions describing how to isolate those problems and correct them (or call for service as appropriate).

- 5) A service directory, including a list of names and telephone numbers for those who should be called to service the system.

f. As-Built Drawings:

- 1) The Contractor will produce two (2) sets of as-built drawings and specifications for the fire alarm system, indicating the location (and programmed address, if applicable) of all devices and appliances, the wiring sequences, wiring methods, connection of the components, and sequence of operation of the protective signaling system as installed, shall be given to the Military Department representatives. This shall be in Accordance with NFPA 72 Refer also to Section 01 77 00 "Closeout Procedures".

1.4 SUBMITTALS

- A. Unless the Contractor is responsible for this service, the independent testing agency shall submit a certified written report, in duplicate, of each inspection, test, or similar service to the Construction Administrator. If the Contractor is responsible for the service, submit a certified written report, in duplicate, of each inspection, test, or similar service through the Contractor.
 1. Submit additional copies of each written report directly to the governing authority, when the authority so directs.
 2. Report Data: Written reports of each inspection, test, or similar service include, but are not limited to, the following:
 - a. Date of issue.
 - b. Project title and number.
 - c. Name, address, and telephone number of testing agency.
 - d. Dates and locations of samples and tests or inspections.
 - e. Names of individuals making the inspection or test.
 - f. Designation of the Work and test method.
 - g. Identification of product and Specification Section.
 - h. Complete inspection or test data.
 - i. Test results and an interpretation of test results.
 - j. Ambient conditions at the time of sample taking and testing.
 - k. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements.
 - l. Name and signature of laboratory inspector.
 - m. Recommendations on re-testing.

1.5 QUALITY ASSURANCE

- A. **Qualifications for Service Agencies:** Engage inspection and testing service agencies, including independent testing laboratories, that are pre-qualified as complying with the National Voluntary Laboratory Accreditation Program and that specialize in the types of inspections and tests to be performed.
 1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the state where the Project is located.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

- A. General: Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes. Comply with Contract Document requirements for Division 01 Section 01 73 29 "Cutting and Patching."

- B. Protect constructions exposed by or for quality-control service activities, and protect repaired construction.
- C. Repair and protection is Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

END OF SECTION 01 45 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 00 General Conditions of the Contract for Construction for Design-Bid-Build and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes requirements for identification badges, parking stickers, construction facilities and temporary controls, including temporary utilities, support facilities, and security and protection.
- B. Temporary utilities include, but are not limited to, the following:
1. Temporary electric power and lighting services.
 2. Temporary heating, cooling and ventilation
- C. Support facilities include, but are not limited to, the following:
1. Field offices – Contractor, Subcontractor, Owner, and Construction Administrator.
 2. Storage and fabrication sheds.
 3. Temporary enclosures.
 4. Temporary project identification signs.
 5. Collection and disposal of waste and cleaning.
- D. Security and protection facilities include, but are not limited to, the following:
1. Enclosure fence.
 2. Security enclosure and lockup.
 3. Protection.
 4. Environmental protection.
 5. Identification badges for Contractor's personnel & parking stickers.

1.3 RELATED SECTIONS

- A. Division 01 Section 01 57 30 "Indoor Environmental Control" for additional provisions governing temporary heating, ventilating and air conditioning.

1.4 QUALITY ASSURANCE

- A. **Regulations:** Comply with industry standards and applicable laws and regulations of authorities having jurisdiction including, but not limited to, the following:
1. Building and fire code requirements.
 2. Health and safety regulations.
 3. Utility company regulations.
 4. Police, fire department, and rescue squad rules.
 5. Environmental protection regulations.
 6. Americans with Disabilities Act.
- B. **Standards:** OSHA. Comply with NFPA 241 "Standard for Safeguarding Construction, Alteration, and Demolition Operations," ANSI A10 Series standards for "Safety Requirements for Construction and Demolition," and NECA 200 "Recommended Practice for Installing and Maintaining Temporary Electric Power at Construction Sites."
1. **Electrical Service:** Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with NFPA 70 "National Electric Code."

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

1.6 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MATERIALS

- A. **General:** Provide new materials. If acceptable to the Architect, the Contractor may use undamaged, previously used materials in serviceable condition. Provide materials suitable for use intended.
- B. **Lumber and Plywood:** "
1. For signs and directory boards, provide 3/4-inch exterior grade, Grade A-B Fir plywood. Mount sign on preservative treated Fir posts.
 - a. Project sign shall be 4' x 8' painted and supported on 4-inch x 4-inch posts, of a design to be provided by the Owner via the Construction Administrator.
 2. **Vision Barriers:** Provide minimum 1/2-inch thick exterior plywood.
 3. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8-inch thick exterior plywood.
- C. **Paint:**
1. For sign and directory boards applying graphics, provide exterior-grade alkyd gloss enamel over exterior primer unless otherwise indicated.
- D. **Tarpaulins:** Provide waterproof, fire-resistant, UL-labeled tarpaulins with flame-spread rating of 15 or less. For temporary enclosures, provide translucent, nylon-reinforced, laminated polyethylene or polyvinyl chloride, fire-retardant tarpaulins.
- E. **Water:** Provide potable water approved by local health authorities.
- F. **Enclosure Fencing:** Provide 0.120-inch thick, galvanized 2-inch chain link fabric fencing six (6) feet high galvanized steel pipe posts, 1-1/2 inches knuckle both bottom and top I.D. for line posts and 2-1/2 inches I.D. for corner posts.

2.2 EQUIPMENT

- A. **General:** Provide new equipment. If acceptable to the Architect, the Contractor may use undamaged, previously used equipment in serviceable condition. Provide equipment suitable for use intended.
1. The Contractor shall furnish tools, apparatus and appliances, hoists and/or cranes and power for same, scaffolding, runways, ladders, temporary supports and bracing and similar work or material necessary to insure convenience and safety in the execution of the Contract except where this is otherwise specified in any Specification Section. All such items shall meet the approval of the Owner but responsibility for design, strength and safety shall remain with the Contractor. All such items shall comply with Federal OSHA regulations and applicable codes, statutes, rules and regulations, including compliance with the requirements of the current edition of the "Manual of Accident Prevention in Construction" published by the Associated General Contractors (AGC) and the standards of the State Labor Department.
 2. Staging, exterior and interior, required for the execution of this Contract, shall be furnished, erected, relocated if necessary and removed by the Contractor. Staging shall be maintained in a safe condition without charge to and for the use of all trades as needed.

- B. **Water Hoses:** Provide 3/4-inch, heavy-duty, abrasion-resistant, flexible rubber hoses with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shutoff nozzles at hose discharge and backflow preventers.
- C. **Electrical Outlets:** Provide properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-Volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light for connection of power tools and equipment.
- D. **Electrical Power Cords:** Provide grounded extension cords. Use hard-service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
- E. **Lamps and Light Fixtures:** Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered-glass enclosures where exposed to breakage. Provide exterior fixtures where exposed to moisture.
- F. **Heating Units:** Provide temporary heating units that have been tested and labeled by UL, FM, or another recognized trade association related to the type of fuel being consumed.
- G. **Temporary Field Offices:** The Agency will allow the use of a designated space in the building for a temporary field office for the contractor's use. All power and communication needs are the responsibility of the contractor.
- H. **Temporary Toilet Units:** The Agency will allow the toilets located in locker room for Contractor use. If others are needed, provide self-contained, single-occupant toilet units of the chemical, aerated recirculation, or combustion type. Provide units properly vented and fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
- I. **Fire Extinguishers:** Provide hand-carried, portable, UL-rated, Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL-rated, Class ABC, dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for the exposures.
 - 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

PART 3 - EXECUTION

3.1 INSTALLATION

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

3.2 TEMPORARY UTILITY INSTALLATION

- A. **General:** Engage the appropriate local utility company to install temporary service or connect to existing service. Where company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with company recommendations.
 - 1. Arrange with company and existing users for a time when service can be interrupted, if necessary, to make connections for temporary services.
 - 2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.
 - 3. Obtain easements to bring temporary utilities to the site where the Owner's easements cannot be used for that purpose.
 - 4. **Use Charges:** If cost or use charges for temporary facilities are specified by this section to be borne by the Owner the cost or use charges for temporary facilities will be borne not longer than **thirty (30)** days after final acceptance of the project.
- C. **Temporary Heating, Cooling and Ventilating:**

1. Provide temporary heat required by construction activities for curing or drying of completed installations or for protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.
 - a. **Heating Facilities:** Except where the Owner authorizes use of the permanent system, provide vented, self-contained, LP-gas or fuel oil heaters with individual space thermostatic control.
 - b. Use of gasoline-burning space heaters, open flame, or salamander heating units is prohibited.
2. **HVAC Equipment:**
 - a. The Owner authorizes Contractor's use of existing HVAC system to maintain specified cooling conditions during the Work. The Owner shall pay cost of energy used. Contractor shall exercise measures to conserve energy.
 - b. When the Owner authorizes Contractor's use of existing HVAC system during the Work and the existing HVAC system is determined to be temporarily insufficient or inoperable to maintain specified the cooling conditions, then the Contractor shall provide and pay for supplemental HVAC cooling devices as needed and in such a manner as to prevent damage to the existing building(s) or new building(s) and their systems.
 - c. The Contractor shall change all HVAC filters in existing system serving area of Work at end of Project.
3. Provide temporary heat during construction for interior areas included in the Contract to counteract low temperatures or excessive dampness. Maintain during said period or periods until final completion of the Contract, unless otherwise approved by the Owner in writing. Windows, doors, ventilators and similar openings shall be temporarily closed. Provide heat and ventilation to maintain specified conditions for construction operations and to protect materials and finishes from damage by temperature or humidity. The permanent heating system is not to be used for temporary heating unless approved, in writing, by the Owner. If approved, use of the permanent heating system by the Contractor does not constitute beneficial use by the Owner. The warrantee for said system will not commence until Substantial Completion is granted. Costs shall be paid by the Contractor. See individual Sections for temperature/humidity limits. Temporary heating methods shall comply with OSHA regulations and other applicable codes, statutes, rules and regulations and shall be approved by the Architect/Engineer and Owner.
4. Permanent air handling equipment, when used for temporary heating, shall be equipped with disposable "construction" filters. The construction filters shall have an average efficiency at least equal to the filters specified under Division 23, but not less than 30 percent when tested in accordance with ASHRAE 52.2 "Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size." The filters shall have an average arrestance of not less than 90 percent efficiency on one (1) micron size particles. Before turning over the system for final acceptance, the contractor shall remove and dispose of the construction filters; clean the ductwork; spray clean the heating and cooling coils, and drain pans to "like new" condition; and install the filters specified in Division 23 Section 23 40 00 "HVAC Air Cleaning Devices."
5. The Contractor may use the existing heating system with temporary extensions, radiators or unit heaters, but such use is subject to the Owner's approval. Coordinate use of existing facilities with Owner. Provide additional, temporary extensions and units to satisfy the criteria given in the preceding paragraph. Owner will pay cost of energy used. Take measures to conserve energy. At the termination of construction, return the facilities to their original condition. Before operation of permanent facilities, verify that installation is approved for operation and that filters are in place.

3.3 SUPPORT FACILITIES INSTALLATION

- A. **General:** Locate field offices, storage sheds, and other temporary construction and support facilities in designated area as shown on the Contract Documents. The location of the trailers on the Drawings is diagrammatic in nature. Final placement of the trailers is to be approved by the Construction Administrator.
 1. Maintain support facilities until Final Completion. Remove prior to Final Completion with permission from the Owner.

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

1. Storage sheds for tools, materials and equipment shall be weathertight with heat, lighting and ventilation for products requiring controlled conditions.
2. Remove temporary materials, equipment services and construction before Substantial Completion.
3. Clean and repair damage caused by installation or use of temporary facilities. Restore existing facilities used during construction to specified or original condition.

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

D. Collection and Disposal of Waste and Cleaning:

1. Collect waste within the contract limit line from construction areas daily. Provide separate containers for proper waste recycling. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than seven (7) days during normal weather or three (3) days when the temperature is expected to rise above 80 degrees F. Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material lawfully.
2. Maintain areas under Contractor's control free of waste materials, debris and rubbish. Maintain in a clean and orderly condition.
3. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces and other closed or remote spaces before closing the space.
4. Periodically clean interior areas before start of surface finishing and continue cleaning on an as-needed basis.
5. Control cleaning operations so that dust and other particulates will not adhere to wet or newly coated surfaces.

E. Temporary Environmental Controls: Contractor is to provide the following controls.

1. Rodent and Pest Control: Before deep foundation work has been completed, retain a local exterminator or pest control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests. Employ this service to perform extermination and control procedures at regular intervals so the Project will be free of pests and their residues at materials.
2. Dust Control (construction and demolition).
3. Noise Control.
4. Erosion and Sediment Control.
5. Pollution Control.
6. Traffic Control.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION (listed in Paragraph 1.2 D)

A. Except for use of permanent fire protection as soon as available, do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion, or longer, as requested by the Owner.

B. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers" and NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations."

1. Provide and locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.
2. Store combustible materials in containers in fire-safe locations.
3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for fighting fires. Prohibit smoking in hazardous fire-exposure areas.

4. Provide supervision of welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
5. The Contractor, during construction, shall be responsible for loss or damage by fire to the work of the Contract until completion. Any fire used within the structure for working purposes shall be extinguished when not in use. Bitumen or tar shall be melted on the ground only. No flammable material shall be stored in the structure in excess of amounts allowed by the authorities. No gasoline shall be stored in or close to the building at any time. The Contractor shall assign a responsible employee to be in charge of fire protection measures.
6. If an EPDM or other single-ply roof is included in the work that requires cleaning of mating surfaces of laps with gasoline, limit amount of gasoline on roof to two (2) gallons which shall be in UL listed containers. Also provide one 30 B:C fire extinguisher within 75 feet of any point on the roof.

C. Security for Site and Agency:

1. Provide security program and facilities to protect work, existing facilities and the Owner and Agency's operations from unauthorized entry, vandalism and theft. Coordinate with the Owner's and Agency's security program.
2. The Contractor shall be solely responsible for damage, loss or liability due to theft or vandalism.

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

1. Provide covered walkways as required by governing authorities for public rights-of-way and for public access to existing buildings.
2. Provide temporary, insulated, weathertight closures at openings to the exterior to provide acceptable working conditions and protection for materials, to allow for temporary heating and to prevent entry of unauthorized persons. Provide doors with self-closing hardware and locks.
3. Barriers and enclosures shall be in conformance with code requirements. Do not block egress from occupied buildings unless necessary to further the work of the Contract. In this case, secure the Owners approval of an alternate egress plan.
4. See also General Conditions Article 19, "Protection of the Work, Persons and Property".

E. Enclosure Fences: Before excavation begins, install an enclosure fence with lockable entrance gates. Locate where indicated on the Construction Documents, or enclose the entire site or the portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering the site, except by the entrance gates.

1. Provide chain link construction fencing with posts set in a compacted mixture of gravel and earth. Use existing fence to the extent possible.

F. Security Enclosure and Lockup: Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Provide keys to the Construction Administrator.

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

G. Protection:

1. Protect buildings, equipment, furnishings, grounds and plantings from damage. Any damage shall be repaired or otherwise made good at no expense to the Owner.
2. Provide protective coverings and barricades to prevent damage. The Contractor shall be held responsible for, and must make good at his own expense, any water or other type of damage due to improper coverings. Protect the public and building personnel from injury.
3. Provide temporary protection for installed products. Control traffic in immediate area to minimize damage.
4. Provide protective coverings for walls, projections, jambs, sills and soffits of openings. Protect finished floors and stairs from traffic, movement of heavy objects and storage. Prohibit traffic and storage on waterproofed and roofed surfaces and on lawn and landscaped areas.

5. Provide temporary partitions and ceilings to separate work areas from Agency-occupied areas to prevent penetration of dust and moisture into Agency-occupied areas and equipment. Erect framing and sheet materials with closed joints and sealed edges at intersections with existing surfaces.
6. See also General Conditions Article 19, "Protection of the Work, Persons and Property".
- H. **Environmental Protection:** Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways, and subsoil might be contaminated or polluted or that other undesirable effects might result.
- I. **Identification Badges for Contractor's Personnel, Visitors and Parking Stickers:**
 1. The Contractor will provide each person working or visiting at the site with an identification badge, bearing the name of the Contractor and a number. As badges are assigned, a record shall be kept by the Contractor and given to the Construction Administrator and Agency Administrator. Update and correct the records of all badges issued on a semi-monthly basis.
 2. Badges are to be worn on outer garment where visible at all times while at the construction site, return them to the Contractor's field office at the end of each day and pick them up there each morning.
 3. All vehicles parking in the Contractor's parking lot and those used around the site require an ID sticker. They will be issued by the Agency. Each contractor shall apply for parking stickers through the Construction Administrator no more than semi-monthly and shall keep record of all stickers issued.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. **Supervision:** Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.
- B. **Maintenance:** Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.
 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
 2. Protection: Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.
- C. **Termination and Removal:** Unless the Architect/CA requests that it be maintained longer, remove each temporary facility when the need has ended, when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 1. Materials and facilities that constitute temporary facilities are the Contractor's property. The Owner reserves the right to take possession of project identification signs.
 2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where the area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil in the area. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at the temporary entrances, as required by the governing authority.
 3. At Substantial Completion, clean and renovate permanent facilities used during the construction period including, but not limited to, the following:
 - a. Replace air filters and clean inside of ductwork and housings.
 - b. Replace significantly worn parts and parts subject to unusual operating conditions.
 - c. Replace lamps burned out or noticeably dimmed by hours of use.

END OF SECTION 01 50 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Microbial and fungal contamination control.
 - 2. Indoor air quality and pollution control.
 - 3. Heating, ventilating, and air conditioning.

1.3 REFERENCES

- 1. **ASTM International (ASTM):**
 - a. ASTM D5116-2006, Standard Guide for Small-Scale Environmental Chamber Determination of Organic Emissions From Indoor Materials/Products.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 MICROBIAL AND FUNGAL CONTAMINATION CONTROL

- A. Perform, schedule, and sequence Work as required to limit conditions supporting formations of microbes, molds, and fungi.
 - 1. Control water penetration, dampness, and humidity to prevent products not treated for exterior use from becoming soaked or damp.
 - 2. Enclose building prior to installing interior materials and finishes.
 - 3. Do not install interior products subject to moisture absorption until building is enclosed and wet work generating moisture and humidity is complete.
- B. When visible formations are observed and when formations cannot be completely removed by non-abrasive surface cleaning:
 - 1. Remove and replace materials identified as food sources for microbes, molds, and fungi.
 - 2. Correct conditions supporting microbial, mold, and fungal growth.
- C. Remove interior products and finishes, identified as food sources that have absorbed sufficient moisture to become damp whether or not microbial, mold, or fungal growth is observed. Include:
 - 1. Gypsum board cores.
 - 2. Organic materials composed of cellulose fiber or paper.
 - 3. Materials containing sucrose or other binders identified as supporting microbial growth.
- D. Remove fibrous insulation materials subject to retaining moisture such as duct liner, insulation, and other materials that are made wet or damp and cannot immediately be made dry.
- E. Repair or replace ductwork, pans, and other conditions subject to moisture condensation, water penetration, or other water source not drained and made dry.
 - 1. Remove conditions that have become an environment for microbes, molds, or fungi.
 - 2. Do not permit conditions leading to standing water.
- F. Install wet work and allow time needed to dry and cure prior to installing materials such as carpet, acoustical material, textiles, and other material of type that may attract and retain moisture.

3.2 INDOOR AIR QUALITY AND POLLUTION CONTROL

- A. Product Emission Rate Standards:** Test to ASTM D5116 for maximum indoor air concentration levels.
- 1. Formaldehyde:**
 - a. 0.03 parts per million where no other requirements are specified.
 - b. 0.005 parts per million where products are specified as formaldehyde free.
 - 2. Total VOC Emissions for Carpet Tile, Adhesives, and Sealers:** 0.05 mg/m² per hour.
 - 3. 4 Phenyl Cyclohexene (4-PC) Particulate Emissions for Carpet:** One (1) part per billion.
 - 4. Total Particulate Emission Rate Levels:** 50 ug/m³.
 - 5. Primary and Secondary Regulated Pollutants:** Conform to USEPA, Code of Federal Regulations, Title 40, Part 50 National Air Ambient Air Quality Standard. Refer to EPA Web Site <http://www.epa.gov/epahome/rules.html#codified>.
 - 6. Other Pollutants Not Listed:** Not greater than 1/10 of Threshold Limit Value - Time Weighted Average (TLV-TWA) industrial workplace standard.
- B. Architectural Coatings - Volatile Organic Compound (VOC) Content Limits:** Conform to US Environmental Protection Agency (EPA) Federal Register 48886/Vol. 63, No.176 Friday, September 11, 1998/ Rules and Regulations. Refer to EPA Web Site: <http://www.epa.gov/ttn/atw/eparules.html>.
- C.** Do not use products in combination with or in contact with other products that can be identified as combining to form toxic fumes or sustained odors.
- D.** Do not use solvents within interior areas that may penetrate and be retained in absorptive materials such as concrete, gypsum board, wood, cellulose products, fibrous material, and textiles.
- E.** Protect construction materials from contamination and pollution from contact with construction dust, debris, fumes, solvents, and other environmentally polluting materials.
- F.** Allow furnishings and materials such as carpet, floor tile, acoustical tile, textiles, office furniture, and casework, to air out in clean environment prior to installation.

3.3 HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

- A.** Do not run permanent HVAC system during course of construction. Seal ductwork intake and exhaust vents.
- B.** Heat, dehumidify, and ventilate building during course of Work as necessary to maintain environmental conditions suitable for drying and curing materials and for prevention of conditions suitable for mold and mildew growth.
1. Ventilate building to remove moisture, dust, fumes, and odors.
 2. Temper and dehumidify air as needed to remove excess moisture.
 3. Do not use propane heaters and other moisture generating heating systems.
- C. Flush out building prior to commissioning.** Refer to Section 01 45 23.13 "Testing for IAQ, Baseline IAQ, & Materials" for procedure.
- D.** Inspect ductwork for refuse, contaminants, moisture and other foreign contamination prior to commissioning. Notify Commissioning Agent (CxA) of satisfactory inspection prior to beginning of Commissioning.
- E.** Clean underfloor plenum at access flooring acting as supply air duct, prior to occupancy.

3.4 REMEDIAL ACTION

- A.** Promptly take action as necessary to inspect and remediate conditions suspected of supporting microbial, fungal or mold conditions and where contaminated by indoor air pollution.
- B.** Notify and consult with Architect prior to beginning remedial action where contamination by hazardous chemicals, microbes, and fungi is suspected.

END OF SECTION 01 57 30

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements governing the Contractor's selection of products for use in the Project.
- B. **Related Sections:** The following Sections contain requirements that relate to this Section:
 - 1. Division 01 Section 01 25 00 "Substitution Procedures" specifies administrative procedures for handling requests for substitutions made after award of the Contract.
 - 2. Division 01 Section 01 33 00 "Submittal Procedures" specifies requirements for submittal of the Contractor's Construction Schedule and the Submittal Schedule.
 - 3. Division 01 Section 01 42 20 "Reference Standards and Definitions" specifies the applicability of industry standards to products specified.

1.3 DEFINITIONS

- A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry.
 - 1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - a. "Named Products" are items identified by the manufacturer's product name, including make or model number or other designation, shown or listed in the manufacturer's published product literature, which is current as of the date of the Contract Documents.
 - 2. "Materials" are products substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.
 - 3. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections, such as wiring or piping.

1.4 QUALITY ASSURANCE

- A. **Source Limitations:** To the fullest extent possible, provide products of the same kind from a single source.
- B. **Compatibility of Options:** When the Contractor is given the option of selecting between two (2) or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.
- C. **Nameplates:** Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.
 - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A.** Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.
1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to the site in an undamaged condition in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Store products in accordance with manufacturers' instructions and maintain within temperature and humidity range required by manufacturer.
 4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
 5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.
 6. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.
 7. Store products subject to damage by the elements above ground, under cover in a weathertight enclosure, with ventilation adequate to prevent condensation.
 8. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.
 9. Store loose granular material on solid surfaces in a well-drained area; prevent mixing with foreign matter.
 10. Arrange storage to provide access for inspection. Periodically inspect to insure products are undamaged and are maintained under required conditions. Keep log showing date, time and problems, if any.
 11. Stone, masonry units and similar materials shall be stored on platforms or dry skids and shall be adequately covered and protected against damage.
 12. Materials and equipment shall be delivered, stored and handled to prevent intrusion of foreign matter and damage by weather or breakage. Packaged materials shall be delivered and stored in original, unbroken packages.
 13. Promptly inspect shipments to assure that products comply with requirements, that quantities are correct and products are undamaged.
 14. Packages, materials and equipment showing evidence of damage will be rejected and replaced at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION

- A. General Product Requirements:** Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, new at the time of installation.
1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and the intended use and effect.
 2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.
- B. Product Selection Procedures:** The Contract Documents and governing regulations govern product selection. Procedures governing product selection include the following:
1. Semi-proprietary Specification Requirements: Where Specifications name two (2) or more products or manufacturers, provide one (1) of the products indicated. Comply with the requirements of Division 01 Section 01 25 00 "Substitution Procedures."
 2. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.

3. Compliance with Standards, Codes, and Regulations: Where Specifications only require compliance with an imposed code, standard, or regulation, select a product that complies with the standards, codes, or regulations specified.
4. Visual Selection: Where specified product requirements include the phrase "*...as selected from manufacturer's standard colors, patterns, textures...*" or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Architect will select the color, pattern, and texture from the product line selected.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

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

END OF SECTION 01 60 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for cutting and patching.
- B. **Related Sections:** The following Sections contain requirements that relate to this Section:
1. Division 01 Section 01 31 00 "Project Management and Coordination" for procedures for coordinating cutting and patching with other construction activities.
 2. Division 01 Section 01 35 16 "Alteration Project Procedures" for procedures for coordinating cutting and patching with other construction activities.
 3. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
 - a. Requirements of this Section apply to mechanical and electrical installations. Refer to Division 22, 23, and 26 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.3 SUBMITTALS

- A. **Cutting and Patching Proposal:** Submit a proposal to the Construction Administrator describing procedures well in advance of the time cutting and patching will be performed and if the Owner's Representative and/or Architect/Engineer requires approval of these procedures before proceeding. Request approval to proceed. Include the following information, as applicable, in the proposal:
1. Describe the extent of cutting and patching required. Show how it will be performed and 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. Describe affects to integrity of weather exposed or moisture resistant element.
 4. Describe affects to efficiency, maintenance, or safety of any operational element.
 5. Describe affects to Work of Owner or separate contractor.
 6. List products to be used and firms or entities that will perform Work.
 7. Indicate dates when cutting and patching will be performed.
 8. **Utilities:** List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.
 9. Where cutting and patching involves adding reinforcement to structural elements, submit details and engineering calculations sealed by an Engineer registered in the State of Connecticut showing integration of reinforcement with the original structure.
 10. Approval by the Construction Administrator to proceed with cutting and patching does not waive the Architect/Engineer of Record's rights to later require complete removal and replacement of unsatisfactory Work.

1.4 QUALITY ASSURANCE

- A. **Requirements for Structural Work:** Do not cut and patch structural elements in a manner that would change their load-carrying capacity or load-deflection ratio.
1. Obtain approval from the Architect/Engineer of the cutting and patching proposal before cutting and patching the following structural elements:
 - a. Structural concrete.
 - b. Structural steel.
 - c. Lintels.

- d. Structural decking.
 - e. Miscellaneous structural metals.
 - f. Exterior curtain-wall construction.
 - g. Equipment supports.
 - h. Piping, ductwork, vessels, and equipment.
- B. Operational Limitations:** Do not cut and patch operating elements or related components in a manner that would result in reducing their capacity to perform as intended. Do not cut and patch operating elements or related components in a manner that would result in increased maintenance or decreased operational life or safety.
- 1. Obtain Architect/Engineer's approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related systems:
 - a. Primary operational systems and equipment.
 - b. Air or smoke barriers.
 - c. Water, moisture, or vapor barriers.
 - d. Membranes and flashings.
 - e. Fire protection systems.
 - f. Noise and vibration control elements and systems.
 - g. Control systems.
 - h. Communication systems.
 - i. Conveying systems.
 - j. Electrical wiring systems.
- C. Visual Requirements:** Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in the Architect's opinion, reduce the building's aesthetic qualities. Do not cut and patch construction in a manner that would result in visual evidence of cutting and patching. Remove and replace construction cut and patched in a visually unsatisfactory manner.

1.5 WARRANTY

- A. Existing Warranties:** Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to void any warranties required or existing.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A.** Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible if identical materials are unavailable or cannot be used. Use materials whose installed performance will equal or surpass that of existing materials.
- B.** The Contractor shall install sleeves, inserts and hangers furnished by the trades needing same.

PART 3 - EXECUTION

3.1 INSPECTION

- A.** Examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed before cutting. If unsafe or unsatisfactory conditions are encountered, notify the Construction Administrator and Architect, before proceeding with corrective action.
- B.** Openings and chases may not be shown on the Drawings. It is the responsibility of the Contractor to examine the Architectural, Electrical, Heating, Cooling, Ventilating and Plumbing Drawings and to provide chases, channels or openings where needed.
- 1. After installing Work into openings, channels and/or chases, the Contractor shall close same. If finishes are to be restored, the new Work shall match the original and shall be done by the trade customarily responsible for the particular kind of Work.

- C. The Contractor shall verify dimensions for built-in Work and/or Work adjoining that of other trades before ordering any material or doing any Work. Discrepancies shall be submitted to the Construction Administrator before proceeding with the Work.
- D. See also General Conditions Article 23 "Cutting, Fitting, Patching & Digging".

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 Work 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. 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.
 - 2. DO perform cutting and patching to integrate elements of Work. Provide penetrations of existing surfaces. Provide samples for testing. Seal penetrations through floors, walls, ceilings and roofs, as applicable; restore or preserve fire-rated and smoke-barrier construction. Construction and finishes shall match original Work.
- B. **Cutting:** Cut existing construction using methods least likely to damage elements 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, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Cut through concrete and masonry using a cutting machine, such as a Carborundum saw or a diamond-core drill.
 - 4. Comply with requirements of applicable Division 32 Sections where cutting and patching requires excavating and backfilling.
 - 5. Where services are required to be removed, relocated, or abandoned, by-pass utility services, such as pipe or conduit, before cutting. 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 removing walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space. 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 surface containing the patch after the area has received primer and second coat.
 - 4. Patch, repair, or re-hang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.4 CLEANING

- A.** Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar items. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

END OF SECTION 01 73 29

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A.** This Section includes requirements for waste management goals, waste management plan and waste management plan implementation.
- B.** Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 01 Section 01 11 00 "Summary of Work".
 - 2. Division 01 Section 01 20 00 "Price and Payment Procedures".
 - 3. Division 01 Section 01 25 00 "Substitution Procedures".
 - 4. Division 01 Section 01 31 19 "Project Meetings".
 - 5. Division 01 Section 01 33 00 "Submittal Procedures".
 - 6. Division 01 Section 01 45 00 "Quality Control".
 - 7. Division 01 Section 01 50 00 "Temporary Facilities and Controls".
 - 8. Division 01 Section 01 60 00 "Product Requirements".
 - 9. Division 01 Section 01 77 00 "Closeout Procedures".

1.3 DEFINITIONS

- A. Construction Waste:** Solid wastes such as building materials, packaging and rubble resulting from construction, paving and infrastructure.
- B. Demolition Waste:** Solid wastes such as concrete, wood, brick, plaster, roofing materials, wallboard, metals, carpeting, insulation, and clean fill resulting from demolition or selective demolition of structures.
- C. Recyclable Materials:** Products and materials that can be recovered and remanufactured into a new product. Recyclable materials include, but are not limited to, the following:
 - 1. Metals (ferrous and non-ferrous), including banding, metal studs, ductwork, and piping.
 - 2. Asphaltic concrete paving.
 - 3. Portland cement concrete.
 - 4. Gypsum products.
 - 5. Paper and cardboard.
 - 6. Wood products, including structural, finish, crates, and pallets.
 - 7. Brick and masonry.
 - 8. Carpet and padding.
 - 9. Plastics.
 - 10. Copper wiring.
- D. Recycling Facility:** A business that specializes in collecting, handling, processing, distributing, or remanufacturing waste materials generated by new construction projects, into products or materials that can be used for this project or by others.
- E. Salvage and Reuse:** Existing usable product or material that can be saved and reused in some manner on the project site. Materials for reuse must be approved by the Architect. Materials that can be salvaged and reused must comply with applicable technical specifications and include, but are not limited to, the following:
 - 1. Dimensional lumber and other wood products.
 - 2. Structural steel.
 - 3. Soil.
 - 4. Masonry products.
 - 5. Plants.

- F. Salvage for Resale:** Existing usable product that can be saved and removed intact (as is) from the project site to another site for resale to others without remanufacturing.

1.4 WASTE MANAGEMENT GOALS

- A.** The Owner has established that this Project shall generate the least amount of waste possible and that processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors shall be employed.
- B.** The Contractor shall use all means available to divert the greatest extent practical and economically feasible, construction waste from landfills and incinerators.
- C.** Of the inevitable waste that is generated, as many of the waste materials as economically feasible shall be reused, salvaged, or recycled. Waste disposal in landfills shall be minimized.
- D.** Recycle and/or salvage a minimum of 50 percent of non-hazardous construction waste by weight of the total solid waste generated by the Project.
- E.** With regard to these goals the Contractor shall develop, for the Architect's review, a Waste Management Plan for this Project.
- F.** Take a pro-active, responsible role in management of construction waste and require all subcontractors, vendors, and suppliers to participate in the effort. Establish a construction waste management program that includes the following categories:
 - 1. Minimizing packaging waste.
 - 2. Salvage and reuse.
 - 3. Salvage for resale or donation.
 - 4. Recycling.
 - 5. Disposal.

1.5 SUBMITTALS

- A. Draft Waste Management Plan:** Within 30 days after receipt of Notice of Award of Bid, or prior to any waste removal, whichever occurs sooner, the Contractor shall submit a copy of a Draft Waste Management Plan to the Construction Administrator.
- B. Final Waste Management Plan:** Once the Owner has determined which of the recycling options addressed in the Draft Waste Management Plan are acceptable, the Contractor shall submit within 10 days a copy of a Final Waste Management Plan.
- C. Progress Reports:** Submit a copy **[three (3)] [Insert]** copies of monthly progress reports, at the same time as the Application for Payment, documenting the following:
 - 1. Material category.
 - 2. Point of waste generation.
 - 3. Total quantity of waste in tons.
 - 4. Quantity of waste salvaged, in tons.
 - 5. Quantity of waste recycled, in tons.
 - 6. Total quantity of waste recovered (salvaged plus recycled) in tons.
 - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- D. Calculations:** Submit a copy of calculations indicating the end-of-project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Project prior to Substantial Completion.
- E. Record Submittals:**
 - 1. **Donations:** Indicate which salvageable materials were donated, who they were donated to, and whether the recipient is tax exempt. Submit documentation indicating receipt of donations.
 - 2. **Sales:** Indicate which salvageable materials were sold, who they were sold to, and whether the recipient is tax exempt. Submit documentation indicating receipt of materials.
 - 3. **Recycling:** Indicate which materials were recycled and the name of the facility licensed to accept them. Submit documentation such as manifests, weight tickets, receipts, and invoices.
 - 4. **Waste Disposal:** Indicate which materials were accepted as waste by landfills and incinerator facilities licensed to accept them. Submit documentation indicating receipt of materials.

1.6 QUALITY ASSURANCE

- A. **Regulatory Requirements:** Comply with regulations of State of Connecticut Department of Environment Protection, Waste Management Bureau Recycling Program.
- B. **Waste Management Conference:** Review and discuss the waste management plan, requirements for documenting quantities of each type of waste and its disposition, procedures for materials separation, procedures for periodic collection and transportation to recycling and disposal facilities. Review waste management requirements for each trade. Verify availability of containers and bins needed to avoid delays.

1.7 WASTE MANAGEMENT PLAN

- A. **Draft Waste Management Plan:** Include the following in the Draft Plan:
 - 1. Analysis of the proposed jobsite waste to be generated, including types and quantities.
 - 2. **Landfill Options:** The name of the landfill(s) where trash will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all Project waste in the landfill(s).
 - 3. **Alternatives to Landfilling:** A list of each material proposed to be salvaged, reused, or recycled during the course of the Project, the proposed local market for each material, and the estimated net cost savings or additional costs resulting from separating and recycling (versus landfilling) each material. "Net" means that the following have been subtracted from the cost of separating and recycling:
 - a. Revenue from the sale of recycled or salvaged materials and
 - b. Landfill tipping fees saved due to diversion of materials from the landfill. The list of these materials is to include, at a minimum, the following materials:
 - i) Cardboard.
 - ii) Clean dimensional wood.
 - iii) Beverage containers.
 - iv) Concrete.
 - v) Metals from banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
- B. **Resources for Development of Waste Management Plan:** The following sources may be useful in developing the Draft Waste Management Plan:
 - 1. **Recycling Haulers and Markets:** Local haulers and markets for recyclable materials. For more information, contact the State of Connecticut Department of Environmental Protection, Waste Management Bureau Recycling Program, (860) 424-3365, www.dep.state.ct.us/wst/recycle/ctrecycle.htm.
- C. **Final Waste Management Plan:** The Final Waste Management Plan shall contain the following:
 - 1. Analysis of the proposed jobsite waste to be generated, including types and quantities.
 - 2. **Landfill Options:** The name of the landfill(s) where trash will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all Project waste in the landfill(s).
 - 3. **Alternatives to Landfilling:** A list of the waste materials from the Project that will be separated for reuse, salvage, or recycling.
 - 4. **Meetings:** A description of the regular meetings to be held to address waste management. Refer to Section 01 31 19 "Project Meetings".
 - 5. **Materials Handling Procedures:** A description of the means by which any waste materials identified in item (3) above will be protected from contamination, and a description of the means to be employed in recycling the above materials consistent with requirements for acceptance by designated facilities.
 - 6. **Transportation:** A description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site) and destination of materials.

1.8 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. **Manager:** The Contractor shall designate an on-site party (or parties) responsible for instructing workers and overseeing and documenting results of the Waste Management Plan for the Project.
- B. **Distribution:** The Contractor shall distribute copies of the Waste Management Plan to the Job Site Foreman, each Subcontractor, the Owner, and the Architect.

- C. **Instruction:** The Contractor shall provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the Project.
- D. **Separation Facilities:** The Contractor shall lay out and label a specific area to facilitate separation of materials for potential recycling, salvage, reuse, and return. Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials.
- E. **Hazardous Wastes:** Hazardous wastes shall be separated, stored, and disposed of according to local regulations.
- F. **Application for Progress Payments:** The Contractor shall submit with each Application for Progress Payment a Summary of Waste Generated by the Project. Failure to submit this information shall render the Application for Payment incomplete and shall delay Progress Payment. The Summary shall be submitted on a form acceptable to the Owner and shall contain the following information:
 - 1. The amount (in tons or cubic yards) of material landfilled from the Project, the identity of the landfill, the total amount of tipping fees paid at the landfill, and the total disposal cost. Include manifests, weight tickets, receipt, and invoices.
 - 2. For each material recycled, reused, or salvaged from the Project: the amount (in tons or cubic yards), the date removed from the jobsite, the receiving party, the transportation cost, the amount of any money paid or received for the recycled or salvaged material, and the net total cost or savings of salvage or recycling of each material shall be indicated. Attach manifests, weight tickets, receipts, and invoices.

PART 2 – PRODUCTS

(Not Applicable)

PART 3 – EXECUTION

3.1 PLAN IMPLEMENTATION

- A. Implement the waste management plan as approved by Owner.
- B. Provide training of workers, contractors, subcontractors, and suppliers on proper waste management procedures.
 - 1. Distribute waste management plan to all parties involved in the Project within three (3) days of submittal return.
 - 2. Distribute plan to parties when they first begin working on the Project site. Review plan procedures and locations established for salvage, recycling, and disposal.

3.2 SEPARATION OF RECYCLABLE WASTE MATERIALS

- A. Provide the necessary containers and bins, to facilitate the waste management program, that are clearly and appropriately marked. Prevent contamination of recyclable materials from incompatible products and materials. Separate construction waste at the project site by one of the following methods:
 - 1. **Source Separated Method:** Waste products and materials, that are recyclable, are separated from trash and sorted into appropriately marked separate containers and then transported to the respective recycling facility for further processing. Trash is transported to a landfill or incinerator.
 - 2. **Co-Mingled Method:** All construction waste is placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed and the remaining trash is transported to a landfill or incinerator.
 - 3. Other methods proposed by the Contractor and approved by the Owner.

END OF SECTION 01 74 19

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for handling requests for building system start up and system demonstration and includes the following:
 - 1. Starting Systems.
 - 2. Demonstration and instructions.
 - 3. Testing, adjusting, and certifications.
- B. **Related Sections:** The following Sections contain requirements that relate to this Section:
 - 1. Division 01 Section 01 45 00 "Quality Control" specifies quality assurance and inspecting services.
 - 2. Division 01 Section 01 77 00 "Closeout Procedures" specifies requirements for contract close out requirements for system operation and maintenance data and extra materials.

1.3 STARTING SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Provide written notification to the Construction Administrator **10 days** prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, and control sequence for other conditions that may cause damage.
- D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components are complete and tested.
- F. Execute the start-up under supervision of manufacturer's representative, in accordance with manufacturer's instructions.
- G. When referenced in individual specification sections, require manufacturer to provide an authorized representative to be present at the site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report in accordance with Division 01 Section 01 45 00 "Quality Control" that the equipment or system has been properly installed and is functioning properly.

1.4 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of Products to Owner and Agency Personnel **fourteen (14)** days prior to substantial completion.
- B. Demonstrate Project equipment and instruct in a classroom environment at location designated by the Construction Administrator and instructed by a qualified manufacturer's representative who is knowledgeable about the Project.
- C. For equipment or systems requiring seasonal operation perform demonstration for season within six (6) months.
- D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner and Agency Personnel in detail to explain all aspects of operation and maintenance.
- E. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, and maintenance, and shutdown of each item at agreed upon scheduled time and at equipment or designated location.
- F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during demonstration.
- G. Starting and adjusting equipment does not constitute acceptance by the owner since commissioning is a requirement of this contract. Additionally, the warrantee does not begin until substantial completion has been granted for that specific item.

1.5 TESTING, ADJUSTING, AND BALANCING

- A.** The Contractor will employ and pay for the testing services of an independent consultant to verify the testing, adjusting, and balancing.
 - 1. Comply with the requirements of Division 01 Section 01 91 00 "Commissioning" as they relate to the Work of this Section.
- B.** Reports will be submitted by the independent testing consultant to the Construction Administrator indicating observations and results of tests and indicating compliance or non-compliance with the requirements of the Contract Documents.
- C.** The Owner may employ and pay for the services of an independent consultant to verify testing, adjusting, and balancing which was performed by the Contractor.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 75 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Project record document submittal.
 - 3. Operation and maintenance manual submittal.
 - 4. Submittal of warranties.
 - 5. Final cleaning.
- B. **Related Sections:** The following Sections contain requirements that relate to this Section:
 - 1. Division 01 Section 01 11 00 "Summary of Work".
 - 2. Division 01 Section 01 29 76 "Progress Payment Procedures".
- C. Closeout requirements for specific construction activities may be included in the appropriate Sections in Divisions 02 through 49.

1.3 SUBSTANTIAL COMPLETION

- A. **General:** Basic contract definitions are included in Article 1 of the General Conditions of the Contract for Construction.
- B. **Preliminary Procedures:** Before requesting inspection for Certification of Substantial Completion, complete the following. List exceptions in the request.
 - 1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete.
 - a. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
 - b. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.
 - 2. Advise the Owner of pending insurance changeover requirements.
 - 3. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications, and similar documents.
 - 4. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, certificates of compliance, operating certificates, and similar releases.
 - 5. Submit record drawings, maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 6. Deliver tools, spare parts, extra stock, and similar items.
 - 7. Make final changeover of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of changeover in security provisions.
 - 8. Demonstrate, thru operation and testing, the functions of all systems and/or equipment to the satisfaction of the Owner for compliance to the Contract. Complete testing of systems and instruction of the Owner's operation and maintenance personnel. Discontinue and remove temporary facilities from the site, along with mockups, construction tools, and similar elements.
 - 9. Complete final cleanup requirements.
 - 10. Certify that required training of personnel is complete.

- C. **Inspection Procedures:** The Contractor shall be ready and prepared when they request a Substantial Completion inspection. If the inspection reveals that the work is not complete, that there are extensive punchlist items that will take more than thirty (30) days to complete and as the items listed in Article 1.3 above are not complete, the Construction Administrator, Architect, and Owner will determine the inspection has failed.
- D. The Contractor is responsible for all costs to re-inspect due to a failed inspection. The Owner will issue a deduct change order to cover all costs for re-inspection.
 - 1. The Architect will repeat inspection when requested and assured that the Work is substantially complete.
 - 2. Results of the completed inspection will form the basis of requirements for final acceptance.

1.4 ACCEPTANCE

- A. **Preliminary Procedures:** Before requesting final inspection for "Certificate of Acceptance" and final payment, complete the following. List exceptions in the request.
 - 1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and completed operations where required.
 - 2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
 - 3. Submit a certified copy of the Architect's final inspection list of items to be completed or corrected, endorsed and dated by the Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by the Architect.
 - 4. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the date of Substantial Completion or when the Owner took possession of and assumed responsibility for corresponding elements of the Work.
 - 5. Submit consent of surety to Final Payment.
 - 6. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 - 7. Touch up and otherwise repair and restore marred, exposed finishes, including touchup painting.
- B. **Re-inspection Procedure:** The Inspection Group will re-inspect the Work upon receipt of notice from the Construction Administrator that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to the Owner.
 - 1. Upon completion of re-inspection, the Construction Administrator will prepare a Certificate of Acceptance. If the Work is incomplete, the Construction Administrator will advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.

1.5 AS-BUILT DOCUMENT SUBMITTALS

- A. **General:** The Contractor shall not use As-built Drawings for construction purposes. Protect contractor As-built Drawings from deterioration and loss in a secure, fire-resistant location. Provide access to As-built Drawings for the Architect's reference during normal working hours. Keep documents current; do not permanently conceal any work until required information has been recorded. **IMPORTANT NOTE: Failure to keep As-built Documents current is sufficient cause to withhold progress payments.**
 - 1. The Contractor shall also hire the services of a Surveyor registered in the State of Connecticut to conduct a final survey to determine the location of exterior underground utility lines and to record the results, and update existing electronic media.
 - 2. The record of exterior underground utilities shall be made at the time of installation on Mylar film drawing and AutoCAD (latest version) compatible disks. The drawing shall bear the seal of the Land Surveyor and a statement of accuracy.
- B. **As-built Drawings:** The Contractor shall maintain **one (1)** clean, complete undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark which drawing is most capable of showing conditions fully and accurately. Where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date. Update As-built Drawings on a monthly basis coincident with the submittal of the Application for Payment.
 - 1. Mark record sets with erasable pencil to distinguish between variations in separate categories of the Work.
 - 2. Mark all new information that is not shown on Contract Drawings.

3. Note related change-order numbers where applicable.
 4. Organize record drawing sheets into manageable sets. Bind sets with durable-paper cover sheets; print suitable titles, dates, and other identification on the cover of each set.
 5. Upon completion of the work, the Contractor shall submit Record Drawings to the Construction Administrator for the Owner's Records who will pass them on to the Architect or Engineer for transferring the changes to the Record Drawing.
 6. Submit electronic format data of all Coordination Drawings as required by the Owner, at no additional cost.
 7. Refer to Section 01 45 00 "Quality Control" Article 1.3 for required as-built drawings and specifications for fire alarm systems.
- C. Record Specifications:** The Contractor shall maintain one (1) complete copy of the Project Manual, including Addenda. Include with the Project Manual one (1) copy of other written construction documents, such as Change Orders and modifications issued in printed form during construction.
1. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications.
 2. Give particular attention to equals and substitutions and selection of options and information on concealed construction that cannot otherwise be readily discerned later by direct observation.
 3. Note related record drawing information and Product Data.
 4. Upon completion of the Work, submit Record Specifications to the Construction Administrator for the Owner's records.
- D. Record Product Data:** The Contractor shall maintain one (1) copy of each Product Data submittal. Note related Change Orders and markup of record drawings and Specifications.
1. Mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the site and from the manufacturer's installation instructions and recommendations.
 2. Give particular attention to concealed products and portions of the Work that cannot otherwise be readily discerned later by direct observation.
 3. Upon completion of markup, submit complete set of Record Product Data to the Construction Administrator for the Owner's records.
- E. Record Sample Submitted:** Immediately prior to Substantial Completion, the Contractor shall meet with the Construction Administrator, Architect and the Owner's personnel at the Project Site to determine which Samples are to be transmitted to the Owner for record purposes. Comply with the Owner's instructions regarding delivery to the Owner's Sample storage area.
- F. Miscellaneous Record Submittals:** Refer to other Specification Sections for requirements of miscellaneous record keeping and submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order. Identify miscellaneous records properly and bind or file, ready for continued use and reference. Submit to the Construction Administrator for the Owner's records.
- G. Maintenance Manuals:** Organize operation and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual, heavy-duty, 2-inch, 3-ring, vinyl-covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder according to Division 01 Section 01 78 23 "Operation & Maintenance Data". Included but not limited to the following types of information:
1. Emergency instructions.
 2. Spare parts list.
 3. Copies of warranties.
 4. Wiring diagrams.
 5. Recommended "turn-around" cycles.
 6. Inspection procedures.
 7. Shop Drawings and Product Data.

DUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES

A. Operation and Maintenance Instructions: Arrange for each Installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. Provide instruction by manufacturer's representatives if installers are not experienced in operation and maintenance procedures. Include a detailed review of the following items:

1. Maintenance manuals.
2. Record documents.
3. Spare parts and materials.
4. Tools.
5. Lubricants.
6. Identification systems.
7. Control sequences.
8. Hazards.
9. Cleaning.
10. Warranties and bonds.
11. Maintenance agreements and similar continuing commitments.

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

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

3.2 FINAL CLEANING

A. General: The General Conditions require general cleaning during construction. Regular site cleaning is included in Division 01 Section 01 50 00 "Temporary Facilities and Controls."

B. Cleaning: Employ professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.

1. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion and Certification of Occupancy.
2. Interior:
 - a. Remove labels that are not permanent labels.
 - b. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Remove paint spots; wash and polish glass.
 - c. Clean exposed interior hard-surfaced finishes to a dust-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original condition. Leave concrete floors broom clean. Vacuum carpeted surfaces.
 - d. Wash washable surfaces of mechanical, electrical equipment and fixtures and replace filters, clean strainers on mechanical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.

- e. Clean and polish finish hardware.
 - f. Clean and polish tile and other glazed surfaces.
 - g. Clean floors; wax and buff resilient tile. Clean vinyl or rubber base.
 - h. Vacuum and/or dust walls, ceilings, lighting fixtures, ceiling diffusers and other wall and ceiling items.
 - i. Remove defacements, streaks, fingerprints and erection marks.
3. Exterior:
- a. Clean the site, including landscape development areas, of rubbish, litter, and other foreign substances. Sweep paved areas broom clean; remove stains, spills, and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth, even-textured surface.
 - b. Clean exposed exterior hard-surfaced finishes to a dust-free condition, free of stains, films, and similar foreign substances.
 - c. Clean roofs, gutters and downspouts.
 - d. Remove waste and surplus materials, rubbish and construction equipment and facilities from the site, and deposit it legally elsewhere.
 - e. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Remove paint spots; wash and polish glass.
- C. Pest Control:** Engage an experienced, licensed exterminator to make a final inspection and rid the work of rodents, insects, and other pests. Provide results of final inspection in writing.
- D. Removal of Protection:** Remove temporary protection and facilities installed for protection of the Work during construction.
- E. Compliance:** Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the site and dispose of lawfully.
- 1. Where extra materials of value remain after completion of associated Work, they become the Owner's property. Dispose of these materials as directed by the Construction Administrator.
 - 2. Leave building clean and ready for occupancy. If the Contractor fails to clean up, the Owner may do so, with the cost charged to the Contractor. The Owner will issue a credit change order to cover the costs.

END OF SECTION 01 77 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 00 General Conditions and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for operation and maintenance manuals, including the following:
1. Preparing and submitting operation and maintenance manuals for building operating systems and equipment.
 2. Preparing and submitting instruction manuals covering the care, preservation, and maintenance of architectural products and finishes.
- B. **Related Sections:** The following Sections contain requirements that relate to this Section:
1. Division 01 Section 01 33 00 "Submittal Procedures" specifies preparation of Shop Drawings and Product Data.
 2. Division 01 Section 01 75 00 "Starting and Adjusting" specifies instruction of the Owner and Agency operating personnel in the operation and maintenance of building systems and equipment and the general requirements for starting-up equipment and systems.
 3. Division 01 Section 01 77 00 "Closeout Procedures" specifies general closeout requirements.
 4. Division 01 Section 01 78 30 "Warranties and Bonds" specifies requirements for submittal of warranties and bonds.
 5. Appropriate Sections of Divisions 02 through 49 specify special operation and maintenance data requirements for specific pieces of equipment or building operating systems.

1.3 QUALITY ASSURANCE

- A. **Maintenance Manual Preparation:** In preparation of maintenance manuals, use personnel thoroughly trained and experienced in operation and maintenance of equipment or system involved.
1. Where maintenance manuals require written instructions, use personnel skilled in technical writing where necessary for communication of essential data.
 2. Where maintenance manuals require drawings or diagrams, use draftsmen capable of preparing drawings clearly in an understandable format.
- B. **Instructions for the Owner and Agency Personnel:** The Construction Manager must use experienced instructors thoroughly trained and experienced in operation and maintenance of equipment or system involved, to instruct the Owner's operation and maintenance personnel.
- C. **Commissioning (Cx) Coordination:** The Commissioning process requires detailed O&M documentation. The Contractor must submit O&M manuals to the Construction Administrator for review and approval by Commissioning Agent (CxA).

1.4 SUBMITTALS

- A. **Submittal Schedule:** Comply with the following schedule for submitting operation and maintenance manuals:
1. Before Substantial Completion, when each installation that requires operation and maintenance manuals is nominally complete, submit four (4) draft copies of each manual to the Owner's Representative, Commissioning Agent (CxA), Agency Representative, and Architect for review. Include a complete index or table of contents of each manual.
 - a. The Owner's Representative will return one (1) copy of the draft with comments within twenty - one (21) calendar days of receipt.
 - b. Submit two (2) copies of data in final form at least twenty-one (21) calendar days before final inspection. The Owner's Representative will return **one (1)** copy within **twenty-one (21)** calendar after final inspection, with comments.
 2. After final inspection, make corrections or modifications to comply with the Commissioning Agent's (CxA), Architect's, and Agency Representative's comments. Submit final copies to the Owner's Representative

within twenty-one (21) calendar days of receipt of the Commissioning Agent's (CxA), Architect's, and Agency Representative's comments.

- B. Form of Submittal:** Prepare operation and maintenance manuals in the form of an instructional manual for use by the Owner's operating personnel. Organize into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder.
- 1. Binders:** For each manual, provide heavy-duty, commercial-quality, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to receive **8-1/2-by-11- inch** paper. Provide a clear plastic sleeve on the spine to hold labels describing contents. Provide pockets in the covers to receive folded sheets.
 - 2. Dividers:** Provide heavy paper dividers with celluloid-covered tabs for each separate section. Mark each tab to indicate contents. Provide a typed description of the product and major parts of equipment included in the section on each divider.
 - 3. Protective Plastic Jackets:** Provide protective, transparent, plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
 - 4. Text Material:** Where maintenance manuals require written material, use the manufacturer's standard printed material. If manufacturer's standard printed material is not available, provide specially prepared data, neatly typewritten, on 8-1/2-by-11-inch, 20-lb/sq ft white bond paper.
 - 5. Drawings:** Where maintenance manuals require drawings or diagrams, provide reinforced, punched binder tabs on drawings and bind in with text.
 - a.** Where oversize drawings are necessary, fold drawings to the same size as text pages and use as a foldout.
 - b.** If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in front or rear pocket of binder. Insert a typewritten page indicating drawing title, description of contents, and drawing location at the appropriate location in the manual.

1.5 MANUAL CONTENT

- A.** In each manual include information specified in the individual Specification Section and the following information for each major component of building equipment and its controls:
1. General system or equipment description.
 2. Design factors and assumptions.
 3. Copies of applicable shop drawings and product data.
 4. System or equipment identification, including:
 - a. Name of manufacturer.
 - b. Model number.
 - c. Serial number of each component.
 5. Operating instructions.
 6. Emergency instructions.
 7. Wiring diagrams.
 8. Inspection and test procedures.
 9. Maintenance procedures and schedules.
 10. Precautions against improper use and maintenance.
 11. Copies of warranties.
 12. Repair instructions including spare parts listing.
 13. Sources of required maintenance materials and related services.
 14. Manual index.
- B.** Organize each manual into separate sections for each piece of related equipment. As a minimum, each manual shall contain a title page; a table of contents; copies of product data, supplemented by drawings and written text; and copies of each warranty, bond, and service contract issued.
- 1. Title Page:** Provide a title page in a transparent, plastic envelope as the first sheet of each manual. Provide the following information:

- a. Subject matter covered by the manual.
 - b. Name and address of the Project.
 - c. Date of submittal.
 - d. Name, address, and telephone number of the Construction Manager.
 - e. Name and address of the Architect and Owner's Representative.
 - f. Cross-reference to related systems in other operation and maintenance manuals.
2. **Table of Contents:** After title page, include a typewritten table of contents for each volume, arranged systematically according to the Project Manual format. Include a list of each product included, identified by product name or other appropriate identifying symbol and indexed to the content of the volume.
 3. Provide a general information section immediately following table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the subcontractor or Installer and the maintenance subcontractor. Clearly delineate the extent of responsibility of each of these entities. Include a local source for replacement parts and equipment.
 4. **Product Data:** Where the manuals include manufacturer's standard printed data, include only sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where the Project includes more than one (1) item in a tabular format, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation, and delete references to information that is not applicable.
 5. **Written Text:** Prepare written text to provide necessary information where manufacturer's standard printed data is not available, and the information is necessary for proper operation and maintenance of equipment or systems. Prepare written text where it is necessary to provide additional information or to supplement data included in the manual. Organize text in a consistent format under separate headings for different procedures. Where necessary, provide a logical sequence of instruction for each operation or maintenance procedure.
 6. **Drawings:** Provide specially prepared drawings where necessary to supplement manufacturer's printed data to illustrate the relationship of component parts of equipment or systems or to provide control or flow diagrams. Coordinate these drawings with information contained in project record drawings to assure correct illustration of the completed installation.
 - a. Do not use original Record Documents as part of operation and maintenance manuals.
 7. **Warranties and/or Bonds:** Provide a copy of each warranty and/or bond in the appropriate manual for the information of the Owner's operating personnel. Provide written data outlining procedures to follow in the event of product failure. List circumstances and conditions that would affect validity of warranty or bond.

1.6 MATERIAL AND FINISHES MAINTENANCE MANUAL

- A. Submit four (4) copies of each manual, in final form, on material and finishes to the Owner's Representative for distribution. Provide one (1) section for architectural products, including applied materials and finishes. Provide a second section for products designed for moisture protection and products exposed to the weather.
 1. Refer to individual Specification Sections for additional requirements on care and maintenance of materials and finishes.
- B. **Architectural Products:** Provide manufacturer's data and instructions on care and maintenance of architectural products, including applied materials and finishes.
 1. **Manufacturer's Data:** Provide complete information on architectural products, including the following, as applicable:
 - a. Manufacturer's catalog number.
 - b. Size.
 - c. Material composition.
 - d. Color.
 - e. Texture.
 - f. Reordering information for specially manufactured products.
 2. **Care and Maintenance Instructions:** Provide information on care and maintenance, including manufacturer's recommendations for types of cleaning agents to be used and methods of cleaning.

Provide information on cleaning agents and methods that could prove detrimental to the product. Include manufacturer's recommended schedule for cleaning and maintenance.

- C. Moisture Protection and Products Exposed to the Weather:** Provide complete manufacturer's data with instructions on inspection, maintenance, and repair of products exposed to the weather or designed for moisture-protection purposes.
- 1. Manufacturer's Data:** Provide manufacturer's data giving detailed information, including the following, as applicable:
 - a. Applicable standards.
 - b. Chemical composition.
 - c. Installation details.
 - d. Inspection procedures.
 - e. Maintenance information.
 - f. Repair procedures.

1.7 EQUIPMENT AND SYSTEMS MAINTENANCE MANUAL

- A.** Submit two (2) copies of each manual, in final form, on equipment and systems to the Owner's Representative for distribution. Provide separate manuals for each unit of equipment, each operating system, and each electric and electronic system.
- 1.** Refer to individual Specification Sections for additional requirements on operation and maintenance of the various pieces of equipment and operating systems.
- B. Equipment and Systems:** Provide the following information for each piece of equipment, each building operating system, and each electric or electronic system.
- 1. Description:** Provide a complete description of each unit and related component parts, including the following:
 - a. Equipment or system function.
 - b. Operating characteristics.
 - c. Limiting conditions.
 - d. Performance curves.
 - e. Engineering data and tests.
 - f. Complete nomenclature and number of replacement parts.
 - 2. Manufacturer's Information:** For each manufacturer of a component part or piece of equipment, provide the following:
 - a. Printed operation and maintenance instructions.
 - b. Assembly drawings and diagrams required for maintenance.
 - c. List of items recommended to be stocked as spare parts.
 - 3. Maintenance Procedures:** Provide information detailing essential maintenance procedures, including the following:
 - 4. Operating Procedures:** Provide information on equipment and system operating procedures, including the following:
 - a. Startup procedures.
 - b. Equipment or system break-in.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Instructions on stopping.
 - f. Shutdown and emergency instructions.
 - g. Summer and winter operating instructions.
 - h. Required sequences for electric or electronic systems.
 - i. Special operating instructions.

5. **Servicing Schedule:** Provide a schedule of routine servicing and lubrication requirements, including a list of required lubricants for equipment with moving parts.
 6. **Controls:** Provide a description of the sequence of operation and as-installed control diagrams by the control manufacturer for systems requiring controls.
 7. **Identification Drawings:** Provide each Subcontractor's Identification Drawings.
 - a. Provide as-installed, color-coded, piping diagrams, where required for identification.
 8. **Valve Tags:** Provide charts of valve-tag numbers, with the location and function of each valve.
 9. **Circuit Directories:** For electric and electronic systems, provide complete circuit directories of panel boards, including the following:
 - a. Controls.
 - b. Communication.
- C. Electronic Media:**
1. For equipment which requires maintenance by operational personnel, provide a professionally developed video for the use of maintenance training for the facility. Each video will be accompanied by a written index which can be utilized to find any specific item of information by time or place on the video.
 2. The Construction Manager is responsible for this production. This video will be provided to the Owner's Representative at the same time as the delivery of the other maintenance material.
 3. The video must be able to be edited for future changes to the equipment and modifications as they occur.
 4. Video to be provided on a USB flash drive media.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 78 23

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for warranties required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.
 - 1. Refer to the General Conditions for terms of the Contractor's period for correction of the Work.
- B. **Related Sections:** The following Sections contain requirements that relate to this Section:
 - 1. Division 01 Section 01 33 00 "Submittal Procedures" specifies procedures for submitting warranties.
 - 2. Division 01 Section 01 77 00 "Closeout Procedures" specifies contract closeout procedures.
 - 3. Division 01 Section 01 78 23 "Operation and Maintenance Data" specifies required operation and maintenance data.
 - 4. Divisions 02 through 49 Sections for specific requirements for warranties on products and installations specified to be warranted.
 - 5. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.
- C. **Disclaimers and Limitations:** Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products. Manufacturer's disclaimers and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

1.3 WARRANTY REQUIREMENTS

- A. **Related Damages and Losses:** When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.
- B. **Reinstatement of Warranty:** When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C. **Replacement Cost:** Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
- D. **Owner's Recourse:** Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, or remedies.
 - 1. **Rejection of Warranties:** The Owner reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
- E. Where the Contract Documents require a special warranty, or similar commitment on the Work or part of the Work, the Owner reserves the right to refuse to accept the Work, until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.
- F. The Contractor shall guarantee all materials and workmanship for a period of **eighteen (18)** months from the date of Substantial Completion of the Work. In addition, the Contractor shall furnish the warranties listed below. Submit four (4) copies of each to the Construction Administrator in the supplier's standard form or in the form given below if there is no standard form available.
- G. **Specification/Warranty Table:** The General Contractor shall provide for all warranties as shown in the Specification/Warranty table:

Specification / Warranty Table		
Item No.	Section No.	Specification Product/Warranty
1	22 15 19	Compressors and Pumps:
		5 years, material and installation,
		24 months, material and installation, and growth.

- H. Submit certification that finish materials are fire rated as specified.

J. Form of Warranty: Warranties shall be submitted in following format:

<p style="text-align: center;">Warranty</p> <p style="text-align: center;"><i>The Adjutant General: Francis J. Evon, Jr.</i> <i>Military Department</i> <i>Construction & Facilities Maintenance Office</i> <i>360 Broad Street, Room 329</i> <i>Hartford, CT 06105</i></p> <p style="text-align: center;"><i>Project Number: 25MIL23702</i> <i>Project Title: CSMS Compressor Replacement – Camp Hartell, Windsor Locks, CT</i></p> <p style="text-align: center;"><i>I (We) hereby warranty</i></p> <p>the _____ work on the referenced project for a period of _____ years from _____, 20 _____ against failures of workmanship and materials in accordance with the requirements of Section _____, Page _____, Paragraph _____, of the Specifications.</p> <p>Installer <input type="checkbox"/> Subcontractor <input type="checkbox"/> Vendor/Suppliers <input type="checkbox"/> Manufacturer <input type="checkbox"/></p> <p><i>Installer or Subcontractor or Vendor/Suppliers or Manufacturer Name:</i> _____</p> <p><i>Installer or Subcontractor or Vendor/Suppliers or Manufacturer Signature:</i> _____</p> <p><i>General Contractor's Name</i> _____</p> <p><i>General Contractor's Signature:</i> _____</p> <p style="text-align: center;"><i>or</i></p> <p><i>General Contractor's Authorized Agent Signature:</i> _____</p>

- K. Bonds shall be by approved Surety Companies, made out to The Adjutant General (TAG), Military Department on companies' standard form.
- L. Warranties, Guarantees, or bonds supplied by the General Contractor's Subcontractors or Vendors/Suppliers or Manufacturers shall reference the project name, number, and location and be certified by the General Contractor to be for the product and installation on the project and must be countersigned by the General Contractor.
- M. Bonds shall be by approved Surety Companies, made out to The Adjutant General (TAG), Military Department, on company's standard form.
- N. Guarantees, warranties or bonds supplied by Subcontractors, Suppliers or Manufacturers shall reference the project name, number, and location and be certified by the Contractor to be for the product and installation on the project and must be countersigned by the Contractor.

1.4 SUBMITTALS

- A. Submit written warranties prior to the date certified for Substantial Completion. If the Architect's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Architect.
- B. Forms for special warranties are included in this Section. Prepare a written document utilizing the appropriate form, ready for execution by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Submit a draft to the Owner, through the Construction Administrator, for approval prior to final execution.

1. Refer to Divisions 02 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Bind warranties and bonds in heavy-duty, commercial-quality, durable 3-ring, vinyl-covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address, and telephone number of the Installer.
 2. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project title or name, and name of the Contractor.
 3. When warranted construction requires operation and maintenance manuals, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not applicable)

END OF SECTION 01 78 30

PART 1 - GENERAL

1.1 GENERAL

- A. Work of this section shall be governed by the Contract Documents. Provide materials, labor, equipment and services necessary to furnish, deliver and install all work of this Section as shown on the drawings, as specified herein, and/or as required by job conditions.
- B. Drawings are diagrammatic and indicate a general arrangement of work. General design concepts indicated must be followed or bettered. The bid shall include offsets, additional piping, valves and plumbing equipment and components as required to meet construction conditions for proper operation. Do not scale drawings. Consult Architectural and Structural drawings for space conditions and additional fixtures. Develop and submit coordination drawings as outlined in Division 22 sections.
- C. The work under this Section shall include all incidentals, labor, material, equipment, appliances, services, hoisting, scaffolding, supports, tools, consumable items, fees, licenses, and administrative tasks required to complete and make operable the plumbing work as intended.
- D. The Contractor shall furnish and install all equipment as necessary to provide a complete installation including coordination, system check out and start up on each item and system.
- E. This Contractor shall inform himself from the general construction specifications and plans, of the exact dimension of finished work and of the height of finished ceilings in all rooms where equipment or pipes are to be placed and arrange his work in accordance with the schedule of interior finishes, as indicated on the architectural drawings.
- F. Manufacturer's qualifications: firms regularly engaged in the manufacture of fixtures, appliances, pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- G. Material qualifications: shall conform to all local, state, and national/federal codes and regulations which may apply and nothing in these specifications shall be interpreted as an infringement of such codes or regulations.
- H. Welding: qualify welding procedures, welders, and operators in accordance with ASME B31.1, or ASME B31.9, as applicable. Certify welding of piping work using Standard Procedure Specifications by, and welders tested under supervision of, National Certified Pipe Welding Bureau (NCPWB).
- I. Brazing: certify brazing procedures, brazers, and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, for shop and job-site brazing of piping work.

1.2 LEAD-FREE STATEMENT

- A. Several plumbing fixtures described in this section fall under jurisdiction of the Federal Reduction of Lead in Drinking Water Act (42 USC 300G) which mandates that effective January 4, 2014 the wetted surfaces of any valve, fitting or fixture that comes in contact with potable water must have a weighted-average lead content of no more than 0.25 percent. The contractor shall be responsible for providing products that are Lead-Free products and meet the requirements of Safe Drinking Water Act Section 1417 (e) (Section 9 of NSF/ANSI Standard 61) and authorities having jurisdiction.

1.3 RELATED DOCUMENTS

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

1.4 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.

7. Grout.
8. Plumbing demolition.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.

1.5 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 2. CPVC: Chlorinated polyvinyl chloride plastic.
 3. PE: Polyethylene plastic.
 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 2. NBR: Acrylonitrile-butadiene rubber.

1.6 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.7 INTENT

- A. It is the intention of the specifications and drawings to provide for finished work, tested and ready for operation.
- B. Items and services not shown on drawings, but mentioned in specifications, or vice versa, or items and services necessary to render the work complete and ready for operation, even if not specified, shall be provided without additional cost.
- C. Where conflicts occur between drawings and specifications, or within either document, the Contractor shall ask for and obtain a written clarification from the Architect prior to submitting his bid. Otherwise, the items or arrangements of superior quality, greater quantity or higher cost shall prevail and be included in the contract price.

1.8 WORK INCLUDED

- A. The work under this Division shall include all labor, material, equipment plant, services and administrative tasks required to complete and make operable the mechanical work shown on the Drawings, required for proper operation and/or specified herein, including but not limited to, the following:
 - 1. Preparation and submission of shop drawings, diagrams and illustrations.
 - 2. Procuring all necessary permits and approvals, and paying all required fees and charges in connection with the work of this Division.
 - 3. Protection, testing, cleaning, adjustment and guarantee of the work of this Division to safely, properly and continuously operate.
 - 4. As-built drawings, operating and maintenance instructions and manuals.
 - 5. Identification labels, tags, charts and diagrams.
 - 6. Maintain existing services to plumbing, etc. (temporary services during construction).
 - 7. Coordination.
 - 8. Project record documents.
 - 9. Operation and Maintenance Data.
 - 10. Cutting and patching.

1.9 GENERAL CONFORMANCE

- A. Obtain all general conformances in accordance with Division 1 - General Requirements.
- B. Submit to the Architect for review a list of manufacturers of equipment proposed for the work. Intent to use exact make specified does not relieve the Contractor of responsibility for submitting the required list.
- C. Where any specific materials, process or method of construction, or manufactured article is specified by name or by reference to catalog number of a manufacturer, or other standards, the intent is not to take precedence over the basic duty and performance specified, noted on drawings, or as required for intended results. In all cases, verify the duty specified with the specific characteristics of the equipment offered for review.
- D. Equipment of one type, shall be products of one manufacturer.
- E. Private Label products, equipment and appurtenances shall not be permitted on this project.

1.10 PERMITS AND CERTIFICATES

- A. Prior to proceeding with any installation, prepare and submit to the proper authorities, for their review, all required working drawings. Provide all necessary notices, obtain all permits and pay all local, state and federal taxes, fees and other costs in connection with the work.
- B. The contractor shall be responsible for performing all controlled inspections required by applicable Administrative Building Code.

1.11 DRAWINGS

- A. Drawings are diagrammatic and indicate the general arrangement of systems and work required. Do not scale the Drawings. Consult the architectural drawings and details, and the drawings of other trades, for exact location of equipment.
- B. Drawings shall be used in layout of work. Check reference drawings to verify spaces in which the work will be installed. Maintain maximum headroom and space conditions. Where headroom or space conditions appear inadequate, Architect shall be notified before proceeding with installation.
- C. If directed by the Architect, make minor modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.
- D. The drawings are schematic and diagrammatic.
 - 1. Symbols and diagrams are used to indicate the various items of work and the complete systems, but not necessarily have dimensional significance, neither do they necessarily delineate all related and subsidiary parts and equipment.
 - 2. The work shall be installed complete and ready for operation in conformity with the intent expressed on the drawings and in the specifications.
 - 3. Coordinate the work with the requirements of the architectural and structural drawings for dimensions, locations and clearances.

4. Locations of items exposed to view shall be taken from the architectural drawings or located as directed.

1.12 EQUIPMENT DEVIATIONS

- A. It is the intent of these specifications that wherever a manufacturer of a product or a catalog number is specified, and terms "or equal" or "or approved equal" are used, the substituted item must conform in all essential respects to the specified item including operating efficiency, noise generated, and method of operation. Consideration will not be given claims that the substituted item meets performance requirements with lesser construction. Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance.
- B. When such approved deviation requires a different quantity and or arrangement of equipment from that specified or indicated on the drawings, provide required equipment, wiring, piping, connections, valves, and structural supports, and any other additional equipment required by the deviation, at no additional cost to the Owner.
- C. When an item of equipment is proposed, other than that detailed or specified on the drawings, which requires any additional equipment or redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical, plumbing or architectural design, such costs shall be incurred by the Contractor without cost to the Owner.
- D. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified at no cost to the Owner. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.13 EQUIPMENT AND SYSTEMS CRITERIA

- A. The criteria of design and performance to produce the required operation is based on equipment shown or scheduled.
 1. The equipment must conform to the structural design provisions for loads applied to the structure, to the dimensions established by drawings for mechanical spaces and other clearances, and for inlet and outlet locations and proper relationship to associated equipment and piping.
- B. The descriptions cover basic equipment and operation but not all the details of design and construction.
 1. The use of singular in descriptions does not limit the quantities of items to be furnished to provide the operation specified. Furnish all equipment required to produce specified performance under installed conditions.
 2. Factory wiring, interconnections, piping and connections shall conform to these specifications for the field work.
 3. Provide all trim, enclosures and accessories required to make a complete installation.

1.14 SUBMITTALS

- A. Procedure: Prepare and make the submissions listed below and in Division 1.
- B. Shop Drawings: Submit shop drawings of all items proposed to be furnished and installed under this Division.
- C. Manufacturer's Drawings.
 1. Equipment listed in each section, include material specifications, operating characteristics and finishes.
- D. Installation Drawings.
 1. Coordinated scale drawings of equipment including interconnecting piping and equipment.
 2. Coordinate space requirements for equipment and services.
 3. Include connections, anchorages and fastenings.
 4. Make allowance for clearances for access to and maintenance of equipment.
- E. Wiring and Control Diagrams.
 1. Electric wiring diagrams and automatic control diagrams and sequences of operation. The wiring diagrams must be complete and coordinated with the equipment actually installed.

- F. Provide composite shop drawings showing work of all related construction, when required to ensure full coordination and proper fitting of the work, and when directed by the Architect.
- G. Provide drawings showing dimensions and locations of concrete work required.
- H. Samples.
 - 1. Color samples for prefinished items.
- I. Reports:
 - 1. Manufacturer's certified pressure tests on vessels.
 - 2. Manufacturer's certified performance tests on operating equipment.
 - 3. Field pipe testing reports and certificates of approval.
 - 4. Welder's certificates and field test report.
 - 5. Field operating test results for operating equipment.
 - 6. Performance report on balancing of systems.
 - 7. Performance report and calculations for vibration isolation equipment.
 - 8. Manufacturer's certified reports on motorized equipment alignment and installation.
- J. If submissions of catalog cuts of standard manufactured items show different types, options, finishes, performance requirements, or variations, those features proposed shall be clearly identified.
 - 1. If any variations from the catalog description are proposed or required, such variations must be clearly noted on the cut.
 - 2. Shop drawings shall clearly indicate all details, sectional views, arrangements, working and erection dimensions, kinds and quality of materials and their finishes, and information necessary for proper checking and for fabrication and installation of the items, and shall include all information required for making connections to other work.
 - 3. Shop drawings shall be numbered consecutively, and drawings related to various units comprising a proposed assembly shall be submitted simultaneously so that units may be checked individually and as an assembly.
 - 4. Keep on the site, in good order, a complete up-to-date set of approved shop drawings. All shop drawings shall be available for inspection by the Architect.
 - 5. On product data submittals, clearly indicate model numbers, dimensions, weights, electrical requirements, accessories and performance data. Submittals not properly prepared will be rejected without further review.
 - 6. The review of shop drawings will be general, and shall not be construed as permitting any departure from the contract requirements other than those specifically brought to the Architect's attention and so approved.
 - a. If the shop drawings show any variations from contract requirements because of standard shop practices or reasons, such variations shall be clearly identified on the drawings in order that, if acceptable, suitable action may be taken for proper adjustment in other work affected thereby.
 - b. Failure to identify such variations will not relieve the Contractor of responsibility for executing the work in accordance with the Contract even though such shop drawings have been reviewed and the work installed.
 - c. Review shall not relieve the Contractor of responsibility for any error in details, dimensions, etc., that may exist on shop drawings nor for the furnishing of materials or work required by the Contract and not indicated on the shop drawings.
 - d. Review shall not be construed as acceptable departure from details or instructions previously furnished by the Architect.
 - e. Review with a requirement for resubmission is a review contingent upon satisfactory resubmission within 30 days. Failure to comply shall result in a revocation of the contingent review.
- K. Shop Drawing Schedule
 - 1. The Contractor shall submit, within 30 days of the award of his contract, a schedule of all proposed shop drawing submissions.
 - 2. The schedule shall include the following information.
 - a. Item to be submitted
 - b. Date of submission
 - c. Latest date for review
 - d. Manufacturers of the specified item.

3. Items not specifically listed as "approved equal" should be listed for consideration at this time.
 4. Shop drawings require a minimum of 10 business days from the date they have been received by the Consulting Engineer's office to adequately review the submittal. If there is any submittal which requires to be expedited sooner than the 10 business days, the Engineer shall be informed in writing at the beginning of construction with a list of those submittals.
- L. Submittals will be reviewed for conformance with the contract drawings and specifications. The engineer's review stamp will be affixed to submittals. One of the following actions will be taken:
1. Reviewed:
 - a. No comments, corrections, or marks have been made to the submittal. Re-review by the engineer is not required. The submittal is in general conformance with the design concept. Construction, fabrication and/or manufacture can proceed subject to the provision that the work shall be in accordance with the requirements of the Contract Documents. Final acceptance of the work shall be contingent upon such compliance.
 2. Furnish As Corrected
 - a. Comments, corrections, or marks made. Re-review is not required. Submission is in general conformance with the design concept subject to notations on the returned Submittal. Construction, fabrication, and/or manufacturer can proceed subject to the provisions that the work shall be carried out in compliance with all annotations and/or corrections indicated on the returned Submittal and in accordance with the Contract Documents. Final acceptance of the work shall be contingent on such compliance.
 3. Revise and Resubmit
 - a. Significant issues/discrepancies/incomplete information was provided in the Submittal. Revise or prepare a new submittal in accordance with the notations and Contract Documents. Resubmit without delay.
 4. Rejected
 - a. Submittal does not meet Contract document intent. Revise or prepare a new submittal in accordance with the notations and Contract Documents. Resubmit without delay.
- M. A submittal review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections or comments made on the shop drawings during this review do not relieve the contractor from Compliance with the requirements of the plans and specifications. Approval of a specific item shall not include approval of an assembly of which the item is a component. The contractor is responsible for: dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences and procedures of construction; coordination of his or her work with that of all other trades; and for performing all work in a safe and satisfactory manner.

1.15 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.16 COORDINATION WITH OTHER TRADES

- A. Closely schedule the work so that work will be installed at the proper time without delaying the completion of the entire project.
- B. Where the work will be installed in close proximity to the work of other trades, or where there is evidence that the work will interfere with the work of other trades, arrange space conditions to make a satisfactory adjustment. If work is installed before coordinating with other trades, make necessary changes to the work to correct the condition without additional cost to the owner.

- C. Prepare complete set of drawings showing all necessary slab openings and structural supports that require structural framing. Drawings shall clearly indicate sizes and location relative to established column lines. Drawings shall be completed in sufficient time to allow for structural steel fabrication so as not to delay project schedule.
- D. Shop drawing submissions shall demonstrate a knowledge of the work of other trades, and shall show the locations of the work of other trades which affects the work of this contract.

1.17 COORDINATION DRAWINGS

- A. Develop and submit coordination drawings as outlined.
- B. Sheet metal, plumbing and fire protection shop drawings that have been coordinated with architectural and structural drawings shall be submitted to engineer for review. Drawings must be returned from engineer either "reviewed" or "furnish as corrected" prior to being used as basis for coordination drawings.
- C. After sheet metal and piping drawings have been revised per engineers comments, reproducible copies shall be sent to the others trades in the following sequence for the inclusion of their work:
 - 1. Mechanical sheet metal
 - 2. Plumbing contractor
 - 3. Electrical work
 - 4. Mechanical piping
 - 5. Sprinkler piping
- D. After all trades have included their work on the coordination drawing and noted conflicts, all trades shall meet to resolve conflicts and agree to acceptable solutions. Each trade shall sign coordination drawings. Items not shown on coordination drawing is responsibility of omitting contractor and contractor is subject to additional costs incurred by other trades.
- E. The architect and engineer are not part of the coordination drawing process. The engineer will provide assistance for noted conflicts only. Coordination drawings are not to be considered piping or duct shop drawings. The contractor is required to submit individual piping and ductwork shop drawings for review by the engineer. Piping and ductwork shop drawings shall follow the design intent of the contract documents.
- F. Submit final signed coordination drawing to engineer for review. Engineer will review coordination drawings for general arrangement and for noted conflicts only. Specific installation requirements will be reviewed only in individual trade shop drawings.
- G. Any work fabricated or installed prior to sign off by all trades which is deemed to be in conflict with coordination drawings shall be removed and re-installed in conformance with coordination drawings.
- H. Each contractor (mentioned above) is responsible for the coordination of his sub-contractors.
- I. The overall coordination of the coordination process is the responsibility of the contractor. The engineer is not responsible for the coordination process. The engineer will respond to questions that arise from the coordination process. Drawings submitted will be reviewed for clearly identified conflicts only. Solutions to conflicts will not bear additional cost.
- J. Drawings shall be submitted in both hard copy and electronic (AutoCAD or Revit version as required by the Owner) version or AutoCAD Version 2010 if not specified. Number of copies of each as requested by the Owner.
- K. Electronic drawing files shall be generated by the Contractor. If requested, electronic files of the mechanical floor plans, sections and elevations only will be made available. Electronic files will be released only upon receipt of the signed Agreement for Transfer of Electronic File Data, Agreement for Transfer of Building Information Model and all fees indicated therein.

1.18 AS-BUILT/RECORD DRAWINGS

- A. Provide a complete set of as-built drawings reflecting as installed conditions. As-built drawings shall indicate all installed conditions of systems within this discipline. Drawings shall be of similar scale as the construction documents and include details as necessary to clearly reflect the installed condition. Drawings shall be bound in a complete and consecutive set. Supplemental sketches and loose paperwork will not be acceptable and will be returned for revision. The contractor shall comply with the engineer's comments to produce a clear and concise set of drawings.

- B. Provide "as-built drawings" indicating in a neat and accurate manner a complete record of all revisions of the original design of the work.
- C. Drawings shall be submitted in both hard copy and electronic (AutoCAD and Revit version as required by the Owner) version or AutoCAD Version 2010 if not specified. Number of copies of each as requested by the Owner. PDF's inserted into an AutoCad file are not acceptable.
 - 1. Indicate the following installed conditions:
 - a. Include all changes and an accurate record, on reproductions of the contract drawings or appropriate shop drawings, of all deviations, between the work shown and work installed.
 - b. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart.
 - c. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - d. Approved substitutions, contract modifications, and actual equipment and materials installed.
 - e. Contract modifications, actual equipment and materials installed.
 - f. Submit for review bound sets of the required drawings, manuals and operating instructions.
 - g. Submit a complete maintenance manual of all equipment installed under this contract.

1.19 GUARANTEES AND SERVICES

- A. All workmanship, installation materials and equipment shall be maintained and serviced for the guarantee period at no additional cost to the Owner.
- B. Leave entire system installed under this Contract in perfect working order, and, without additional charge, replace any work or material which develops defects within the guarantee period, including all other work damaged as a result of such defects.
- C. Manufacturers' Warranties
 - 1. The manufacturer shall warrant that the equipment which he has furnished is free from defects in material and workmanship. Obligations under this warranty shall be as follows:
 - a. The equipment manufacturer or supplier shall provide and pay for all labor, parts, accessories, materials, freight and other services to repair or replace any equipment or part thereof which, in the course of installation, start-up and testing is found to be defective.
 - b. For a period of eighteen months from the date of acceptance by the Owner, the manufacturer shall replace any defective equipment or part thereof; freight costs for return of defective parts, labor for parts replacement, and replacement of lost refrigerant, are the responsibility of the installing contractor.
 - c. The manufacturer shall provide an additional warranty on all equipment as indicated in their respective specification section.
 - d. Performance - where equipment is specified by size, guarantee that it will have the capacity specified in the system in which it is installed.
 - 2. The final acceptance of the equipment will be made after the manufacturer has adjusted his equipment, balanced the various systems, demonstrated that it fulfills the requirements of the drawings and specifications, and has furnished all the required certificates of inspection and acceptance.

1.20 SYSTEM MAINTENANCE

- A. Contractor shall provide routine and preventive maintenance during the warranty period.
- B. Contractor shall submit to Engineer for review a comprehensive plan covering items to be maintained and service to be performed. Plan shall include checklist for use by maintenance personnel.
- C. Owner's representative(s) shall accompany contractors' maintenance personnel, and receive instructions on proper maintenance of equipment.
- D. Maintenance performed shall include a complete check out of each piece of equipment at least twice during warranty period. The first shall occur approximately half way through the warranty

period (change of season) and the second at the conclusion of the warranty period and prior to commencement of the owner's maintenance. Each system and/or piece of equipment shall be inspected, operated through its complete range of operation, and adjusted as required. This inspection shall be the same as performed at the initial start-up of the item or system. In addition, there shall be monthly maintenance inspections of each piece of equipment.

- E. During the monthly inspections, equipment shall be checked for items such as dirty filters, belt wear, lubrication, unusual sounds or unusual operating conditions. Monthly inspections shall also include recording of system operating temperatures and pressures.
- F. Contractor shall include all labor and material to perform the maintenance, including replaceable items such as filters and belts.
- G. Maintenance on the following items shall be included:
 - 1. Valves
 - 2. Air Compressors
 - 3. Dryers
 - 4. Filters

1.21 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In 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 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Furnish manufacturers operating and maintenance instructions, parts lists and sources of supply for replacements in accordance with Division 1 - General Requirements.
- B. Provide the following:
 - 1. Complete sets of final and correct shop drawings, maintenance and replacement parts manuals, and operating instructions, for equipment supplied.
 - 2. Bind each set within a common binder. Index and organize with a table of contents, to permit quick and convenient reference.
 - 3. Three days of instruction in operation and maintenance of equipment to Owner's maintenance force. Design a 2-week period, convenient to Owner, during which qualified personnel, including manufacturers' technicians and engineers will be available for Owner's instruction.
- C. Master Operating Manual (submit in duplicate and PDF – refer to DIV 00 and 01 requirements.)
 - 1. Complete sets of final and correct shop drawings, maintenance and replacement parts manuals, and operating instructions, for equipment supplied.
 - 2. Manufacturer's mechanical and electrical equipment parts lists of all components of the systems listed on the equipment schedules, control diagrams and wiring diagrams of controllers.
 - a. List shall give system number, unit number, manufacturer's model number, and manufacturer's drawing numbers.
 - 3. Step by step operating instructions for each system including preparation for starting, summer operation, winter operation, shutdown and draining.
 - 4. Maintenance instructions for each type of equipment.
 - 5. List of nearest local suppliers for all equipment.
 - 6. Manufacturer's literature describing each piece of equipment listed on the equipment schedules, control diagrams and wiring diagrams of controllers and a copy of the air balance report.
 - 7. As-installed control diagrams by the control manufacturer.

8. Description of sequence operation by the control manufacturer.
9. Recommended trouble shooting procedures in the event of foreseeable mechanical system failure.
10. Chart of the tag numbers, location and function of each valve.
11. Copies of the following test reports:
 - a. System Performance.
 - b. Required Pressure Tests.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. All underground piping shall be laid on a 6" sand bed and backfilled with clean fine earth compacted to 12" above pipe. Complete backfill with available earth free of large boulders and sharp rocks. Tamp backfill in 6" elevations and overfill to allow for settlement.
- D. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping to permit valve servicing.
- H. Install piping at indicated slopes.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install piping to allow application of insulation.
- L. Select system components with pressure rating equal to or greater than system operating pressure.
- M. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

- N. Verify final equipment locations for roughing-in.
- O. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

- A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- B. Thoroughly clean all surfaces, requiring prime painting, of rust, loose scale, oil and grease.
 - 1. Dry surfaces before painting.
 - 2. Do not paint controls, nameplates, or labels.

- C. Paint all equipment not painted at the factory with one prime coat.
- D. Provide field painting as follows:
 - 1. All exposed iron work, including uninsulated ferrous piping and conduit system components, hangers, supports, equipment bases, and apparatus; prime coat, red oxide primer.

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 of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.10 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.11 COORDINATION AND LAYOUT

- A. Study Drawings and Specifications to insure completeness of work required.
 - 1. Include supplementary items normal to manufacturers' requirements or standard accepted trade practices as necessary to complete work, though not specifically indicated or specified.
- B. Verify measurements and conditions in field before starting work.

- C. Examine materials to which work is to be applied and notify the Architect, in writing, of any conditions existing, which are detrimental to proper and expeditious installation of work.
 - 1. Starting of work shall be construed as acceptance of conditions.
- D. Confer with other trades, install work to avoid interference with other trades, and possible necessary adjustments to conform to structural conditions and work of other trades.
- E. Coordinate and set inserts and locate openings in floors and walls in new construction.
 - 1. Locate pipes to avoid interference with other work shown on the drawings and as directed by the Architect.
 - 2. Keep all concealed pipes within the enclosing construction provided.
 - 3. Arrange exposed work neatly in parallel runs and parallel with walls or structure, with uniformly spaced hangers and supports, and within the spaces assigned for each kind of work.
- F. Make coordinated layouts showing concrete work required for housekeeping pads, equipment bases and inertia masses, which are cast in place, including the location of anchors and dowels.
 - 1. Coordinate the scheduling and placing of the concrete to suit the mechanical work schedules.
 - 2. Concrete housekeeping pads are to cover the full area of each piece of equipment.
 - 3. Concrete bases are to be of dimension and heights to suit the equipment.
 - 4. The forming and placing of concrete will be provided under this specification section.

3.12 MAINTENANCE OF EQUIPMENT AND SYSTEM PRIOR TO FINAL ACCEPTANCE

- A. Maintain all equipment and systems installed until final acceptance by the Architect and the Owner, and take such measures as necessary to insure adequate protection of all equipment and materials during delivery, storage, installation and shut-down conditions.
 - 1. This responsibility shall include all provisions required to meet the conditions incidental to the delays pending final test of systems and equipment.
- B. After installation of systems has been completed, operate the system to determine the capability of the equipment and controls to conform to the requirements of the drawings and specifications prior to performance testing.

3.13 EQUIPMENT INSTALLATION

- A. Locate and set equipment anchor bolts, dowels and aligning devices for all equipment requiring them. Refer to concrete work coordination.
 - 1. Level the equipment and grout solid between the equipment and the surface below. Grout to be premixed Embeco or Five Star Grout mixed in accordance with manufacturer's specifications.
- B. The field assembly, installation and alignment of equipment is to be done under field supervision provided by the manufacturer or with inspections, adjustments and reviewed by the manufacturer.
- C. Equipment startup.
 - 1. Each manufacturer of equipment shall provide qualified personnel to inspect, review and to supervise the operating tests of the equipment.
- D. Equipment and system test operation.
 - 1. Notify the Architect in advance of beginning the equipment and system test operation.
 - 2. Each piece of equipment shall be operated in its system as long as required to provide proper functioning.
 - 3. Perform an operating test of each complete system for twenty-four hours continuous operation as a minimum, or as long as required to provide coordination and proper functioning of all related systems and controls.
 - 4. The operating criteria for each test shall be determined in advance with the Architect's acceptance whenever seasonal conditions will not produce a full design load on any equipment or system.
 - 5. Certify to the Owner that all equipment is functioning properly.
 - 6. Should the apparatus fail to meet the contract requirements, adjust, repair or replace all defective or inoperative parts and again conduct the complete performance tests.

3.14 CLEANING AND ADJUSTING

- A. Blow out, clean and flush each system of piping, and equipment as required to thoroughly clean the systems.
 - 1. Clean all materials and equipment, and leave in condition ready to operate and receive succeeding finishes where required.
 - 2. Adjust and align all equipment interconnected with couplings or belts.
 - 3. Adjust valves of all types and operating equipment of all types to provide proper operation.
 - 4. Clean all strainers.
- B. Lubricate equipment as recommended by the manufacturer, during temporary construction use, and provide complete lubrication just prior to acceptance.
- C. Permanent equipment operated during construction shall not be abused or be used in service different from its design application.
- D. Equipment furnished with factory finishes shall be retouched and repainted as required to present a new appearance.
- E. Provide and maintain protection for all of the work whether completed or in progress.
 - 1. Provide coverings and enclosures as required.
- F. New and existing operating equipment and systems shall be clean and dust free inside and out.
 - 1. Concealed and unoccupied areas such as plenums, pipe and duct spaces and Equipment Rooms shall be free of rubbish and swept clean at time of acceptance.

3.15 CONNECTIONS TO EQUIPMENT

- A. Provide mechanical connections to equipment and fixtures requiring such connections which are supplied by Owner or under other divisions.
- B. Provide unions, nipples, adapters, valves, flexible connections, and other trim required for final connections for each such fixture or item of equipment, as required for complete and perfect operation.

3.16 WORKMANSHIP

- A. Perform all work in a practical, neat and workmanlike manner with mechanics skilled in work, and using the best practices of the trade involved.
- B. No work shall be concealed until it has been inspected and approved by the Architect.
- C. Workmanship or materials not meeting with requirements of the specifications and drawings and satisfaction of the Architect shall be rejected and immediately replaced in an acceptable manner, without additional cost to the Owner.

3.17 LUBRICATION

- A. All equipment furnished, installed or connected under this division, shall be inspected for proper lubrication when connected and before operation of the equipment is begun.
- B. The Contractor for the work of this division will be held responsible for any damage to equipment that is operated without having been properly lubricated.

3.18 REMOVALS AND RELOCATIONS

- A. All components of abandoned systems and abandoned portions of systems shall be removed, and, unless specifically noted to be relocated and reused, become the Owner's property. Contractor shall dispose of removed materials as directed by the Owner.
- B. Where portions of systems noted for removal remain in use, permanently seal the point of disconnection so as not to interfere with the system operation.
- C. Where interferences between the existing system components and new work require relocation of the existing components to clear that interference, they may be reused, except where specifically noted to the contrary, providing that their condition is noted by the Owner's representative and they are approved by him as equivalent to new.
- D. Where existing system components are required to be replaced, all new components shall be provided.

- E. System components include all accessories, cables, controls, conduits, hangers, bases and supports and outlets.
- F. The work specified under this contract specifically excludes the removal or patching of "hazardous materials." This includes but is not limited to asbestos, PCBs or any other material having been designated by the Environmental Protection Agency as a hazardous material. If this contractor finds anything, which is suspected of being a hazardous material, it should be immediately brought to the Owner's attention.

3.19 USE OF PREMISES AND CLEANING

- A. Remove and dispose of all waste materials and rubbish due to all construction operations under the contract, except as otherwise noted, and keep the building free from rubbish and dirt caused by his and/or his subcontractors' employees.
 - 1. During the entire progress of the work, rubbish removal shall be made frequently so as to prevent any potential safety or health hazard.
- B. Upon completion of the work, remove all protection, paint, putty, and other stains from all fixtures and glass and leave the premises thoroughly broom cleaned.

3.20 CUTTING, ALTERING AND PATCHING

- A. Provide all cutting, chasing, drilling, altering and rough patching required for the work of this division.
 - 1. Including the restoring of existing work cut for or damaged by installation of new work, and where present work is removed.
 - 2. All materials and workmanship required in connection with cutting, altering and rough patching shall match the existing work in every respect.
- B. Do all shoring, bracing, cutting, patching, piecing out, filling in, repairing and refinishing of all present work as made necessary by the alteration and the installation of new work.
- C. All holes and openings occurring in the existing floors after equipment, partitions, floors, steel work, conduits and pipes are removed or installed shall be closed up with materials similar to the adjacent work.
- D. The size and location of items requiring an opening, chase or other provisions to receive it shall be given by the trade requiring same in ample time to avoid undue cutting of any new work to be installed. These provisions shall not relieve the Contractor from keeping informed as to the required opening, chases, etc., nor from responsibility for the correctness thereof, nor for cutting and repairing after the new work is in place.
- E. Include all cutting, repairing and patching in connection with the work that may be required to make the several parts come together properly and fit it to receive or be received by the work of other trades, as shown on the drawings and/or specified, or reasonably implied by the drawings and specifications.
- F. All repairing, patching, piecing-out, filling-in, restoring and refinishing shall be neatly done by mechanics skilled in their trade to leave same in condition satisfactory to the Owner.
- G. Materials and their methods of application for patching shall comply with applicable requirements of the specifications.
 - 1. Materials and workmanship not covered by the specifications and items of work exposed to view adjoining existing work to remain shall conform to similar materials and workmanship existing in or adjacent to the spaces to be altered.
- H. Cutting, repairing and patching shall include all items shown on the drawings, specified in the specifications or required by the installation of new work or the removal of existing work.
- I. Remove partitions, walls, suspended ceilings, etc., as necessary to perform the required alterations or new construction work.
 - 1. Avoid damage to construction and finishes that are to remain.
- J. Protect and be responsible for the existing building, facilities and improvements.
 - 1. Any disturbance or damage to the work, the existing building, and improvements, or any impairments of facilities resulting from the construction operations, shall be promptly rectified, with the disturbed, damaged, or impaired work, restored, repaired or replaced at no extra cost.

- K. All alterations which are not indicated on the drawings nor specified herein but necessary to make good existing work disturbed by reason of the work shall be restored to a condition satisfactory to the Owner.
- L. All holes in masonry floors and walls are to be core drilled.
- M. Disturbed concrete and /or cement floor areas shall be patched with approved type latex mortar.
 - 1. When cement mortar is used for patching, the surfaces shall be depressed a minimum depth of 1".
- N. Reinstall all weather protection work in waterproof manner.
- O. Openings in roofs.
 - 1. Openings in roofs shall be kept properly plugged and caulked at all times, except when being worked on, to preclude the possibility of flooding due to storms or other causes. After completion of work, openings shall be permanently sealed.
- P. Temporary openings.
 - 1. All temporary openings cut in walls, floors or ceilings for pipe or ductwork shall be closed off with transite or an equally non-combustible material except when mechanics are actually working at the particular opening.

3.21 SHUTDOWN OF EXISTING BUILDING SYSTEMS

- A. Do not interrupt existing services or systems in the building unless absolutely necessary. Such interruptions and interferences must be made as brief as possible and only after coordination with the Owner. The Owner requires a minimum of seven (7) days notice. Obtain prior permission, in writing.
- B. Where the work makes temporary interruptions unavoidable, they shall be made during off hours. "Off hours" shall be dictated by the Owner.
- C. Arrange to work continuously, including overtime, if required, to ensure that systems will shut down only during the time actually required to make the necessary connections to existing work.

3.22 DEMONSTRATION AND TRAINING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain all new equipment. Refer to Division 1 Section "Demonstration and Training."
- B. The contractor and subcontractors shall be responsible for coordinating, scheduling and completing operations and maintenance training for the Owners designated personnel on all systems and equipment.
- C. All training materials (agenda, hand-outs, etc.) shall be submitted to the Owner for review and approval at least two weeks in advance of scheduled training.
- D. Equipment training shall be provided by a factory authorized technical representatives, experienced in training, operation and maintenance procedures for installed systems, subsystems and equipment.
- E. All qualifications and certifications of the individual performing the training shall be submitted to the Owner for review and approval at least two weeks in advance of scheduled training.
- F. Each Subcontractor responsible for training will submit a written training plan to the Owner for review and approval at least two weeks in advance of scheduled training. The plan will include field orientation during installation, classroom instruction and field training after the completion of installation.
- G. For all major automated electrically controlled systems and equipment, the contractor shall provide a short discussion of the control of the equipment during the mechanical or electrical training conducted by others in addition to formal training on workstation operation, graphics, etc.
- H. Provisions shall be included to provide formal classroom training to representatives of the Owner's personnel for select systems and equipment above and beyond typical preventative maintenance training (e.g. manufacturer provided training school, etc.). Coordinate requirements with the owner.

- I. Provisions shall be included to provide professional videotaping of classroom training. For systems not being commissioned, the CM will carry the responsibility of hiring the Cx Videographer. The duration and intensity of the videotaping is to be specified at the discretion of the Owner.
- J. Training Requirements Outline:
 - 1. General familiarization and operating procedures for each of the building's system installations.
 - 2. Routine maintenance procedures for equipment.
 - 3. Specific operating and maintenance procedures for:
 - a. Mechanical systems
 - b. Electrical systems
 - c. Plumbing systems
 - 4. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Schedule for routine cleaning and maintenance.
 - e. Repair instructions.
 - 5. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
 - 6. Quantity of training: The maintenance personnel shall be trained on the various building systems in sessions of not less than 40 hours of training time. The training shall be of a sufficient extent to allow the trained staff, to train their peers and to demonstrate the training sessions were effective.
 - 7. Video Documentation: The contractor(s) shall provide for the services of a qualified videographer to digitally record the training sessions.

END OF SECTION 22 05 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Grout.
 - 4. Silicone sealants.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. GPT; an EnPro Industries company.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends. Applications in new, poured concrete shall be furnished with an integral waterstop collar unless otherwise indicated.
- C. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot dipped galvanized, with plain ends Applications in new, poured concrete shall be furnished with an integral waterstop collar unless otherwise indicated.
- D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. GPT; an EnPro Industries company.
 - 4. Metraflex Company (The).
 - 5. Proco Products, Inc.
- B. Description:
 - 1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 2. Designed to form a hydrostatic seal of 20 psig minimum.
 - 3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 4. Pressure Plates: Carbon Steel.
 - 5. Connecting Bolts and Nuts: Carbon Steel with corrosion resistant coating, of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.

- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.4 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, Use NT.
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in concrete floors, concrete roof slabs, and concrete/masonry walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 2. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves or galvanized steel pipe sleeves with sleeve seal system.

- 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Cast-iron pipe sleeves. or galvanized steel pipe sleeves with sleeve seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
2. Exterior Concrete Walls below Grade:
- a. Piping Smaller Than NPS 6: Galvanized steel pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Galvanized steel pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs-on-Grade:
- a. Piping Smaller Than NPS 6: Galvanized steel pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Galvanized steel pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
- a. Piping Smaller Than NPS 6: Galvanized steel pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized steel pipe sleeves.
5. Interior Masonry and Concrete Walls:
- a. Piping Smaller Than NPS 6: Galvanized steel pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.
6. Pipe Penetrations Through Fire Rated Assemblies:
- a. The Contractor shall coordinate with the firestopping system manufacturer to determine if a pipe sleeve is required to comply with the manufacturer's installation instructions and the listed firestop system's testing standards.
 - b. All penetrations shall maintain the fire-resistance rating of the wall or assembly.

END OF SECTION 22 05 17

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Liquid-in-glass thermometers.
 - 2. Thermowells.
 - 3. Pressure gages.
 - 4. Gage attachments.
 - 5. Test plugs.
 - 6. Test-plug kits.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Terice, H. O. Co
 - b. Weksler
 - c. Miljoco
 - 2. Standard: ASME B40.200.
 - 3. Case: Cast aluminum; 6-inch nominal size.
 - 4. Case Form: Back angle unless otherwise indicated.
 - 5. Tube: Glass with magnifying lens and blue or red organic liquid.
 - 6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
 - 7. Window: Glass or plastic.
 - 8. Stem: Aluminum or brass and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 - 9. Connector: 3/4 inch, with ASME B1.1 screw threads.
 - 10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

- A. Thermowells:
 - 1. Standard: ASME B40.200.
 - 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 - 3. Material for Use with Copper Tubing: CNR or CUNI.
 - 4. Material for Use with Steel Piping: CRES.
 - 5. Type: Stepped shank unless straight or tapered shank is indicated.
 - 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
 - 7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
 - 8. Bore: Diameter required to match thermometer bulb or stem.
 - 9. Insertion Length: Length required to match thermometer bulb or stem.
 - 10. Lagging Extension: Include on thermowells for insulated piping and tubing.
 - 11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Ashcroft Inc.
 - b. Marsh Bellofram.
 - c. Miljoco Corporation.
 - d. Noshok.
 - e. Palmer Wahl Instrumentation Group.
 - f. Terice, H. O. Co.
 - g. Weksler Glass Thermometer Corp.
 - h. Winters Instruments - U.S.
 - 2. Standard: ASME B40.100.
 - 3. Case: Liquid-filled Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
 - 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 - 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 - 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
 - 8. Pointer: Dark-colored metal.
 - 9. Window: Glass or plastic.
 - 10. Ring: Stainless steel.
 - 11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. IMI Flow Design, Inc.
 - 2. Miljoco Corporation.
 - 3. Nexus Valve, Inc.
 - 4. Sisco Manufacturing Company, Inc.
 - 5. Terice, H. O. Co.
 - 6. Weiss Instruments, Inc.
 - 7. Weksler Glass Thermometer Corp.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.6 TEST-PLUG KITS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. IMI Flow Design, Inc.
 - 2. Miljoco Corporation.
 - 3. Nexus Valve, Inc.
 - 4. Sisco Manufacturing Company, Inc.
 - 5. Terice, H. O. Co.
 - 6. WATTS.

- 7. Weiss Instruments, Inc.
- B. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.
- D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.
- E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch-diameter dial and probe. Dial range shall be at least 0 to 200 psig.
- F. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gage for fluids.
- H. Install test plugs in piping tees.
- I. Install thermometers in the following locations:
 - 1. Inlet and outlet of each compressor and drer.
- J. Install pressure gages in the following locations:
 - 1. Outlet of each compressor
 - 2. Inlet and outlet of each pressure-reducing valve.
 - 3. Inlet and outlet of each filter housing.
 - 4. Outlet of each receiver tank.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

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

3.4 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Air:
 - 1. 0 to 150 deg F.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Air
 - 1. 0 to 200 psi.

END OF SECTION 22 05 19

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ball valves.
 - 2. Butterfly valves.
 - 3. Check valves.
 - 4. Gate valves.
 - 5. Chainwheels.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer.
- C. FKM: Fluoroelastomer.
- D. NBR: Nitrile butadiene rubber (also known as Buna-N).
- E. NRS: Nonrising stem.
- F. OS&Y: Outside screw and yoke.
- G. PTFE: Polytetrafluoroethylene.
- H. RPTFE: Reinforced polytetrafluoroethylene.
- I. RS: Rising stem.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of product.
 - a. Include material descriptions and dimensions of individual components.
 - b. Include operating characteristics and furnished accessories.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooved ends, press ends, solder ends, and weld ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
 - 4. Set butterfly valves closed or slightly open.
 - 5. Block check valves in either closed or open position.
 - 6. Set gate valves closed to prevent rattling.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems or other components as lifting or rigging points unless specifically indicated for this purpose in manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Standards:
 - 1. Domestic-water piping valves intended to convey or dispense water for human consumption must comply with the U.S. Safe Drinking Water Act (SDWA), requirements of authorities having jurisdiction, and NSF 61/NSF 372; or to be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI)-accredited third-

party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded-end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.5 for flanges on steel valves.
 - 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 5. ASME B16.18 for cast-copper solder-joint connections.
 - 6. ASME B16.22 for wrought-copper solder-joint connections.
 - 7. ASME B16.34 for flanged- and threaded-end connections.
 - 8. ASME B16.51 for press joint connections.
 - 9. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Bypass and Drain Connections: MSS SP-45.
- H. Valve Actuator Type:
 - 1. Gear Actuator: For quarter-turn ball valves NPS 4 and larger.
 - 2. Hand Lever: For quarter-turn ball valves smaller than NPS 4.
- I. Valves in Insulated Piping:
 - 1. Provide 2-inch extended neck stems. Milwaukee Insulator/MS Handle (TIH) or approved equal.
 - 2. Provide extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
 - 3. Provide memory stops that are fully adjustable after insulation is applied.

2.3 BALL VALVES, LEAD FREE

- A. Ball Valves, Lead Free, Threaded or Soldered Ends - Brass, Two Piece with Full Port and Brass Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. WATTS.
 - 2. Standards: MSS SP-110 and MSS SP-145.
 - 3. CWP Rating: 600 psig.
 - 4. Body Design: Two piece.
 - 5. Body Material: Forged brass.
 - 6. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
 - 7. Seats: PTFE.
 - 8. Stem: Brass.
 - 9. Ball: Chrome-plated brass.
 - 10. Port: Full.
- B. Ball Valves, Lead Free, Press Ends - Brass, Two Piece with Full Port and Brass Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Viega ProPress
 - b. Apollo
 - c. Milwaukee
 - d. Nibco

2. Standards: MSS SP-110, MSS SP-145, IAPMO/ANSI Z1157.
 3. CWP Rating: Minimum 200 psig.
 4. Body Design: Two piece.
 5. Body Material: Forged brass.
 6. Ends: Press.
 7. Press-End Connections Rating: Minimum 200 psig.
 8. Seats: PTFE or RPTFE.
 9. Stem: Brass.
 10. Ball: Chrome-plated brass.
 11. Port: Full.
 12. O-Ring Seal: NBR or EPDM.
- C. Ball Valves, Lead Free, Threaded or Soldered Ends - Brass, Two Piece with Full Port and Stainless Steel Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. WATTS.
 2. Standards: MSS SP-110 and MSS SP-145.
 3. CWP Rating: 600 psig.
 4. Body Design: Two piece.
 5. Body Material: Forged brass.
 6. Ends: Threaded or soldered. See Part 3 ball valve schedule articles.
 7. Seats: PTFE.
 8. Stem: Stainless steel.
 9. Ball: Stainless steel, vented.
 10. Port: Full.
- D. Ball Valves, Lead Free, Press Ends - Brass, Two Piece with Full Port and Stainless Steel Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Viega
 - b. Apollo
 - c. Milwaukee
 - d. Nibco
 2. Description:
 - a. Body: Two Piece Zero Lead Bronze Body
 - b. Ball: Full Port 316 Stainless Steel
 - c. Stem: Blowout – Proof 316 Stainless Steel
 - d. Sealing Element: EPDM
 - e. Smart Connect (SC) – Leak detection feature on un-pressed valves.
 - f. 600 WOG
 - g. Listings: UP Code NSF 61 Annex G CSA on ½" - 1"
 - h. Metal Handle
 - i. Conforms to MSS SP-110
 - j. Parameters: 200 PSI Maximum Working Pressure / 0° - 250° F Operating Temperature.

2.4 CHECK VALVES, LEAD FREE

- A. Check Valves, Lead Free, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 125:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. WATTS.
 2. Standard: MSS SP-80, Type 3.
 3. CWP Rating: 200 psig.
 4. Body Design: Horizontal flow.

5. Body Material: ASTM B62, bronze.
 6. Ends: Threaded or soldered. See Part 3 check valve schedule articles.
 7. Disc: Bronze.
- B. Check Valves, Lead Free, Swing Type, Threaded or Soldered Ends - Bronze, with Bronze Disc, Class 150:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. WATTS.
 2. Standard: MSS SP-80, Type 3.
 3. CWP Rating: 300 psig.
 4. Body Design: Horizontal flow.
 5. Body Material: ASTM B62, bronze.
 6. Ends: Threaded or soldered. See Part 3 check valve schedule articles.
 7. Disc: Bronze.
- C. Check Valves, Lead Free, Swing Type, Press Ends - Bronze:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Viega
 - b. Apollo
 - c. Milwaukee
 - d. Nibco
 2. Standards: MSS SP-80 and MSS SP-139.
 3. CWP Rating: Minimum 200 psig.
 4. Body Design: Horizontal flow.
 5. Body Material: ASTM B584, bronze.
 6. Ends: Press.
 7. Press-End Connections Rating: Minimum 200 psig.
 8. Disc: Brass or bronze.
- D. Check Valves, Lead Free, Swing Type, Flanged or Threaded Ends - Iron, with Metal Seats, Class 125:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. WATTS.
 2. Standard: MSS SP-71, Type I.
 3. CWP Rating: 200 psig.
 4. Body Design: Clear or full waterway.
 5. Body Material: ASTM A126, gray iron with bolted bonnet.
 6. Ends: Flanged or threaded. See Part 3 check valve schedule articles.
 7. Trim: Bronze.
 8. Gasket: Asbestos free.
- E. Check Valves, Lead Free, Swing Type, Flanged or Threaded Ends - Iron, with Metal Seats, Class 250:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. WATTS.
 2. Standard: MSS SP-71, Type I.
 3. CWP Rating: 500 psig.
 4. Body Design: Clear or full waterway.
 5. Body Material: ASTM A126, gray iron with bolted bonnet.

6. Ends: Flanged or threaded. See Part 3 check valve schedule articles.
7. Trim: Bronze.
8. Gasket: Asbestos free.
9. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Victaulic
 - b. Engineer Approved Equal
10. CWP Rating: 300 psig.
11. Body Material: ASTM A536, ductile iron.
12. Seat: EPDM.
13. Disc: Spring operated, ductile iron or stainless steel.

2.5 GATE VALVES, LEAD FREE

- A. Gate Valves, Lead Free, Threaded or Soldered Ends - Bronze, NRS, Class 125:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. Nibco
 - d. WATTS.
 2. Standard: MSS SP-80, Type 1.
 3. CWP Rating: 200 psig.
 4. Body Material: Bronze with integral seat and screw-in bonnet.
 5. Ends: Threaded or solder joint. See Part 3 gate valve schedule articles.
 6. Stem: Bronze.
 7. Disc: Solid wedge, bronze.
 8. Packing: Asbestos free.
 9. Handwheel: Malleable iron.
- B. Gate Valves, Lead Free, Threaded or Soldered Ends - Bronze, RS, Class 125:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. Nibco
 - d. WATTS.
 2. Standard: MSS SP-80, Type 2.
 3. CWP Rating: 200 psig.
 4. Body Material: Bronze with integral seat and screw-in bonnet.
 5. Ends: Threaded or solder joint. See Part 3 gate valve schedule articles.
 6. Stem: Bronze.
 7. Disc: Solid wedge, bronze.
 8. Packing: Asbestos free.
 9. Handwheel: Malleable iron, bronze, or aluminum.
- C. Gate Valves, Lead Free, Threaded Ends - Bronze, NRS, Class 150:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. Nibco
 - d. WATTS.
 2. Standard: MSS SP-80, Type 1.
 3. CWP Rating: 300 psig.
 4. Body Material: Bronze with integral seat and union-ring bonnet.
 5. Ends: Threaded.
 6. Stem: Bronze.
 7. Disc: Solid wedge, bronze.
 8. Packing: Asbestos free.
 9. Handwheel: Malleable iron, bronze, or aluminum.

- D. Gate Valves, Lead Free, Threaded Ends - Bronze, RS, Class 150:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. Nibco
 - d. WATTS.
 2. Standard: MSS SP-80, Type 2.
 3. CWP Rating: 300 psig.
 4. Body Material: Bronze with integral seat and union-ring bonnet.
 5. Ends: Threaded.
 6. Stem: Bronze.
 7. Disc: Solid wedge, bronze.
 8. Packing: Asbestos free.
 9. Handwheel: Malleable iron, bronze, or aluminum.
- E. Gate Valves, Lead Free, Press Ends - Bronze:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Viega
 2. Standards: MSS SP-80 and MSS SP-139.
 3. CWP Rating: Minimum 200 psig.
 4. Body Material: Bronze with integral seat and union-ring bonnet.
 5. Ends: Press.
 6. Press Ends Connection Rating: Minimum 200 psig.
 7. Stem: Brass or bronze, RS or NRS. See Part 3 gate valve schedule articles.
 8. Disc: Solid wedge, bronze.
 9. Packing: Graphite.
 10. Port: Full.
 11. Handwheel: Malleable iron, bronze, or aluminum.
- F. Gate Valves, Lead Free, Flanged Ends - Iron, NRS, Class 125:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. Nibco
 - d. WATTS.
 2. Standard: MSS SP-70, Type I.
 3. CWP Rating: 200 psig.
 4. Body Material: Gray iron with bolted bonnet.
 5. Ends: Flanged.
 6. Trim: Bronze.
 7. Disc: Solid wedge.
 8. Packing and Gasket: Asbestos free.
- G. Gate Valves, Lead Free, Flanged Ends - Iron, NRS, Class 250:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Apollo Valves.
 - b. Milwaukee Valve Company.
 - c. Nibco
 - d. WATTS.
 2. Standard: MSS SP-70, Type I.
 3. CWP Rating: 500 psig.
 4. Body Material: Gray iron with bolted bonnet.
 5. Ends: Flange.
 6. Trim: Bronze.
 7. Disc: Solid wedge.
 8. Packing and Gasket: Asbestos free.

2.6 IRON BUTTERFLY VALVES

- A. 150 CWP, Iron, Butterfly Valves with Stainless-Steel Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bray Controls; a division of Bray International.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. Red-White Valve Corporation.
 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 150 psig (1035 kPa).
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Stainless steel.
 - h. Handle: Gear actuator

2.7 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Babbitt Steam Specialty Co.
 2. Roto Hammer Industries; Rotork.
 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to hand wheels.
1. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve. Include zinc or epoxy coating.
 2. Chain: Hot-dip galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Examine press fittings to verify they have been properly pressed.
- F. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Provide support of piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.
- D. For valves in horizontal piping, install valves with stem at or above center of pipe.

- E. Install valves in position that does not project into aisles or block access to other equipment.
- F. Install valves in position to allow full stem and actuator or manual operator movement.
- G. Verify that joints of each valve have been properly installed and sealed to ensure there is no leakage or damage.
- H. Chainwheels: Install chainwheels on manual operators for butterfly globe and gate valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- I. Install check valves for proper direction of flow and as follows:
 - 1. Check Valves, Swing Type: In horizontal position with hinge pin level.
- J. Valve Tags: Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- K. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's written recommended maximum.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 6. Wafer-Type Valves: Flanged connections.

3.5 VALVE SCHEDULE

- A. Refer to Schedule on Drawings

END OF SECTION 22 05 23

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Fastener systems.
 - 5. Pipe stands.
 - 6. Pipe-positioning systems.
 - 7. Equipment supports.
- B. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of trapeze hangers.
 - 2. Include design calculations for designing trapeze hangers.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Pipe stands.
 - 4. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with these specifications, metal pipe hanger and support systems shall be one of the following or engineer-approved equal.
1. Anvil International
 2. Empire Industries
 3. ERICO, Inc.
 4. PHD
 5. Hubbard Enterprises

2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 2. Galvanized Metallic Coatings: , hot-dip galvanized, or electro-galvanized.
 3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Copper Pipe and Tube Hangers:
1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-line; brand of Eaton, Electrical Sector.
 - b. Flex-Strut Inc.
 - c. Gregory Industries.
 - d. Unistrut; Atkore International.
 - e. Wesanco, Inc.
 2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
 3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
 4. Channels: Continuous slotted carbon-steel channel with inturned lips.
 5. Channel Width: Selected for applicable load criteria.
 6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
 8. Metallic Coating: No coating.
 9. Paint Coating: Green epoxy, acrylic, or urethane.
- B. Non-MFMA Manufacturer Metal Framing Systems:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
 - b. CADDY; brand of nVent Electrical plc.
 - c. Empire Industries, Inc.
 - d. MIRO Industries.
 - e. PHD Manufacturing, Inc.
 2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
 3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.

4. Channels: Continuous slotted [carbon-steel] [stainless-steel] <Insert material> channel with inturred lips.
5. Channel Width: Select for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
8. Metallic Coating: No coating
9. Paint Coating: Green epoxy, acrylic, or urethane.

2.5 FASTENER SYSTEMS

- A. Mechanical-Wedge Anchors: Wedge-type, [zinc-coated] [stainless] steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 1. Manufacturers:
 - a. Powers Fasteners; Model Power-Stud
 - b. B-Line Systems, Inc.; a division of Cooper Industries; Model AWA
 - c. Hilti, Inc.; Model KB
 - d. ITW Ramset/Red Head; Model Trubolt
 - e. MKT Fastening, LLC; Model Sup-R-Stud
- B. Mechanical Anchor: Steel threaded fastening system for suspending threaded rod vertically overhead; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 1. Manufacturers:
 - a. Powers Fasteners; Model Vertigo; Wood Vertical Hanger and Wood Side Hanger
 - b. B-Line Systems, Inc.; a division of Cooper Industries; Model ARS, ARSW
 - c. Simpson Strong-Tie; Model RWV, RWH

2.6 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Manufacturers:
 1. ERICO/Michigan Hanger Co.
 2. MIRO Industries.
 3. Portable Pipe Hangers.
- C. Compact Pipe Stand:
 1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
 2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
 3. Hardware: Galvanized steel or polycarbonate.
 4. Accessories: Protection pads.
- D. Low-Profile, Single-Base, Single-Pipe Stand:
 1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
 2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
 3. Vertical Members: Two galvanized-steel, continuous-thread, 1/2-inch rods.
 4. Horizontal Member: Adjustable horizontal, galvanized-steel pipe support channels.
 5. Pipe Supports: Strut clamps or Clevis hanger.
 6. Hardware: Galvanized steel.
 7. Accessories: Protection pads.
 8. Height: 12 inches above roof.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.8 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.

- C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. All hanger rod and channel ends; exposed and less than or equal to 12ft above finished floor; shall be provided with plastic caps and plastic channel safety end caps. Color shall be same throughout the project.
- E. Thermal Hanger-Shield Installation: Install in all pipe hangers and shields for insulated piping.
- F. Fastener System Installation:
 - 1. Powder-actuated fasteners are not acceptable.
 - 2. When possible, install concrete inserts before placing concrete.
 - 3. Install mechanical-wedge type anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
 - 4. Pin/nail anchors, spikes, expansion shields, expansion anchors, dropin anchors, wedge bolts, self tapping screw anchors, and friction clamps are not acceptable.
- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. 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.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.
- L. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- N. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.

- c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal hanger-shield inserts shall be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - 5. Insert Material: Length at a minimum of 2" longer; in each direction; than protective shield length.
- O. All pipe hangers shall be sized to accommodate the pipe, pipe insulation thickness and protective shields and saddles. Insulation shall be continuous through all hangers and penetrations.
 - 1. Insulation may not be continuous through the hanger when riser clamps and pipe clamps are utilized for vertical support. Insulation shall be continuous around the pipe clamp and continue 3" on the method of support; threaded rod, pipe stand.
 - 2. Insulation shall be continuous through the hanger when pipe clamps are utilized for horizontal suspension. Full circumference protective shield shall be utilized.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M 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 so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.
- C. Provide plastic caps on the ends of all threaded rod exposed and less than or equal to 12ft above finished floor. Color shall be same throughout the project.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

- B. Touchup: Clean and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal hanger-shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system 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.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated and insulated stationary pipes NPS 1/2 to NPS 8.
 - 5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For floor mounting of insulated, stationary pipes NPS 3/8 to NPS 3.
 - 6. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 - 7. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
 - 8. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
 - 9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
 - 10. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Wedge type mechanical expansion anchor: For upper attachment to suspend hangers from concrete.
 2. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 3. Top-Beam Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape. Retaining strap/clip required.
 4. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 5. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 6. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 7. C-Clamps (MSS Type 23): For structural shapes. Only acceptable for support of pipes less than or equal to NPS 2. Retaining strap/clip required.
 8. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 9. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 10. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 11. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 12. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 13. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 14. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 15. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 16. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
 1. Each pipe shall be provided with a U-bolt to retain the pipe on the hanger.
 2. Each insulated pipe shall be provided with a 360 degree insulation shield at each U-bolt.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use mechanical-wedge type anchors in concrete after concrete is placed and completely cured instead of building attachments where required in concrete construction.
 1. Powder-actuated fasteners are not acceptable.
 2. When possible, install concrete inserts before placing concrete.
 3. Install mechanical-wedge type anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
 4. Pin/nail anchors, spikes, expansion shields, expansion anchors, dropin anchors, wedge bolts, self tapping screw anchors, and friction clamps are not acceptable.

END OF SECTION 22 05 29

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Elastomeric hangers.
 - 5. Spring hangers.
 - 6. Spring hangers with vertical-limit stops.
 - 7. Pipe riser resilient supports.
 - 8. Resilient pipe guides.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Annotate to indicate application of each product submitted and compliance with requirements.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corporation.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control.
 - 6. Mason Industries.

7. Vibration Eliminator Co., Inc.
 8. Vibration Isolation.
 9. Vibration Mountings & Controls, Inc.
- B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
1. Resilient Material: Oil- and water-resistant neoprene.
- C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- D. Restrained Mounts: All-directional mountings with seismic restraint.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- E. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch-thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- F. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch-thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- G. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 2. Base: Factory drilled for bolting to structure.
 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.
- H. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- I. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- J. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- K. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch-thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
- L. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch-thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
1. Powder coating on springs and housings.
 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 3. Baked enamel or powder coat for metal components on isolators for interior use.
 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- B. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment Restraints:
 - 1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches.
- B. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- C. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- F. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.

5. Test to 90 percent of rated proof load of device.
 6. Measure isolator restraint clearance.
 7. Measure isolator deflection.
 8. Verify snubber minimum clearances.
 9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 22 05 48

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Warning tape.
 - 4. Pipe labels.
 - 5. Stencils.
 - 6. Valve tags.
 - 7. Warning tags.

1.2 RELATED DOCUMENTS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve-numbering scheme.
- E. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Brimar Industries, Inc.
 - c. Craftmark Pipe Markers.
 - d. LEM Products Inc.
 - e. Marking Services, Inc.
 - f. Seton Identification Products; a Brady Corporation company.
 - 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
 - 3. Letter and Background Color: As indicated for specific application under Part 3.
 - 4. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 5 by 3 inch.
 - 6. Minimum Letter Size: 1 inch for name of units if viewing distance is less than 24 inches, 2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless steel rivets or self-tapping screws; adhesive for locations where screws or rivets would void warranty of equipment.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.

2. Brimar Industries, Inc.
 3. Craftmark Pipe Markers.
 4. Marking Services Inc.
 5. Seton Identification Products; a Brady Corporation company.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 5 by 3 inch.
- F. Minimum Letter Size: 1 inch for name of units if viewing distance is less than 24 inches, 2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws; adhesive for locations where screws or rivets would void warranty of equipment.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information plus emergency notification instructions.
- J. Plastic labels shall be plenum rated when located in plenums.

2.3 WARNING TAPE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brady Corporation.
 2. Brimar Industries, Inc.
 3. Craftmark Pipe Markers.
 4. National Marker Company.
 5. Seton Identification Products; a Brady Corporation company.
- B. Material: Vinyl.
- C. Minimum Thickness: 0.005 inch.
- D. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.
- E. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.
- F. Maximum Temperature: 160 deg F.
- G. Minimum Width: 2 inches.

2.4 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brimar Industries, Inc.
 2. Craftmark Pipe Markers.
 3. Marking Services Inc.
 4. Seton Identification Products; a Brady Corporation company.
- B. General Requirements for Manufactured Pipe Labels: Machine printed, color coded, with lettering indicating service pipe size, and showing flow direction in accordance with ASME A13.1. Marker/hand written labels are not acceptable.
- C. Pretensioned Pipe Labels: MS-970 Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners (straps for 6" O.D. of insulation and larger are acceptable) or adhesive. Self-adhesive, sticker type, or pre-coiled polyester with self-sealing lap are not acceptable. Pipe labels and pipe labels adhered to a clear pretensioned sleeve are not acceptable.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
 - 1. Pipe size.
 - 2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
 - 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.
- F. Pipe labels located within plenums only:
 - 1. MS-900 Self-adhesive, sticker type.
 - 2. Pipe Label Contents: Include identification of piping service, pipe size, and an arrow indicating flow direction.
- G. Pipe-Label Colors:
 - 1. In accordance with ANSI A13.1 and local fire code requirements

2.5 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. Brimar Industries, Inc.
 - 3. Craftmark Pipe Markers.
 - 4. Marking Services Inc.
 - 5. Seton Identification Products; a Brady Corporation company.
- B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: aluminum, 0.031-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass beaded chain with S-hook or jack chain with S-hook.
- C. Valve Tag Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, valve number and service.
 - 1. Example: HW
 Isolation
 001
- D. Letter and Background Color: As indicated for specific application under Part 3.
- E. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Include valve-tag schedule in operation and maintenance data.
 - 2. Valve-tag schedule shall be framed behind glass and located in each mechanical room

2.6 WARNING TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Brady Corporation.
 - 2. Brimar Industries, Inc.
 - 3. Craftmark Pipe Markers.
 - 4. Marking Services Inc.
 - 5. Seton Identification Products; a Brady Corporation company.
- B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Letter and Background Color: As indicated for specific application under Part 3.
- C. Plastic labels shall be plenum rated when located in plenums.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of plumbing equipment.
- B. Sign and Label Colors.
 - 1. White letters on an ANSI Z535.1 safety-green background.
- C. Locate equipment labels where accessible and visible. Where equipment is located within finished spaces, equipment labels shall not be located on the face of the equipment; where possible, the label shall be located on the least conspicuous side.

3.4 INSTALLATION OF PIPE LABELS

- A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- B. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Within 3 ft. of each valve and control device.
 - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 3. Within 3 ft. of equipment items and other points of origination and termination.
 - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.
 - 5. At all changes of direction.
 - 6. And at all locations required to conform to ASME/ANSI A13.1.
- C. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- D. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe Label Color Schedule: Coordinate with facility standards. If no facility standards exist or are not desired, conform to ASME/ANSI A13.1 - 2007.
- F. All self-adhesive/sticker type labels located in plenums shall be secured with additional flow arrow tape at each end of the label. Flow arrow tape shall be installed a minimum of 1.5 wraps around the entire circumference of the pipe at each end of the label.

3.5 INSTALLATION OF VALVE TAGS

- A. Install tags on all valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.

- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. All services: 1-1/2 inches, round.
 - 2. Valve-Tag Color:
 - a. All services: Natural.
 - 3. Letter Color:
 - a. All services: Black.
 - 4. Valve-Tag Colors:
 - a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

3.6 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.
- B. Markings shall be provided in locations required by and meeting the color requirements of the "Safety Code Color for Marking Physical Hazards", ANSI Z53.1, latest revision.

END OF SECTION 22 05 53

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 and related specialties for general-service compressed-air systems operating at 200 psig or less.
- B. Related Sections include the following:
 - 1. Section 22 15 19 "General-Service Packaged Air Compressors and Receivers" for general-service air compressors and accessories.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. CR: Chlorosulfonated polyethylene synthetic rubber.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. HDPE: High-density polyethylene plastic.
- E. NBR: Acrylonitrile-butadiene rubber.
- F. PE: Polyethylene plastic.
- G. PVC: Polyvinyl chloride plastic.
- H. High-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures between 150 and 200 psig.
- I. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig or less.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Pipes, fittings, and valves.
 - 2. Dielectric fittings.
 - 3. Flexible pipe connectors.
 - 4. Safety valves.
 - 5. Pressure regulators. Include rated capacities and operating characteristics.
 - 6. Automatic drain valves.
 - 7. Filters. Include rated capacities and operating characteristics

1.5 INFORMATIONAL SUBMITTALS

- A. Brazing and welding certificates.
- B. Qualification Data: For Installers.
- C. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For general-service compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Air Filter Cartridges - 1 plus spare for each unit.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:

1. Extruded-Tee Outlet Procedure: Qualify operators according to training provided by T-DRILL Industries Inc., for making branch outlets.
 2. Pressure-Seal Joining Procedure for Copper Tubing: Qualify operators according to training provided by Viega; Plumbing and Heating Systems.
 3. Pressure-Seal Joining Procedure for Steel Piping. Qualify operators according to training provided by Victaulic Company.
- B. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- D. ASME Compliance:
1. Comply with ASME B31.1, "Power Piping," for high-pressure compressed-air piping.
 2. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Compressed-Air Service: Do not interrupt compressed-air service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary compressed-air service according to requirements indicated:
1. Notify Owner no fewer than five days in advance of proposed interruption of compressed-air service.
 2. Do not proceed with interruption of compressed-air service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Schedule 40, Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, black or hot-dip zinc coated with ends threaded according to ASME B1.20.1.
1. Steel Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized seamless steel pipe. Include ends matching joining method.
 2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.
 3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.
 4. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel, threaded.
 5. Wrought-Steel Butt-Welding Fittings: ASME B16.9, Schedule 40.
 6. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.
- B. Copper Tube: ASTM B 88, Type K or L and ASTM B 88, Type M seamless, drawn-temper, water tube.
1. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
 2. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300.
 3. Copper Unions: ASME B16.22 or MSS SP-123.
 4. Press-Type Fittings, NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Viega; Plumbing and Heating Systems.
 5. Press-Type Fittings, NPS 2-1/2 to NPS 4: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Viega; Plumbing and Heating Systems.
 6. Extruded-Tee Outlets: Procedure for making branch outlets in copper tube according to ASTM F 2014.

- a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering procedure that may be incorporated into the Work include, but are not limited to, the following:
 - 1) T-DRILL Industries Inc.

2.2 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for compressed-air piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 VALVES

- A. Metal Ball, Butterfly, Check, Gate, and Globe Valves: Comply with requirements in Section 22 05 23 "General-Duty Valves for Plumbing Piping."

2.4 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International Ltd.
 - e. Matco-Norca, Inc.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.
 - 2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: **150 psig**.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Matco-Norca, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.
 - 2. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: **150 psig**.

- d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: **150 psig**.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.

2.5 FLEXIBLE PIPE CONNECTORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Flex-Hose Co., Inc.
 - 2. Flexicraft Industries.
 - 3. Hyspan Precision Products, Inc.
 - 4. Mercer Rubber Co.
 - 5. Metraflex, Inc.
 - 6. Proco Products, Inc.
 - 7. Unaflex, Inc.
 - 8. Universal Metal Hose; a Hyspan Company
- B. Bronze-Hose Flexible Pipe Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - 1. Working-Pressure Rating: 200 psig minimum.
 - 2. End Connections, NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 - 3. End Connections, NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - 1. Working-Pressure Rating: 200 psig minimum.
 - 2. End Connections, NPS 2 and Smaller: Threaded steel pipe nipple.
 - 3. End Connections, NPS 2-1/2 and Larger: Flanged steel nipple.

2.6 SPECIALTIES

- A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.
 - 1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.
- B. Air-Main Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for **1250-psig** inlet pressure, unless otherwise indicated.
 - 1. Type: Pilot operated.
- C. Air-Line Pressure Regulators: **Diaphragm or pilot** operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for **200-psig** minimum inlet pressure, unless otherwise indicated.
- D. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket for wall mounting.
- E. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate

when selected maximum pressure drop has been exceeded. Include mounting bracket for wall mounting.

- F. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock. Include mounting bracket for wall mounting.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Compressed-Air Piping: Use the following piping materials for each size range:
1. NPS 2-1/2 and Smaller and all breathing air: Type K or L, copper tube; wrought-copper fittings; and brazed joints or mechanical press joins
 2. NPS 3 to NPS 4: Schedule 40, black-steel pipe; wrought-steel fittings; and welded joints.
- B. Drain Piping: Use the following piping materials:
1. NPS 2 and Smaller: Type M copper tube; wrought-copper fittings; and brazed or soldered joints.
 2. 1/4" Poly Tubing and fittings for filters and misc drains to oil water separator.

3.2 VALVE APPLICATIONS

- A. General-Duty Valves: Comply with requirements in Section 22 05 23 "General-Duty Valves for Plumbing Piping" for metal general-duty valves. Use metal valves, unless otherwise indicated.
1. Metal General-Duty Valves: Use valve types specified in "Valve Applications" Article in Section 22 05 23 "General-Duty Valves for Plumbing Piping" according to the following:
 - a. Low-Pressure Compressed Air: Valve types specified for low-pressure compressed air.
 - b. High-Pressure Compressed Air: Valve types specified for medium-pressure compressed air.
 - c. Equipment Isolation NPS 2-1/2" and Smaller: Safety-exhaust, copper-alloy ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.
- B. Pressure Relief
1. Install on system per ASME and OSHA guidelines and requirements.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- D. Install piping adjacent to equipment and machines to allow service and maintenance.
- E. Install air and drain piping with 1 percent slope downward in direction of flow.
- F. Install all drain lines and tubing to oil water separator per manufacturer's instructions.
- G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.
- H. Equipment and Specialty Flanged Connections:
1. Use steel companion flange with gasket for connection to steel pipe.
 2. Use cast-copper-alloy companion flange with gasket and brazed[**or soldered**] joint for connection to copper tube. Do not use soldered joints for connection to air compressors or to equipment or machines producing shock or vibration.
- I. Flanged joints may be used instead of specified joint for any piping or tubing system.

- J. Extended-tee outlets with brazed branch connection may be used for copper tubing, within extruded-tee connection diameter to run tube diameter ratio for tube type, according to Extruded Tee Connections Sizes and Wall Thickness for Copper Tube (Inches) Table in ASTM F 2014.
- K. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- L. Install full size tee connections at compressor and equipment connections with minimum 3" drip leg with 3/4" valve and capped blow off.
- M. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
- N. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- O. Install piping to permit valve servicing.
- P. Install piping free of sags and bends.
- Q. Install fittings for changes in direction and branch connections.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. 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.
- D. Welded Joints for Steel Piping: Join according to AWS D10.12/D10.12M.
- E. Brazed Joints for Copper Tubing: Join according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Join according to ASTM B 828 or CDA's "Copper Tube Handbook."
- G. Extruded-Tee Outlets for Copper Tubing: Form branches according to ASTM F 2014, with tools recommended by procedure manufacturer, and using operators qualified according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
- I. Pressure-Sealed Joints: Join with tools recommended by fitting manufacturer, using operators qualified according to Part 1 "Quality Assurance" Article.
- J. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.5 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Section 22 05 23 "General-Duty Valves for Plumbing Piping."
- B. Install shutoff valves and unions or flanged joints at compressed-air piping to air compressors.
- C. Install shutoff valve at inlet to each automatic drain valve, filter, lubricator, and pressure regulator.

- D. Install check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment and at temporary connection line.

3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. NPS 2 and Smaller: Use dielectric unions.
- C. NPS 2-1/2 to NPS 4 Use dielectric flanges.

3.7 FLEXIBLE PIPE CONNECTOR INSTALLATION

- A. Install flexible pipe connectors in discharge piping of each air compressor.
- B. Install bronze-hose flexible pipe connectors in copper compressed-air tubing.
- C. Install stainless-steel-hose flexible pipe connectors in steel compressed-air piping.

3.8 SPECIALTY INSTALLATION

- A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.
- B. Install air-main pressure regulators in compressed-air piping at or near air compressors.
- C. Install air-line pressure regulators in branch piping to equipment.
- D. Install automatic drain valves on aftercoolers, receivers, and dryers. Discharge condensate into oil water separator.
- E. Install mechanical filters in compressed-air piping at compressor and dryer discharges. Mount on wall at locations indicated or inline on piping as conditions permit. Provide valves and inlet and outlets with unions and a valved bypass.

3.9 CONNECTIONS

- A. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.
- B. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment and machine.

3.10 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- B. Vertical Piping: MSS Type 8 or 42, clamps.
- C. Individual, Straight, Horizontal Piping Runs:
 - 1. 100 Feet or Less: MSS Type 1, adjustable, steel clevis hangers.
 - 2. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
- D. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- E. Base of Vertical Piping: MSS Type 52, spring hangers.
- F. Support horizontal piping within **12 inches** of each fitting and coupling.
- G. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- H. Install hangers for Schedule 40, steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1/4 to NPS 1/2: 96 inches with 3/8-inch rod.
 - 2. NPS 3/4 to NPS 1-1/4: 84 inches with 3/8-inch rod.
 - 3. NPS 1-1/2: 12 feet with 3/8-inch rod.
 - 4. NPS 2: 13 feet with 3/8-inch rod.
 - 5. NPS 2-1/2: 14 feet with 1/2-inch rod.
 - 6. NPS 3: 15 feet with 1/2-inch rod.
 - 7. NPS 3-1/2: 16 feet with 1/2-inch rod.

- 8. NPS 4: 17 feet with 5/8-inch rod.
- I. Install supports for vertical, Schedule 40, steel piping every 15 feet.
- J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1/4: 60 inches with 3/8-inch rod.
 - 2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
 - 3. NPS 3/4: 84 inches with 3/8-inch rod.
 - 4. NPS 1: 96 inches with 3/8-inch rod.
 - 5. NPS 1-1/4: 108 inches with 3/8-inch rod.
 - 6. NPS 1-1/2: 10 feet with 3/8-inch rod.
 - 7. NPS 2: 11 feet with 3/8-inch rod.
- K. Install supports for vertical copper tubing every 10 feet.

3.11 LABELING AND IDENTIFICATION

- A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.12 FIELD QUALITY CONTROL

- A. Perform field tests and inspections.
- B. Tests and Inspections:
 - 1. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 - 2. Repair leaks and retest until no leaks exist.
 - 3. Inspect filters, dryers, drain valves, and pressure regulators for proper operation.
- C. Prepare test reports.

END OF SECTION 22 15 13

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Materials furnished under this work shall be in compliance with the Build America Buy America Act (BABA) Refer to general conditions for further requirements.

1.2 SUMMARY

- A. Section Includes:
 - 1. Oil-sealed, rotary, sliding-vane air compressors.
 - 2. Inlet-air filters.
 - 3. Air-cooled, compressed-air aftercoolers.
 - 4. Refrigerant compressed-air dryers.
 - 5. Breathing Air Enclosed Scroll Air System
 - 6. Computer interface cabinet.

1.3 DEFINITIONS

- A. Actual Air: Air delivered from air compressors. Flow rate is delivered compressed air measured in acfm.
- B. Standard Air: Free air at 68 deg F and 1 atmosphere before compression or expansion and measured in scfm.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include diagrams for power, signal, and control wiring.
- C. For compressed-air equipment mounting.
 - 1. Detail fabrication and assembly of supports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For compressed-air equipment to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Air-Compressor, Inlet-Air-Filter Elements: Full plus a spare set for each unit.

1.7 FIELD CONDITIONS

- A. Interruption of Existing Compressed-Air Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of compressed-air service.
 - 2. Do not proceed with interruption of compressed-air service without Owner's written permission.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- 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. ASME Compliance: Fabricate and label receivers to comply with ASME Boiler and Pressure Vessel Code.

2.2 GENERAL REQUIREMENTS FOR PACKAGED AIR COMPRESSORS AND RECEIVERS

- A. General Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.
- B. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.
 - 1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
 - 2. Motor Controllers: Full-voltage, combination magnetic type with undervoltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.
 - 3. Control Voltage: 120-V ac or less, using integral control power transformer.
 - 4. Motor Overload Protection: Overload relay in each phase.
 - 5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
 - 6. Automatic control switches to alternate lead-lag compressors for duplex air compressors.
 - 7. Instrumentation: Include discharge-air pressure gage, air-filter maintenance indicator, hour meter, compressor discharge-air and coolant temperature gages, and control transformer.
 - 8. Alarm Signal Device: For connection to alarm system to indicate when backup air compressor is operating.
- C. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 1. Pressure Rating: At least as high as highest discharge pressure of connected compressors, and bearing appropriate code symbols.
 - 2. Interior Finish: Corrosion-resistant coating.
 - 3. Accessories: Include safety valve, pressure gage, zero loss drain, and pressure-reducing valve.

2.3 OIL-FLOODED, ROTARY-SCREW AIR COMPRESSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Ingersoll-Rand; Air Solutions Group.
 - 2. Sullair Corporation.
 - 3. Sullivan-Palatek.
- B. Compressor(s): Oil-flooded, rotary-screw type with lubricated helical screws and lubricated gear box.
 - 1. Coupling: Nonlubricated, flexible type.
 - 2. Cooling/Lubrication System: Unit-mounted, fan forced air-cooled exchanger package prepiped to unit; with air pressure circulation system with coolant stop valve, full-flow coolant filter, and thermal bypass valve.
 - 3. Air Filter: Dry type, with maintenance indicator and cleanable, replaceable filter element.
 - 4. Air/Coolant Receiver and Separation System: 150-psig-rated steel tank with ASME safety valve, coolant-level gage, multistage air-coolant separator element, minimum pressure valve, blowdown valve, discharge check valve, coolant stop valve, full-flow coolant filter, and thermal bypass valve.
 - 5. Capacity Control: Capacity modulation between zero and 100 percent air delivery, with operating pressures between 50 and 125 psig. Include necessary control to hold constant pressure. When air demand is zero, unload compressor by using variable speed drive and blowdown valve.
- C. Capacities and Characteristics:
 - 1. Air Compressor(s): One; single stage.
 - 2. Standard-Air Capacity of Each Air Compressor: As scheduled.

3. Actual-Air Capacity of Each Air Compressor: As scheduled
4. Discharge-Air Pressure: As scheduled
5. Motor (Each Air Compressor):
 - a. Horsepower: As scheduled
 - b. Speed: Variable.
6. Electrical Characteristics:
 - a. Volts: 460v.
 - b. Phase(s): Three.
 - c. Hertz: 60.
 - d. Full-Load Amperes: As scheduled.
 - e. Minimum Circuit Ampacity: As scheduled.
 - f. Maximum Overcurrent Protection: As scheduled.
7. Enclosure: Steel with sound-attenuating material lining.

2.4 REFRIGERANT COMPRESSED-AIR DRYERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Ingersoll-Rand Company; Compressed Air Solutions.
 2. Sullair
 3. Sullivan-Palatek
- B. Description: Cycling, air-cooled, electric-motor-driven unit with steel enclosure and capability to deliver 35 deg F, 125-psig air at dew point. Include automatic ejection of condensate from airstream, step-down transformers, disconnect switches, inlet and outlet pressure gages, thermometers, automatic controls, and filters.
 1. All-In-One Aluminum Heat Exchanger
 2. Low Pressure Drop less than 2 psi
 3. Air/air heat exchanger to precool incoming air
 4. Refrigeration circuit designed to help minimize the volume of refrigerant used
 5. High-efficiency stainless steel demister for stable dewpoint in all operating conditions
 6. Energy-saving cycling technology to match supply to demand at partial loads while maintaining a stable dewpoint
 7. Scroll compressor
 8. Zero loss electric drain
 9. Digital LED controller with remote connectivity

2.5 BREATHING AIR ENCLOSED SCROLL AIR SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Powerex.
- B. Capacities and Characteristics:
 1. Base Model Number: LSE2005-X-5-P
 2. System Capacity: 60.8 CFM @ 100 PSIG (116# max)
 3. Horsepower (total): 20HP (4 x 5)
 4. Sound Level: 58 dBa @ 1 meter
 5. Receiver Size/Configuration: 200 Gallons/Vertical
 6. Voltage/Phase/Hertz: 208/230/460V, 3Phase, 60 Hertz
- C. GENERAL The unit is designed with scroll compressors mounted inside of a rigid steel enclosure. Enclosure shall have a powder coated finish, and shall include sound deadening insulation. Noise level shall not exceed 58 dBa with compressor in operation. System shall include a solid-state controller to operate the necessary compressor to maintain the pressure requirement and to minimize the operating cost.
- D. AIR COMPRESSOR SYSTEM The package shall include enclosed oil-less scroll air compressors and associated equipment, one ASME tank, one desiccant air dryer with filtration, one pressure regulating valve, all mounted, piped and wired on a steel skid base with single point connection. System dimensions are 32" wide by 79" long, and shall be capable of passing through a standard 36" door opening. Scroll Enclosed Series system are complete with multiple oil-less scroll compressors, mounted inside of a rigid steel enclosure. Enclosures to have a powder coated finish, and include sound deadening insulation. Noise levels shall not exceed 56 dba with all compressor units in operation. Each compressor pump has a 1725-rpm TEFC motor, V-belt drive, and air-cooled aftercooler. System to include the Powerex SOS (Scroll Operating System) controller for energy efficiency.

- E. **OILLESS SCROLL COMPRESSOR PUMP** The compressors shall be belt driven oil-less rotary scroll single stage, air-cooled oil-less construction with absolutely no oil needed for operation. The rotary design shall not require any inlet or exhaust valves and shall be rated for 100% continuous duty. Direct drive compressors shall not be used. Tip seals shall be of a composite PTFE material and be rated for 10,000 hours operation. Compressor bearings shall be external to the air compression chamber and shall all be serviceable for extended compressor life. Bearing maintenance shall not be required until 10,000 run hours. Compressors with bearings that are not accessible for service have a limited life span and shall not be accepted. Compressors shall have an integral radial flow fan for cooling and shall not require any additional electric cooling fans. Each compressor shall have flexible connectors on intake and discharge. Each compressor shall deliver 15.2 scfm at 100 psi, and shall include a discharge check valve, a diverter isolation valve, an air-cooled aftercooler, a moisture separator with automatic drain, and a high discharge temperature shut down switch.
- F. **MOTORS** Each compressor shall be belt driven by a 1750 RPM, TEFC NEMA construction motor. Motors running at speeds higher than 1750 RPM shall not be acceptable. AIR
- G. **RECEIVER** The system shall include an ASME air receiver rated for 200 PSI MAWP. The tank shall be equipped with a pressure gauge, safety relief valve, block and by-pass valves, and condensate sight gauge and automatic electronic tank drain with manual override. The receiver shall be internally lined with an FDA approved material for corrosion resistance.
- H. **CONTROL SYSTEM** Each Unit sequenced with the Powerex SOS circuit card logic controller with digital display. Controller to have four display modes to monitor the operation of the unit. Operating Mode to display the compressors running status, unit run hours, and system pressures. Caution mode to indicate high temperature shutdown status, high current draw, and failure of temperature switch. Service mode to inform user when scheduled maintenance interval is reached. Set Mode allows the user to adjust some of the parameters of the operational mode such as start/stop pressures. Compressors are sequenced on and off based on the air demand of the system creating a highly energy efficient system to the user.
- I. **AIR PURIFICATION PACKAGE** The air purification package shall be sized in conformance with NFPA 99 specifications and consist of the following: Dual desiccant air dryers, dual filter and regulator bank with sample ports, Dew Point Monitor with alarms, and all bypass piping. Piping to be brass, stainless, or type K copper, and cleaned for medical air use. All components shall be mounted piped and wired to the air receiver.
- J. **DESICCANT AIR DRYERS** Each twin-tower desiccant dryer shall be sized for the peak calculated system demand to provide a pressure dew point of Zero degrees F. Dryer controls shall include a re-pressurization cycle to prevent shocking of the desiccant bed prior to switching towers. An integral purge saving control system shall be provided and shall suspend the purge air loss during periods of low demand. When the dryer is in purge control mode, the tower switching valves shall not operate, and only one desiccant tower shall be on-line. Dryers that continue to operate the switching valves on a fixed cycle, while in purge control mode shall not be acceptable.
- K. **FILTRATION AND PRESSURE REDUCING STATION** The filtration systems shall consist of 3 stages of filtration, two pressure reducing valves with pressure gauges, a 75 psig final line safety valve, and a sample air port. The first stage of filtration shall include dual .01 micron coalescing pre-filters with element change indicators and automatic condensate drains and installed up-stream of the air dryers. The second stage shall include dual 1-micron particulate filters with element change indicators and installed downstream of the air dryers. The third stage shall include dual activated carbon filters installed downstream of the air dryers. A dual set of pressure reducing valves with pressure gauges shall be installed downstream of the final filters and shall be adjusted to an outlet pressure of 55 psig. Each filter/dryer/regulator assembly shall be plumbed with bypass valves to enable service without disrupting air flow to the facility.
- L. **MONITORING EQUIPMENT** • CO Monitor with audible/visual alarms & dryer contacts remote alarm signal • Dew point with audible/visual alarms & dryer contacts remote alarm signal
- M. **SYSTEM CONNECTIONS** The system is supplied with inlet and discharge flex connectors. All piping complies with current NFPA 99 requirements

2.6 COMPUTER INTERFACE CABINET

- A. Description:
 - 1. Wall mounting.

2. Welded steel with white enamel finish.
3. Gasketed door.
4. Grounding device.
5. Factory-installed, signal circuit boards.
6. Power transformer.
7. Circuit breaker.
8. Wiring terminal board.
9. Internal wiring capable of interfacing 20 alarm signals.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Equipment Mounting: Install air compressors and air dryers on concrete bases using elastomeric pads.
 1. Minimum Deflection: 1/4 inch.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Install compressed-air equipment anchored to substrate.
- C. Arrange equipment so controls and devices are accessible for servicing.
- D. Maintain manufacturer's recommended clearances for service and maintenance.
- E. Install the following devices on compressed-air equipment:
 1. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
 2. Pressure Regulators: Install downstream from air compressors and dryers.
 3. Automatic Drain Valves: Install on aftercoolers, receivers, and dryers. Discharge condensate to oil water separator.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 22 15 13 "General-Service Compressed-Air Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to machine, allow space for service and maintenance.
- C. Coordinate exhaust ductwork connections with Division 23000 work.

3.3 IDENTIFICATION

- A. Identify general-service air compressors and components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Check for lubricating oil in lubricated-type equipment.
 3. Check belt drives for proper tension.
 4. Verify that air-compressor inlet filters and piping are clear.
 5. Check for equipment vibration-control supports and flexible pipe connectors, and verify that equipment is properly attached to substrate.
 6. Check safety valves for correct settings. Ensure that settings are higher than air-compressor discharge pressure, but not higher than rating of system components.
 7. Drain receiver tanks.
 8. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 9. Test and adjust controls and safeties.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air compressors, aftercoolers, and air dryers.

END OF SECTION 22 15 19

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Division shall be governed by the Contract Documents. Provide materials, labor, equipment, and services necessary to furnish, deliver and install all work of this Division as shown on the drawings, as specified herein, and/or as required by job conditions.
- B. Requirements given herein may be affected by other related requirements of the project specification. Correlation of the contract requirements is the responsibility of the contractor.
- C. Perform the work in accordance with the above requirements and the provisions of all applicable codes and laws.
- D. Standard Specifications and Abbreviations
 - 1. The following abbreviations used in the Specifications refer to organizations publishing specifications and standards. These shall be construed to mean the latest standard adopted and published at the date of advertisement for bids and such specifications are made part of the Contract Documents to the same extent as if written out in full.
 - ADC-Air Diffusion Council
 - AHDGA-American Hot Dip Galvanizing Association
 - AISC-American Institute of Steel Construction
 - AMCA-Air Moving and Conditioning Association
 - ANSI-American National Standards Institute
 - ARI-American Refrigeration Institute
 - ASHRAE-American Society of Heating, Refrigerating and Air Conditioning Engineers
 - ASME-American Society of Mechanical Engineers
 - ASSE-American Society of Sanitary Engineers
 - ASTM -American Society for Testing Materials
 - AWS-American Welding Society
 - AWWA-American Water Works Association
 - FIA-Factory Insurance Association
 - FM-Factory Mutual
 - FS-Federal Specifications
 - MCAA-Mechanical Contractors Association of America
 - MSS-Manufacturers Standardization Society of Valve and Fittings Industry
 - NBFU-National Board of Fire Underwriters
 - NBS-National Bureau of Standards
 - NEC-National Electrical Code
 - NEMA-National Electrical Manufacturers Association
 - NFPA-National Fire Protection Association
 - NSF-National Sanitation Foundation
 - OSHA-Occupational Safety Health Act
 - PDI-Plumbing and Drainage Institute
 - PPI-Plastics Pipe Institute
 - SMACNA-Sheet Metal and Air Conditioning Contractors National Association, Inc.
 - SSPC-Steel Structures Painting Council
 - STI-Steel Tank Institute
 - UL-Underwriters Laboratories, Inc.
 - USDC-United States Department of Commerce
 - USPHS-United States Public Health Service
 - 2. Conform to ANSI - 31.1.0 and addenda for basic materials and methods of installation for closed piping systems with pressures in excess of 30 PSI, and for pipe welding regardless of system pressures.
 - 3. Conform to ASME Boiler and Pressure Vessel Code Section VIII and FM requirements for construction of unfired pressure vessels.

- E. Where the word "provided" is used in this document, it shall be understood to mean, "provided and installed."

1.2 SUMMARY

- A. This Section includes the following:
1. HVAC demolition.
 2. Concrete bases.
 3. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. Where the word "provided" is used in this document, it shall be understood to mean "provided and installed."
- G. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 2. NBR: Acrylonitrile-butadiene rubber.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.5 INTENT

- A. It is the intention of the specifications and drawings to provide for finished work, tested and ready for operation.
- B. Items and services not shown on drawings, but mentioned in specifications, or vice versa, or items and services necessary to render the work complete and ready for operation, even if not specified, shall be provided without additional cost.
- C. Where conflicts occur between drawings and specifications, or within either document, the Contractor shall ask for and obtain a written clarification from the Architect prior to submitting his bid. Otherwise, the items or arrangements of superior quality, greater quantity or higher cost shall prevail and be included in the contract price.

1.6 WORK INCLUDED

- A. The work under this Division shall include all labor, material, equipment plant, services and administrative tasks required to complete and make operable the mechanical work shown on the

Drawings, required for proper operation and/or specified herein, including but not limited to, the following:

1. Preparation and submission of shop drawings, diagrams and illustrations.
2. Procuring all necessary permits and approvals, and paying all required fees and charges in connection with the work of this Division.
3. Protection, testing, cleaning, adjustment and guarantee of the work of this Division to safely, properly and continuously operate.
4. As-built drawings, operating and maintenance instructions and manuals.
5. Identification labels, tags, charts and diagrams.
6. Maintain existing services to heating, etc. (temporary services during construction).
7. Coordination.
8. Project record documents.
9. Operation and Maintenance Data.
10. Cutting and patching.

1.7 WORK NOT INCLUDED

- A. Removal, patching, or otherwise handling of hazardous materials.

1.8 SITE INVESTIGATION

- A. Examine the drawings and specifications of all trades, and the site, and from these investigations be responsible for the nature and location of work, general and local conditions, particularly those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads, etc.

1.9 DRAWINGS

- A. Drawings are diagrammatic and indicate the general arrangement of systems and work required. Do not scale the Drawings. Consult the architectural drawings and details, and the drawings of other trades, for exact location of equipment.
- B. Drawings shall be used in layout of work. Check reference drawings to verify spaces in which the work will be installed. Maintain maximum headroom and space conditions. Where headroom or space conditions appear inadequate, Architect shall be notified before proceeding with installation.
- C. If directed by the Architect, make minor modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.
- D. The drawings are schematic and diagrammatic.
 1. Symbols and diagrams are used to indicate the various items of work and the complete systems, but not necessarily have dimensional significance, neither do they necessarily delineate all related and subsidiary parts and equipment.
 2. The work shall be installed complete and ready for operation in conformity with the intent expressed on the drawings and in the specifications.
 3. Coordinate the work with the requirements of the architectural and structural drawings for dimensions, locations and clearances.
 4. Locations of items exposed to view shall be taken from the architectural drawings or located as directed.

1.10 COORDINATION WITH OTHER TRADES

- A. Closely schedule the work so that work will be installed at the proper time without delaying the completion of the entire project.
- B. Where the work will be installed in close proximity to the work of other trades, or where there is evidence that the work will interfere with the work of other trades, arrange space conditions to make a satisfactory adjustment. If work is installed before coordinating with other trades, make necessary changes to the work to correct the condition without additional cost to the owner.
- C. Prepare complete set of drawings showing all necessary slab openings and structural supports that require structural framing. Drawings shall clearly indicate sizes and location relative to established

column lines. Drawings shall be completed in sufficient time to allow for structural steel fabrication so as not to delay project schedule.

- D. Shop drawing submissions shall demonstrate a knowledge of the work of other trades, and shall show the locations of the work of other trades which affects the work of this contract.

1.11 EQUIPMENT DEVIATIONS

- A. It is the intent of these specifications that wherever a manufacturer of a product or a catalog number is specified, and terms "or equal" or "or approved equal" are used, the substituted item must conform in all essential respects to the specified item including operating efficiency, noise generated, and method of operation. Consideration will not be given claims that the substituted item meets performance requirements with lesser construction. Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance.
- B. When such approved deviation requires a different quantity and or arrangement of equipment from that specified or indicated on the drawings, provide required equipment, wiring, piping, connections, valves, and structural supports, and any other additional equipment required by the deviation, at no additional cost to the Owner.
- C. When an item of equipment is proposed, other than that detailed or specified on the drawings, (this includes equipment by manufacturers indicated in the specifications) which requires any additional equipment or redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical, plumbing or architectural design, such costs shall be incurred by the Contractor without cost to the Owner. Redesign, updates, revisions required for any trade as a result of the use of equipment not detailed on the drawings shall be performed and borne by the contractor.
- D. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified at no cost to the Owner. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.12 EQUIPMENT AND SYSTEMS CRITERIA

- A. The criteria of design and performance to produce the required operation is based on equipment shown or scheduled.
 - 1. The equipment must conform to the structural design provisions for loads applied to the structure, to the dimensions established by drawings for mechanical spaces and other clearances, and for inlet and outlet locations and proper relationship to associated equipment, piping and ducts.
- B. The descriptions cover basic equipment and operation but not all the details of design and construction.
 - 1. The use of singular in descriptions does not limit the quantities of items to be furnished to provide the operation specified. Furnish all equipment required to produce specified performance under installed conditions.
 - 2. Factory wiring, interconnections, piping and connections shall conform to these specifications for the field work.
 - 3. Provide all trim, enclosures and accessories required to make a complete installation.

1.13 GENERAL CONFORMANCE

- A. Obtain all general conformances in accordance with Division 1 - General Requirements.
- B. Submit to the Architect for review a list of manufacturers of equipment proposed for the work. Intent to use exact make specified does not relieve the Contractor of responsibility for submitting the required list.
- C. Where any specific materials, process or method of construction, or manufactured article is specified by name or by reference to catalog number of a manufacturer, or other standards, the intent is not to take precedence over the basic duty and performance specified, noted on drawings,

or as required for intended results. In all cases, verify the duty specified with the specific characteristics of the equipment offered for review.

- D. Equipment and material of one type, shall be products of one manufacturer. Multiple manufacturers for like items are not acceptable.

1.14 SUBMITTALS

- A. Manufacturer's Drawings.
 - 1. Equipment listed in each section, include material specifications, operating characteristics and finishes.
- B. Installation Drawings.
 - 1. Coordinated scale drawings of equipment including interconnecting piping and ductwork.
 - 2. Coordinate space requirements for equipment and services.
 - 3. Include connections, anchorages and fastenings.
 - 4. Make allowance for clearances for access to and maintenance of equipment.
- C. Wiring and Control Diagrams.
 - 1. Electric wiring diagrams and automatic control diagrams and sequences of operation. The wiring diagrams must be complete and coordinated with the equipment actually installed.
- D. Provide composite shop drawings showing work of all related construction, when required to ensure full coordination and proper fitting of the work, and when directed by the Architect.
- E. Provide drawings showing dimensions and locations of concrete work required for the mechanical work.
- F. Reports:
 - 1. Manufacturer's certified pressure tests on vessels.
 - 2. Manufacturer's certified performance tests on operating equipment.
 - 3. Field pipe testing reports and certificates of approval.
 - 4. Welder's certificates and field test report.
 - 5. Field operating test results for operating equipment.
 - 6. Performance report on the balancing of air and water systems.
 - 7. Performance report and calculations for vibration isolation equipment.
 - 8. Manufacturer's certified reports on motorized equipment alignment and installation.
- G. If submissions of catalog cuts of standard manufactured items show different types, options, finishes, performance requirements, or other variations, those features proposed shall be clearly identified.
 - 1. If any variations from the catalog description are proposed or required, such variations must be clearly noted on the cut.
 - 2. Shop drawings shall clearly indicate all details, sectional views, arrangements, working and erection dimensions, kinds and quality of materials and their finishes, and other information necessary for proper checking and for fabrication and installation of the items, and shall include all information required for making connections to other work.
 - 3. Shop drawings shall be numbered consecutively, and drawings related to various units comprising a proposed assembly shall be submitted simultaneously so that units may be checked individually and as an assembly.
 - 4. Keep on the site, in good order, a complete up-to-date set of approved shop drawings. All shop drawings shall be available for inspection by the Architect.
 - 5. On product data submittals, clearly indicate model numbers, dimensions, weights, electrical requirements, accessories and performance data. Submittals not properly prepared will be rejected without further review.

6. The review of shop drawings will be general, and shall not be construed as permitting any departure from the contract requirements other than those specifically brought to the Architect's attention and so approved.
 - a. If the shop drawings show any variations from contract requirements because of standard shop practices or other reasons, such variations shall be clearly identified on the drawings in order that, if acceptable, suitable action may be taken for proper adjustment in other work affected thereby.
 - b. Failure to identify such variations will not relieve the Contractor of responsibility for executing the work in accordance with the Contract even though such shop drawings have been reviewed and the work installed.
 - c. Review shall not relieve the Contractor of responsibility for any error in details, dimensions, etc., that may exist on shop drawings nor for the furnishing of materials or work required by the Contract and not indicated on the shop drawings.
 - d. Review shall not be construed as acceptable departure from details or instructions previously furnished by the Architect.
 - e. Review with a requirement for resubmission is a review contingent upon satisfactory resubmission within 30 days. Failure to comply shall result in a revocation of the contingent review.
- H. Shop Drawing Schedule
 1. The Contractor shall submit, within 30 days of the award of his contract, a schedule of all proposed shop drawing submissions. The schedule shall include the following information.
 - a. Item to be submitted
 - b. Date of submission
 - c. Latest date for review
 - d. Manufacturers of the specified item.
 2. Items not specifically listed as "approved equal" should be listed for consideration at this time.
 3. Shop drawings require a minimum of 10 business days from the date they have been received by the Consulting Engineer's office to adequately review the submittal. If there is any submittal which requires to be expedited sooner than the 10 business days, the Engineer shall be informed in writing at the beginning of construction with a list of those submittals.
- I. Submittals will be reviewed for conformance with the contract drawings and specifications. The engineer's review stamp will be affixed to submittals. One of the following actions will be taken:
 1. Reviewed:
 - a. No comments, corrections, or marks have been made to the submittal. Re-review by the engineer is not required. The submittal is in general conformance with the design concept. Construction, fabrication and/or manufacture can proceed subject to the provision that the work shall be in accordance with the requirements of the Contract Documents. Final acceptance of the work shall be contingent upon such compliance.
 2. Furnish As Corrected
 - a. Comments, corrections, or marks made. Re-review is not required. Submission is in general conformance with the design concept subject to notations on the returned Submittal. Construction, fabrication, and/or manufacturer can proceed subject to the provisions that the work shall be carried out in compliance with all annotations and/or corrections indicated on the returned Submittal and in accordance with the Contract Documents. Final acceptance of the work shall be contingent on such compliance.
 3. Revise and Resubmit
 - a. Significant issues/discrepancies/incomplete information was provided in the Submittal. Revise or prepare a new submittal in accordance with the notations and Contract Documents. Resubmit without delay.
 4. Rejected

- a. Submittal does not meet Contract document intent. Revise or prepare a new submittal in accordance with the notations and Contract Documents. Resubmit without delay.
- J. A submittal review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections or comments made on the shop drawings during this review do not relieve the contractor from Compliance with the requirements of the plans and specifications. Approval of a specific item shall not include approval of an assembly of which the item is a component. The contractor is responsible for: dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences and procedures of construction; coordination of his or her work with that of all other trades; and for performing all work in a safe and satisfactory manner.

1.15 GUARANTEES AND SERVICES

- A. All workmanship, installation materials and equipment shall be maintained and serviced for the guarantee period at no additional cost to the Owner.
- B. Leave entire system installed under this Contract in perfect working order, and, without additional charge, replace any work or material which develops defects within the guarantee period, including all other work damaged as a result of such defects.
- C. Non-durable, expendable items such as air filter media are not subject to replacement after the date of acceptance.
- D. The guarantee period shall be extended as follows:
 - 1. For heating systems, one year plus the time necessary to include one continuous heating season from November 1st to April 1st.
 - 2. For air-conditioning systems, one year plus the time necessary to include one continuous cooling season from May 1st to October 1st.
- E. Manufacturers' Warranties
 - 1. The manufacturer shall warrant that the equipment which he has furnished is free from defects in material and workmanship. Obligations under this warranty shall be as follows:
 - a. The equipment manufacturer or supplier shall provide and pay for all labor, parts, accessories, materials, freight and other services to repair or replace any equipment or part thereof which, in the course of installation, start-up and testing is found to be defective.
 - b. For a period of eighteen months from the date of acceptance by the Owner, the manufacturer shall replace any defective equipment or part thereof; freight costs for return of defective parts, labor for parts replacement, and replacement of lost refrigerant, are the responsibility of the installing contractor.
 - c. The manufacturer shall provide an additional warranty on all equipment as indicated in their respective specification section.
 - d. Performance - where equipment is specified by size, guarantee that it will have the capacity specified in the system in which it is installed.
 - 2. The final acceptance of the equipment will be made after the manufacturer has adjusted his equipment, balanced the various systems, demonstrated that it fulfills the requirements of the drawings and specifications, and has furnished all the required certificates of inspection and acceptance.

1.16 SYSTEM MAINTENANCE

- A. Contractor shall provide routine and preventive maintenance during the warranty period.
- B. Contractor shall submit to Engineer for review a comprehensive plan covering items to be maintained and service to be performed. Plan shall include checklist for use by maintenance personnel.
- C. Owner's representative(s) shall accompany contractors' maintenance personnel, and receive instructions on proper maintenance of equipment.

- D. Maintenance performed shall include a complete check out of each piece of equipment at least twice during warranty period. The first shall occur approximately half way through the warranty period (change of season) and the second at the conclusion of the warranty period and prior to commencement of the owner's maintenance. Each system and/or piece of equipment shall be inspected, operated through its complete range of operation, and adjusted as required. This inspection shall be the same as performed at the initial start-up of the item or system. In addition, there shall be monthly maintenance inspections of each piece of equipment.
- E. During the monthly inspections, equipment shall be checked for items such as dirty filters, belt wear, lubrication, unusual sounds or unusual operating conditions. Monthly inspections shall also include recording of system operating temperatures and pressures.
- F. Contractor shall include all labor and material to perform the maintenance, including replaceable items such as filters and belts.
- G. Maintenance on the following items shall be included:
 - 1. Fans
 - 2. Filters
 - 3. Temperature controls
 - 4. Actuators

1.17 PERMITS AND CERTIFICATES

- A. Prior to proceeding with any installation, prepare and submit to the proper authorities, for their review, all required working drawings. Provide all necessary notices, obtain all permits and pay all local, state and federal taxes, fees and other costs in connection with the work.
- B. The contractor shall be responsible for performing all controlled inspections required by applicable Administrative Building Code.

1.18 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces.
- D. It is the intent of these specifications that wherever a manufacturer of a product or a catalog number is specified, and terms "or equal" or "or approved equal" are used, the substituted item must conform in all essential respects to the specified item including operating efficiency, noise, physical size, capacity, quality, and material.

1.19 COORDINATION DRAWINGS

- A. Sheet metal and plumbing shop drawings that have been coordinated with architectural and structural drawings shall be submitted to Engineer for review. Drawings must be returned from Engineer either "Reviewed" or "Furnish as corrected" prior to being used as basis for coordination drawings. Refer to Section 23 31 13 for sheet metal shop drawing and 232113 for piping shop-drawing requirements.
- B. The contractor shall submit for review sheet metal shop standards. Any sheet metal shop drawings submitted prior to the submission of the shop standards shall be returned "not reviewed".
- C. After sheet metal and piping drawings have been revised per Engineers comments, reproducible copies shall be sent to the others trades in the following sequence for the inclusion of their work:
 - 1. Plumbing contractor
 - 2. Electrical work
 - 3. Mechanical piping
- D. After all trades have included their work on the coordination drawing and noted conflicts, all trades shall meet to resolve conflicts and agree to acceptable solutions. Each trade shall sign

coordination drawings. Items not shown on coordination drawing is responsibility of omitting contractor and contractor is subject to additional costs incurred by other trades.

- E. The Architect and Engineer are not part of the coordination drawing process. The Engineer will provide assistance relative to acceptability of installations.
- F. Submit final signed coordination drawing to engineer for review. Engineer will review for acceptability of installations.
- G. Any work fabricated or installed prior to sign off by all trades shall be removed and re-installed in conformance with coordination drawings.
- H. Each contractor (mentioned above) is responsible for the coordination of his sub-contractors.
- I. The overall coordination of the coordination process is the responsibility of the general contractor and/or construction manager.
- J. The overall coordination of the coordination process is the responsibility of the general contractor and/or construction manager. The Engineer is not responsible for the coordination process. The Engineer will respond to questions that arise from the coordination process. Drawings submitted will be reviewed for clearly identified conflicts only. Solutions to conflicts will not bear additional cost.
- K. Drawings shall be submitted in both hard copy and electronic (AutoCAD or Revit version as required by the Owner) version or AutoCAD Version 2018 if not specified. Number of copies of each as requested by the Owner.
- L. Electronic drawing files shall be generated by the Contractor.

1.20 AS BUILT DRAWINGS/RECORD DRAWINGS

- A. Provide a complete set of as-built drawings reflecting as installed conditions. As-built drawings shall indicate all installed conditions of systems within this discipline. Drawings shall be of similar scale as the construction documents and include details as necessary to clearly reflect the installed condition. Drawings shall be bound in a complete and consecutive set. Supplemental sketches and loose paperwork will not be acceptable and will be returned for revision. The contractor shall comply with the engineer's comments to produce a clear and concise set of drawings.
- B. Provide "As-Built Drawings" indicating in a neat and accurate manner a complete record of all revisions of the original design of the work.
 - 1. Drawings shall be submitted in both hard copy and electronic (AutoCAD and Revit version as required by the Owner) version or AutoCAD Version 2018 if not specified. Number of copies of each as requested by the Owner. PDFs inserted into an AutoCad file are not acceptable.
 - 2. Indicate the following installed conditions:
 - a. All changes and an accurate record from the contract drawings or appropriate shop drawings, of all deviations, between the work shown and work installed.
 - b. Ductwork mains and branches, size and location; locations of dampers and other control devices; filters, boxes, coils and terminal units requiring periodic maintenance or repair.
 - c. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart.
 - d. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - e. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
 - f. Contract modifications, actual equipment and materials installed.
 - g. Submit for review bound sets of the required drawings, manuals and operating instructions.
 - 3. Electronic drawing files shall be generated by the Contractor.

PART 2 - PRODUCTS

2.1 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Furnish manufacturers operating and maintenance instructions, parts lists and sources of supply for replacements in accordance with Division 1 - General Requirements.
- B. Provide the following:
 - 1. Complete sets of final and correct shop drawings, maintenance and replacement parts manuals, and operating instructions, for equipment supplied.
 - 2. Bind each set within a common binder. Index and organize with a table of contents, to permit quick and convenient reference.
 - 3. Three days of instruction in operation and maintenance of equipment to Owner's maintenance force. Design a 2-week period, convenient to Owner, during which qualified personnel, including manufacturers' technicians and engineers will be available for Owner's instruction.
- C. Master Operating Manual (submit in quadruplicate and as digital PDF document)
 - 1. Complete sets of final and correct shop drawings, maintenance and replacement parts manuals, and operating instructions, for equipment supplied.
 - a. Directory Manual – A TOC for all volumes in the Systems Manual shall be provided. Each heading should include a brief description of contents of each section to help when searching the PDF document.
 - b. Owner's Project Requirements (OPR)
 - c. Basis of Design (BOD)
 - d. Construction Record Documents
 - e. System and equipment operating data / Maintenance Procedures – O&M materials as submitted and approved. This should not be limited to MEP O&M's, but should include all applicable O&M materials through the specified divisions.
 - f. Final ATC as-built documents
 - g. Warranty Manual – A separate manual inclusive of all project warranties. Warranty start dates shall be clearly presented and conform with project requirements. Warranty claims procedures shall be clearly presented.
 - 1) Manual shall be compiled in electronic format, shall be unprotected, and shall be searchable. The documents within this manual shall be easy to navigate provided with table of contents, filed individually tabbed & bookmarked.
 - 2. Manufacturer's mechanical and electrical equipment parts lists of all components of the systems listed on the equipment schedules, control diagrams and wiring diagrams of controllers.
 - a. List shall give system number, unit number, manufacturer's model number, and manufacturer's drawing numbers.
 - 3. Step by step operating instructions for each system including preparation for starting, summer operation, winter operation, shutdown and draining.
 - 4. Maintenance instructions for each type of equipment.
 - 5. List of nearest local suppliers for all equipment.
 - 6. Manufacturer's literature describing each piece of equipment listed on the equipment schedules, control diagrams and wiring diagrams of controllers and a copy of the air balance report.
 - 7. As-installed control diagrams by the control manufacturer.
 - 8. Description of sequence operation by the control manufacturer.
 - 9. Recommended trouble shooting procedures in the event of foreseeable mechanical system failure.
 - 10. Chart of the tag numbers, location and function of each valve.
 - 11. Copies of the following test reports:
 - a. System Performance.
 - b. Required Pressure Tests.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

- A. Refer to Division 1 Sections "Cutting and Patching" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.3 PAINTING

- A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- B. Inside of all ductwork where visible through registers and grilles: one coat of flat black paint.

3.4 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement.

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

3.6 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.7 COORDINATION AND LAYOUT

- A. Study Drawings and Specifications to insure completeness of work required.
 - 1. Include supplementary items normal to manufacturers' requirements or standard accepted trade practices as necessary to complete work, though not specifically indicated or specified.
- B. Verify measurements and conditions in field before starting work.
- C. Examine materials to which work is to be applied and notify the Architect, in writing, of any conditions existing, which are detrimental to proper and expeditious installation of work.
 - 1. Starting of work shall be construed as acceptance of conditions.
- D. Confer with other trades, install work to avoid interference with other trades, and possible necessary adjustments to conform to structural conditions and work of other trades.
- E. Coordinate and set inserts and locate openings in floors and walls in new construction.
 - 1. Locate pipes and ducts to avoid interference with other work shown on the drawings and as directed by the Architect.
 - 2. Keep all concealed pipes and ducts within the enclosing construction provided.
 - 3. Arrange exposed work neatly in parallel runs and parallel with walls or structure, with uniformly spaced hangers and supports, and within the spaces assigned for each kind of work.
- F. Make coordinated layouts showing concrete work required for housekeeping pads, equipment bases and inertia masses, which are cast in place, including the location of anchors and dowels.
 - 1. Coordinate the scheduling and placing of the concrete to suit the mechanical work schedules.
 - 2. Concrete housekeeping pads are to cover the full area of each piece of equipment.
 - 3. Concrete bases are to be of dimension and heights to suit the equipment.
 - 4. The forming and placing of concrete will be provided under this specification section.

3.8 MAINTENANCE OF EQUIPMENT AND SYSTEM PRIOR TO FINAL ACCEPTANCE

- A. Maintain all equipment and systems installed until final acceptance by the Architect and the Owner, and take such measures as necessary to insure adequate protection of all equipment and materials during delivery, storage, installation and shut-down conditions.
 - 1. This responsibility shall include all provisions required to meet the conditions incidental to the delays pending final test of systems and equipment.

- B. After installation of systems has been completed, operate the system to determine the capability of the equipment and controls to conform to the requirements of the drawings and specifications prior to performance testing.

3.9 EQUIPMENT INSTALLATION

- A. Locate and set equipment anchor bolts, dowels and aligning devices for all equipment requiring them. Refer to concrete work coordination.
 - 1. Level the equipment and grout solid between the equipment and the surface below. Grout to be premixed Embeco or Five Star Grout mixed in accordance with manufacturer's specifications.
- B. The field assembly, installation and alignment of equipment is to be done under field supervision provided by the manufacturer or with inspections, adjustments and reviewed by the manufacturer.
- C. Equipment startup.
 - 1. Each manufacturer of equipment shall provide qualified personnel to inspect, review and to supervise the operating tests of the equipment.
- D. Equipment and system test operation.
 - 1. Notify the Architect in advance of beginning the equipment and system test operation.
 - 2. Each piece of equipment shall be operated in its system as long as required to provide proper functioning.
 - 3. Perform an operating test of each complete system for twenty-four hours continuous operation as a minimum, or as long as required to provide coordination and proper functioning of all related systems and controls.
 - 4. The operating criteria for each test shall be determined in advance with the Architect's acceptance whenever seasonal conditions will not produce a full design load on any equipment or system.
 - 5. Certify to the Owner that all equipment is functioning properly.
 - 6. Should the apparatus fail to meet the contract requirements, adjust, repair or replace all defective or inoperative parts and again conduct the complete performance tests.

3.10 WORK RELATING TO CONTROLS AND INSTRUMENTS

- A. Under Sections 230900 as applicable, provide control wiring for the following:
 - 1. All circuits actuated by a temperature control system component.
 - 2. All circuits which actuate a temperature control component.
 - 3. All control panel wiring to terminal strips and field wiring from terminal strips to field mounted devices.
 - 4. All wiring from the "AUTO" side of hand-off-auto switches on units being controlled by Sections 230900
 - 5. Wiring of electro-mechanical devices required to be located on or in temperature control panels.
 - 6. Wiring of DDC trunk, communication, and sensor cable wiring.
 - 7. Wiring shall comply with material and workmanship standards of Division 26.
 - 8. All 120 volt power wiring to vav boxes, damper actuators, line voltage thermostats, valve actuators, relay's, etc. not powered by 24 volt power is work of this division. Wiring shall comply with material and workmanship standards of Division 26.
- B. Under Division 26, perform the following work under supervision of Sections 230900
 - 1. Wiring of all devices and circuits carrying voltages greater than 120 volts.
 - 2. Wiring of line and load power feeds to all disconnects, starters, and electric motors.
 - 3. Wiring of 115 volt power feeds to all temperature control panels.
 - 4. Power wiring to all motors 110 volt to 480 volt.
 - 5. Furnish smoke detectors for mounting in ducts.
 - 6. Specific power feeds shown or specified in Div 26 documents.

3.11 CLEANING AND ADJUSTING

- A. Blow out, clean and flush each system of piping, and equipment as required to thoroughly clean the systems.

1. Clean all materials and equipment, and leave in condition ready to operate and receive succeeding finishes where required.
2. Adjust and align all equipment interconnected with couplings or belts.
 - a. Adjust valves of all types and operating equipment of all types to provide proper operation.
 - b. Remove and clean elements in all steam trap bodies.
 - c. Clean all strainers.
- B. Lubricate equipment as recommended by the manufacturer, during temporary construction use, and provide complete lubrication just prior to acceptance.
- C. Permanent equipment operated during construction shall not be abused or be used in service different from its design application.
 1. Temporary disposable filters shall be used during temporary operation.
 2. All expendable media, including belts used for temporary operation and similar expendable materials shall be replaced just prior to acceptance.
 3. Packing boxes of equipment operated during construction must be replaced just prior to system acceptance, using materials and methods specified by the supplying manufacturer.
- D. Equipment furnished with factory finishes shall be retouched and repainted as required to present a new appearance.
- E. Provide and maintain protection for all of the work whether completed or in progress.
 1. Provide coverings and enclosures as required.
- F. New and existing operating equipment and systems shall be clean and dust free inside and out.
 1. Concealed and unoccupied areas such as plenums, pipe and duct spaces and Equipment Rooms shall be free of rubbish and swept clean at time of acceptance.

3.12 PAINTING

- A. Thoroughly clean all surfaces, requiring prime painting, of rust, loose scale, oil and grease.
 1. Dry surfaces before painting.
 2. Do not paint controls, nameplates, or labels.
- B. Paint all equipment not painted at the factory with one prime coat.
- C. Provide field painting as follows:
 1. All exposed iron work, including uninsulated ferrous piping and conduit system components, hangers, supports, equipment bases, and apparatus; prime coat, red oxide primer.
 2. Un-insulated ductwork and casing exposed to view and exposed galvanized surfaces of conduit and piping and of equipment prime painted at the shop as indicated on the drawings to be painted Prime coat, zinc chromate for galvanized surfaces.
 3. Inside of all ductwork/plenums where visible through registers and grilles: One coat of flat black paint specifically designed for metal surfaces. Paint shall be low VOC.
 4. Inside of all outdoor air intake plenums where visible through louvers: One coat of flat black paint specifically designed for exterior metal surface. Paint shall be low VOC.

3.13 CONNECTIONS TO EQUIPMENT

- A. Provide mechanical connections to equipment and fixtures requiring such connections which are supplied by Owner or under other divisions.
- B. Provide unions, nipples, adapters, valves, flexible connections, and other trim required for final connections for each such fixture or item of equipment, as required for complete and perfect operation.

3.14 WORKMANSHIP

- A. Perform all work in a practical, neat and workmanlike manner with mechanics skilled in work, and using the best practices of the trade involved.

- B. No work shall be concealed until it has been inspected and approved by the Architect.
- C. Workmanship or materials not meeting with requirements of the specifications and drawings and satisfaction of the Architect shall be rejected and immediately replaced in an acceptable manner, without additional cost to the Owner.

3.15 LUBRICATION

- A. All equipment furnished, installed or connected under this division, shall be inspected for proper lubrication when connected and before operation of the equipment is begun.
- B. The Contractor for the work of this division will be held responsible for any damage to equipment that is operated without having been properly lubricated.

3.16 REMOVALS AND RELOCATIONS

- A. All components of abandoned systems and abandoned portions of systems shall be removed, and, unless specifically noted to be relocated and reused, become the Owner's property. Contractor shall dispose of removed materials as directed by the Owner.
- B. Where portions of systems noted for removal remain in use, permanently seal the point of disconnection so as not to interfere with the system operation.
- C. Where interferences between the existing system components and new work require relocation of the existing components to clear that interference, they may be reused, except where specifically noted to the contrary, providing that their condition is noted by the Owner's representative and they are approved by him as equivalent to new.
- D. Where existing system components are required to be replaced, all new components shall be provided.
- E. System components include all accessories, cables, controls, conduits, hangers, bases and supports and outlets.
- F. The work specified under this contract specifically excludes the removal or patching of "hazardous materials." This includes but is not limited to asbestos, PCBs or any other material having been designated by the Environmental Protection Agency as a hazardous material. If this contractor finds anything, which is suspected of being a hazardous material, it should be immediately brought to the Owner's attention.

3.17 USE OF PREMISES AND CLEANING

- A. Remove and dispose of all waste materials and rubbish due to all construction operations under the contract, except as otherwise noted, and keep the building free from rubbish and dirt caused by his and/or his subcontractors' employees.
 - 1. During the entire progress of the work, rubbish removal shall be made frequently so as to prevent any potential safety or health hazard.
- B. Upon completion of the work, remove all protection, paint, putty, and other stains from all fixtures and glass and leave the premises thoroughly broom cleaned.

3.18 CUTTING, ALTERING AND PATCHING

- A. Provide all cutting, chasing, drilling, altering and rough patching required for the work of this division.
 - 1. Including the restoring of existing work cut for or damaged by installation of new work, and where present work is removed.
 - 2. All materials and workmanship required in connection with cutting, altering and rough patching shall match the existing work in every respect.
- B. Do all shoring, bracing, cutting, patching, piecing out, filling in, repairing and refinishing of all present work as made necessary by the alteration and the installation of new work.
- C. All holes and openings occurring in the existing floors after equipment, partitions, floors, steel work, conduits and pipes are removed or installed shall be closed up with materials similar to the adjacent work.

- D. The size and location of items requiring an opening, chase or other provisions to receive it shall be given by the trade requiring same in ample time to avoid undue cutting of any new work to be installed. These provisions shall not relieve the Contractor from keeping informed as to the required opening, chases, etc., nor from responsibility for the correctness thereof, nor for cutting and repairing after the new work is in place.
- E. Include all cutting, repairing and patching in connection with the work that may be required to make the several parts come together properly and fit it to receive or be received by the work of other trades, as shown on the drawings and/or specified, or reasonably implied by the drawings and specifications.
- F. All repairing, patching, piecing-out, filling-in, restoring and refinishing shall be neatly done by mechanics skilled in their trade to leave same in condition satisfactory to the Owner.
- G. Materials and their methods of application for patching shall comply with applicable requirements of the specifications.
 - 1. Materials and workmanship not covered by the specifications and items of work exposed to view adjoining existing work to remain shall conform to similar materials and workmanship existing in or adjacent to the spaces to be altered.
- H. Cutting, repairing and patching shall include all items shown on the drawings, specified in the specifications or required by the installation of new work or the removal of existing work.
- I. Remove partitions, walls, suspended ceilings, etc., as necessary to perform the required alterations or new construction work.
 - 1. Avoid damage to construction and finishes that are to remain.
- J. Protect and be responsible for the existing building, facilities and improvements.
 - 1. Any disturbance or damage to the work, the existing building, and improvements, or any impairments of facilities resulting from the construction operations, shall be promptly rectified, with the disturbed, damaged, or impaired work, restored, repaired or replaced at no extra cost.
- K. All alterations which are not indicated on the drawings nor specified herein but necessary to make good existing work disturbed by reason of the work shall be restored to a condition satisfactory to the Owner.
- L. All holes in masonry floors and walls are to be core drilled.
- M. Disturbed concrete and /or cement floor areas shall be patched with approved type latex mortar.
 - 1. When cement mortar is used for patching, the surfaces shall be depressed a minimum depth of 1".
- N. Reinstall all weather protection work in waterproof manner.
- O. Openings in roofs.
 - 1. Openings in roofs shall be kept properly plugged and caulked at all times, except when being worked on, to preclude the possibility of flooding due to storms or other causes. After completion of work, openings shall be permanently sealed.
- P. Temporary openings.
 - 1. All temporary openings cut in walls, floors or ceilings for pipe or ductwork shall be closed off with transite or an equally non-combustible material except when mechanics are actually working at the particular opening.

3.19 TEMPORARY HEAT

- A. Provide all labor, fuels, materials, tools, appliances and equipment and perform all operations necessary to maintain sufficient temporary heat to ensure uninterrupted progress in the work and to protect all work and materials against injury from dampness and cold until issuance of the Architect's Final Certificate. The contractor shall assume the cost of the fuel, the cost of other operating supplies used for temporary heating and the costs involved in the operation and maintenance of the temporary wiring and electricity. If the adaptation of the temporary heating system to the contractor's temporary heating needs makes necessary the installation of temporary

control valves, gauges, or piping, or the installation of temporary radiation units, the contractor shall bear the costs of such adaptations. In addition to the foregoing, the contractor shall provide temporary heat to the extent itemized below, but not limited to the following:

1. During the placing, setting and curing of all concrete, an ambient temperature of 50° F in the areas involved.
 2. During the placing, setting and/or curing of interior masonry, metal furring, plaster, tile; and taping and spackling of drywall an ambient temperature of 60° F shall be maintained in the space involved.
 3. In spaces where resilient floor coverings or temperature sensitive material are stored an ambient temperature of 70°F shall be maintained, and such temperature of 70°F shall be maintained, and such temperature shall be maintained 48 hours before, during and 48 hours after installation in each space where such covering is required.
 4. Except as noted above, all areas in which work is in progress, shall be maintained at 45°F during working hours.
- B. The building will be considered in an enclosed condition when roofing and exterior walls are in place and openings in exterior walls and roof have been provided with temporary or permanent closures.
- C. The medium and procedure of providing temporary heat at all times shall be subject to the acceptance of the Owner and Architect.
- D. Prior to the building being in an enclosed condition, temporary heat may be provided by approved type of heating and devices complete with covers, vents and/or smoke connections to the outer air so that all human hazards may be eliminated and the surfaces of the buildings protected against damage by deleterious substances resulting from the heating operations.
- E. Only heaters employing tanked gas will be permitted. The use of oil or coke as fuels will not be accepted. Provide thermal protection under heating units.
- F. Prior to starting the metal lathing, or drywall spackling, the work shall be sufficiently advanced for the building to be enclosed and for temporary heat to be produced by the permanent heating system.
- G. After the building is enclosed and the permanent heating system or portion of the system is substantially complete and acceptable to the Owner for temporary heating use, the contractor may, at the Owner's discretion, be permitted to use such heating facilities for temporary heat.
- H. The contractor in using the permanent heating system for temporary heating agrees to the following:
1. After the Architect and the Owner approve and accept the project heating system, or portion thereof, for temporary heating purposes, the heating system shall be turned over to the contractor. When the contractor has no further need for temporary heat, the heating system shall be returned to the Owner.
 2. The contractor shall assume the cost of the fuel, the cost of other operating supplies used for temporary heating and the costs involved in the operation and maintenance of the temporary wiring and electricity. If the adaptation of the temporary heating system to the contractor's temporary heating needs makes necessary the installation of temporary control valves, gauges, or piping, or the installation of temporary radiation units, the contractor shall bear the costs of such adaptations.
 3. That portion of the project's heating system and other related mechanical equipment termed the temporary heating system shall be limited to equipment and the necessary piping, traps, valves, strainers, controls, pumps, starters, wiring and all other apparatus and equipment necessary to cause the temporary heating system to function correctly.
- I. The cost of maintenance of the temporary heating system for temporary heating is the responsibility of the contractor.
- J. The permanent boilers, piping and air handling systems may not be utilized for temporary heating without the operation of the permanent water treatment system and approval from the Building Owner.

- K. These provisions for temporary heating do not alter the requirements of the "General and Supplementary General Conditions" with respect to "Guarantees" and/or any "General Guaranty" contained herein.

3.20 PENETRATIONS THROUGH FIRE SEPARATIONS AND NON-RATED ASSEMBLIES

- A. Pack annular space between duct (insulation), sleeve and pipe (insulation) and / or conduit in fire rated and non-rated construction with fire retardant putty, sealant and / or caulk. Material shall be non-asbestos based and installed in accordance with manufacturers instructions for fire rating required.
- B. Penetrations of multiple items and penetrations with annular space greater than 1/2" shall be provided with a backing material in accordance with manufacturer's instructions and as part of a UL listed assembly.
- C. Fire retardant sealer and system shall meet ASTM E-84, ASTM E-814, and UL-1479.
- D. All fire stopping shall be provided by one (1) manufacturer.
- E.

MANUFACTURER	MODEL
1. Dowsil	Firestop 700
2. STI	SSP100 Fire Putty
3. Nelson	CLK, FSP
4. 3M	CP-25WB, Fire Putty MP

3.21 SHUTDOWN OF EXISTING BUILDING SYSTEMS

- A. Do not interrupt existing services or systems in the building unless absolutely necessary. Such interruptions and interferences must be made as brief as possible and only after coordination with the Owner. The Owner requires a minimum of seven (7) days notice. Obtain prior permission, in writing.
- B. Where the work makes temporary interruptions unavoidable, they shall be made during off hours. "Off hours" shall be dictated by the Owner.
- C. Arrange to work continuously, including overtime, if required, to ensure that systems will shut down only during the time actually required to make the necessary connections to existing work.

3.22 DEMONSTRATION AND TRAINING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain all new equipment. Refer to Division 1 Section "Demonstration and Training."
- B. The contractor and subcontractors shall be responsible for coordinating, scheduling and completing operations and maintenance training for the Owners designated personnel on all systems and equipment.
- C. All training materials (agenda, hand-outs, etc.) shall be submitted to the Owner for review and approval at least two weeks in advance of scheduled training.
- D. Equipment training shall be provided by a factory authorized technical representatives, experienced in training, operation and maintenance procedures for installed systems, subsystems and equipment.
- E. All qualifications and certifications of the individual performing the training shall be submitted to the Owner for review and approval at least two weeks in advance of scheduled training.
- F. Each Subcontractor responsible for training will submit a written training plan to the Owner for review and approval at least two weeks in advance of scheduled training. The plan will include field orientation during installation, classroom instruction and field training after the completion of installation.
- G. For all major systems and equipment, the automated temperature controls subcontractor shall provide a short discussion of the control of the equipment during the mechanical or electrical

training conducted by others in addition to formal automated temperature controls training on work station operation, graphics, etc.

- H. Provisions shall be included to provide formal classroom training to representatives of the Owner's personnel for select systems and equipment above and beyond typical preventative maintenance training (e.g. manufacturer provided training school, etc.). Coordinate requirements with the owner.
- I. Provisions shall be included to provide professional videotaping of classroom training. For systems not being commissioned, the CM will carry the responsibility of hiring the Cx Videographer. The duration and intensity of the videotaping is to be specified at the discretion of the Owner.
- J. Training Requirements Outline:
 - 1. General familiarization and operating procedures for each of the building's system installations.
 - 2. Routine maintenance procedures for equipment.
 - 3. Specific operating and maintenance procedures for:
 - a. Mechanical systems
 - b. Electrical systems
 - c. Plumbing systems
 - d. Fire protection systems
 - e. Temperature control system
 - f. Envelope systems
 - 4. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Schedule for routine cleaning and maintenance.
 - e. Repair instructions.
 - 5. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
 - 6. Quantity of training: The maintenance personnel shall be trained on the various building systems in sessions of not less than 40 hours of training time. The training shall be of a sufficient extent to allow the trained staff, to train their peers and to demonstrate the training sessions were effective.
 - 7. Video Documentation: The contractor(s) shall provide for the services of a qualified videographer to digitally record the training sessions.

END OF SECTION 23 00 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Warning signs and labels.
 - 2. Duct labels.
 - 3. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 5 by 3 inches.
 - 6. Minimum Letter Size: 1 inch for name of units. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws; adhesive for locations where screws or rivets would void warranty of equipment.
- B. Label Content: Include equipment's Drawing designation tag or unique equipment number, equipment description, and electrical panel designation serving the equipment. Pump tags shall also indicate gpm, ft of head, and HP for the pump, as indicated on the balance report submittal.
 - 1. Label Format:

EQUIPMENT NUMBER
DESCRIPTION
SERVICE
DATA
ELECTRIC PANEL
 - 2. Examples:

CWP-5	AHU-1
CHILLED WATER PUMP	VAV AIR HANDLING UNIT
CHILLED BEAMS	FIRST FLOOR EAST
210 GPM / 55 FT / 5 HP	15,000 CFM,
EP-7 / CKT 15,16,17	EP-9 / CKT 21,22,23
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

- D. Plastic labels shall be plenum rated when located in plenums.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 5 by 3 inch.
- F. Minimum Letter Size: 1 inch for name of units. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws; adhesive for locations where screws or rivets would void warranty of equipment.
- H. Label Content: Include caution and warning information, plus emergency notification instructions.
- I. Plastic labels shall be plenum rated when located in plenums.

2.3 DUCT LABELS

- A. Stencils: Minimum letter height of 2 inches for ducts; and minimum letter height of 1 inch for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: Fiberboard or metal.
 - 2. Paint: Exterior, acrylic enamel in colors as indicated.
- B. Label Contents: Include identification of duct service using same designations as used on Drawings, duct size, and an arrow indicating flow direction.
- C. Lettering, background, and arrows color shall meet the facilities standards, if no standard exists, confirm the following color scheme is acceptable prior to commencement of work:
 - 1. All lettering and arrows: Black
 - 2. Background:
 - a. Blue: For outside air supply ducts.
 - b. Yellow: For hot air supply ducts, cold air supply ducts and combined hot/cold air supply ducts.
 - c. Green: For exhaust, relief, return, and mixed air ducts.
 - d. Red: For hazardous material exhaust.

2.4 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 inches high by 7 inches long.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Red background with white lettering.
- B. Plastic labels shall be plenum rated when located in plenums.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Permanently fasten labels on each major item of mechanical equipment.

- B. Locate equipment labels where accessible and visible. Where equipment is located within finished spaces, equipment labels shall not be located on the face of the equipment; where possible, the label shall be located on the least conspicuous side.
- C. All motor driven equipment, HVAC components, and major electrical boxes shall be individually numbered. (Example: For unit heaters, use UH-1, UH-2, etc., even though both units are of the same size and type.) All designations shall be unique, integrated with and distinguished from existing designations.
- D. Pump tags (for base mounted pumps) shall be a minimum of 3-inch-high and 18-inch-long with 1-inch-high lettering and fastened to the end face of the isolation base.
- E. Air handling unit tags shall have a minimum of 1-inch-high lettering.
- F. The Contractor shall make it possible for the personnel operating and maintaining the equipment and systems in this project to readily identify the various pieces of equipment, valves, piping, etc., by marking them. All items of equipment such as fans, pumps, etc., shall be clearly marked using engraved nameplates as hereinafter specified. The item of equipment shall indicate the same number as shown on the Drawings.

3.3 DUCT LABEL INSTALLATION

- A. Stenciled Duct Label: Stenciled labels, showing service and flow direction.
- B. Locate labels/stencils:
 - 1. Near points where ducts enter into concealed spaces.
 - 2. At maximum intervals of 25 feet in each space where ducts are exposed or concealed by removable ceiling system.
 - 3. At all changes of direction.
 - 4. Both sides of penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 5. Near major equipment items and other points of origination and termination.
- C. Labeling/stenciling of all exposed ductwork shall be coordinated with the architect and engineer prior to the commencement.

3.4 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.
- B. Markings shall be provided in locations required by and meeting the color requirements of the "Safety Code Color for Marking Physical Hazards", ANSI Z53.1, latest revision.
- C. Each Machinery and Chiller Room door shall be labeled with the refrigerant(s) present and the health hazard warning labels associated with each.
- D. All emergency break glass (BG) and emergency power off (EPO) switches shall be label with a complete description of their operation and the equipment they serve.
 - 1. Example: CH-1 and CH-2 Emergency Shut Off
This button shuts down chillers CH-1 and CH-2
- E. All refrigerant alarm lights shall be labeled with a complete description of their operation.
 - 1. Example: Refrigerant Warning
DO NOT ENTER
When flashing, high levels of refrigerant are present

END OF SECTION 23 05 53

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 00 and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Section 23 09 93 "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.2 SUMMARY

- A. All work of this Division shall be coordinated and provided by the single Building Management System (BMS) Contractor.
- B. Materials furnished under this work shall be in compliance with the Build America Buy America Act (BABA) Refer to general conditions for further requirements.
- C. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 23 Sections for details.
- D. The work of this Division shall be as required by the Specifications, Point Schedules and Drawings.
- E. If the BMS Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team.
- F. This contractor shall include and provide the controls, equipment, meters, devices, gauges, sensors and control wiring for all equipment and sequences indicated and implied in this section, Specification Section 23 09 93 SEQUENCE OF OPERATION, on the plans, schedules, and on the flow and control diagrams.
- G. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

1.3 DEFINITIONS

- A. Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.
- B. Binary: A two-state system where an "ON" condition is represented by one discrete signal level and an "OFF" condition is represented by a second discrete signal level.
- C. Building Management System (BMS): The total integrated system of fully operational and functional elements, including equipment, software, programming, and associated materials, to be provided by this Division BMS Contractor and to be interfaced to the associated work of other related trades.
- D. BMS Contractor: The single Contractor to provide the work of this Division. This Contractor shall be the primary manufacturer, installer, commissioner and ongoing service provider for the BMS work.
- E. Control Sequence: A BMS pre-programmed arrangement of software algorithms, logical computation, target values and limits as required to attain the defined operational control objectives.
- F. Direct Digital Control: The digital algorithms and pre-defined arrangements included in the BMS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.
- G. BMS Network: The total digital on-line real-time interconnected configuration of BMS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.
- H. Node: A digitally programmable entity existing on the BMS network.

- I. BMS Integration: The complete functional and operational interconnection and interfacing of all BMS work elements and nodes; including third party controls and devices, in compliance with all applicable codes, standards and ordinances so as to provide a single coherent BMS as required by this Division.
- J. Provide: The term "Provide" and its derivatives when used in this Division shall mean to furnish, install in place, connect, calibrate, test, commission, warrant, document and supply the associated required services ready for operation.
- K. PC: Personal Computer from a recognized major manufacturer
- L. Furnish: The term "Furnish" and its derivatives when used in this Division shall mean supply at the BMS Contractor's cost to the designated third party trade contractor for installation. BMS Contractor shall connect furnished items to the BMS, calibrate, test, commission, warrant and document.
- M. Wiring: The term "Wiring" and its derivatives when used in this Division shall mean provide the BMS wiring and terminations.
- N. Install: The term "Install" and its derivatives when used in this Division shall mean receive at the jobsite and mount.
- O. Protocol: The term "protocol" and its derivatives when used in this Division shall mean a defined set of rules and standards governing the on-line exchange of data between BMS network nodes.
- P. Software: The term "software" and its derivatives when used in this Division shall mean all of programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the BMS industry for real-time, on-line, integrated BMS configurations.
- Q. The use of words in the singular in these Division documents shall not be considered as limiting when other indications in these documents denote that more than one such item is being referenced.
- R. Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in the Division documents are for general information only and are to assist in the reading and interpretation of these Documents.
- S. The following abbreviations and acronyms may be used in describing the work of this Division:

ADC	-	Analog to Digital Converter
AI	-	Analog Input
AN	-	Application Node
ANSI	-	American National Standards Institute
AO	-	Analog Output
ASCII	-	American Standard Code for Information Interchange
ASHRAE	-	American Society of Heating, Refrigeration and Air Conditioning Engineers
AWG	-	American Wire Gauge
CPU	-	Central Processing Unit
CRT	-	Cathode Ray Tube
DAC	-	Digital to Analog Converter
DDC	-	Direct Digital Control
DI	-	Digital Input
DO	-	Digital Output
EEPROM	-	Electrically Erasable Programmable Read Only Memory
EMI	-	Electromagnetic Interference
FAS	-	Fire Alarm Detection and Annunciation System
GUI	-	Graphical User Interface
HOA	-	Hand-Off-Auto
ID	-	Identification
IEEE	-	Institute of Electrical and Electronics Engineers
I/O	-	Input/Output
LAN	-	Local Area Network
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
MCC	-	Motor Control Center

NC	-	Normally Closed
NIC	-	Not In Contract
NO	-	Normally Open
OWS	-	Operator Workstation
OAT	-	Outdoor Air Temperature
PC	-	Personal Computer
RAM	-	Random Access Memory
RF	-	Radio Frequency
RFI	-	Radio Frequency Interference
RH	-	Relative Humidity
ROM	-	Read Only Memory
RTD	-	Resistance Temperature Device
SPDT	-	Single Pole Double Throw
SPST	-	Single Pole Single Throw
XVGA	-	Extended Video Graphics Adapter
TBA	-	To Be Advised
TCP/IP	-	Transmission Control Protocol/Internet Protocol
TTD	-	Thermistor Temperature Device
UPS	-	Uninterruptible Power Supply
VAC	-	Volts, Alternating Current
VAV	-	Variable Air Volume
VDC	-	Volts, Direct Current
WAN	-	Wide Area Network

1.4 BMS DESCRIPTION

- A. This functionality shall extend into the equipment rooms. Devices residing on the automation network located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the BMS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.
- B. All points of user interface shall be on standard PCs that do not require the purchase of any special software from the BMS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser.
- C. The work of the single BMS Contractor shall be as defined individually and collectively in all Sections of this Division's specification together with the associated Drawings and the associated interfacing work as referenced in the related documents.
- D. The BMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BMS.
- E. Provide a complete, neat and workmanlike installation. Use only manufacturer approved employees/contractors who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.
- F. Manage and coordinate the BMS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades. Notify relevant contractors, owner and design team if the work of other trades is impeding any BMS work.
- G. The BMS as provided shall incorporate, at minimum, the following integrated features, functions and services:
 - 1. Operator information, alarm management and control functions.
 - 2. Enterprise-level information and control access.
 - 3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
 - 4. Diagnostic monitoring and reporting of BMS functions.

5. Offsite monitoring and management access.
 6. Energy management
 7. Standard applications for terminal HVAC systems.
- H. Vendor shall provide ALL required hardware, software, equipment, programming, wiring, power, etc. for a fully functional and complete operational system.
- I. All controllers, local control units, control units, unitary controllers, shall be provided with uninterruptable power supplies. In the event of the loss of normal power, the controllers shall continue to operate for a user adjustable period of up to 10 minutes to maintain controls. until the backup power/generator is fully running.
- J. All controls work shall be provided and installed by the BMS contractor, unless specified otherwise. Equipment shall be controlled, monitored and programmed through the BMS with end-devices provided by the BMS Contractor.
- K. BMS time shall utilize the astronomical time clock.

1.5 QUALITY ASSURANCE

- A. General
1. The Building Management System Contractor shall be the primary manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Building Management Systems.
 2. The BMS Contractor shall be a recognized national manufacturer, installer and service provider of BMS.
 3. The BMS Contractor shall have a branch facility within a 100-mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis.
 4. As evidence and assurance of the contractor's ability to support the Owner's system with service and parts, the contractor must have been in the BMS business for at least the last ten (10) years and have successfully completed total projects of at least 10 times the value of this contract in each of the preceding five years.
 5. The Building Management System architecture shall consist of the products of a manufacturer regularly engaged in the production of Building Management Systems, and shall be the manufacturer's latest standard of design at the time of bid.
 6. BMS manufacturer shall be able to show backward compatibility of software and controllers for a minimum of 10 years.
- B. Workplace Safety and Hazardous Materials
1. Provide a safety program in compliance with the Contract Documents.
 2. The BMS Contractor shall have a corporately certified comprehensive Safety Certification Manual and a designated Safety Supervisor for the Project.
 3. The Contractor and its employees and subtrades comply with federal, state and local safety regulations.
 4. The Contractor shall ensure that all subcontractors and employees have written safety programs in place that covers their scope of work, and that their employees receive the training required by the OSHA have jurisdiction for at least each topic listed in the Safety Certification Manual.
 5. Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.
 6. Hazards observed but not created by the Contractor or its subcontractors shall be reported to either the General Contractor or the Owner within the same day. The Contractor shall be required to avoid the hazard area until the hazard has been eliminated.
 7. The Contractor shall sign and date a safety certification form prior to any work being performed, stating that the Contractors' company is in full compliance with the Project safety requirements.
 8. The Contractor's safety program shall include written policy and arrangements for the handling, storage and management of all hazardous materials to be used in the work in compliance with the requirements of the AHJ at the Project site.
 9. The Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

- C. Quality Management Program
1. Designate a competent and experienced employee to provide BMS Project Management. The designated Project Manager shall be empowered to make technical, scheduling and related decisions on behalf of the BMS Contractor. At minimum, the Project Manager shall:
 - a. Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.
 - b. Manage the financial aspects of the BMS Contract.
 - c. Coordinate as necessary with other trades.
 - d. Be responsible for the work and actions of the BMS workforce on site.
 2. The Project Manager shall be the same through the course of the project and shall not be changed without notification to and approval by the Owner.

1.6 REFERENCES

- A. All work shall conform to the following Codes and Standards, as applicable:
1. National Fire Protection Association (NFPA) Standards.
 2. National Electric Code (NEC) and applicable local Electric Code.
 3. Underwriters Laboratories (UL) listing and labels.
 4. UL 864 UUKL Smoke Control
 5. UL 268 Smoke Detectors.
 6. UL 916 Energy Management
 7. NFPA 70 - National Electrical Code.
 8. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.
 9. NFPA 92A and 92B Smoke Purge/Control Equipment.
 10. Factory Mutual (FM).
 11. American National Standards Institute (ANSI).
 12. National Electric Manufacturer's Association (NEMA).
 13. American Society of Mechanical Engineers (ASME).
 14. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
 15. Air Movement and Control Association (AMCA).
 16. Institute of Electrical and Electronic Engineers (IEEE).
 17. American Standard Code for Information Interchange (ASCII).
 18. Electronics Industries Association (EIA).
 19. Occupational Safety and Health Administration (OSHA).
 20. American Society for Testing and Materials (ASTM).
 21. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
 22. Americans Disability Act (ADA)
 23. ANSI/EIA 909.1-A-1999 (LonWorks)
 24. ANSI/ASHRAE Standard 135-2010 (BACnet)
- B. In the case of conflicts or discrepancies, the more stringent regulation shall apply.
- C. All work shall meet the approval of the Authorities Having Jurisdiction at the project site.

1.7 SUBMITTALS

- A. Shop Drawings, Product Data, and Samples
1. The BMS contractor shall submit a list of all shop drawings with submittals dates within 60 days of contract award.
 2. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.
 3. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BMS Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Owner.
 4. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.
 5. The BMS Contractor shall correct any errors or omissions noted in the first review, these and any further corrections and additions to subsequent submittals shall be bubbled with a revision cloud.

6. At a minimum, submit the following:
 - a. BMS network architecture diagrams including all nodes and interconnections.
 - b. Systems schematics, sequences and flow diagrams.
 - c. Points schedule for each point in the BMS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.
 - d. Samples of Graphic Display screen types and associated menus.
 - e. Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
 - f. Control Damper Schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.
 - g. Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Design and Actual Valve CV, Design Pressure and Actual Pressure Drop, and Actuator Type.
 - h. Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address
 - i. Details of all BMS interfaces and connections to the work of other trades.
 - j. Product data sheets or marked catalog pages including part number, photo and description for all products including software.
- B. The BMS shall adhere to the most recent version of the Facilities control system standards.
- C. Laminated control drawings including system control schematics, as-built sequences of operation, as-built controller locations and panel termination drawings, shall be provided in panels for major pieces of equipment. Terminal unit drawings shall be located in the central plant equipment panel or mechanical room panel. The drawings shall accurately record the actual controller programming and settings at the time of building turnover and an electronic copy of all as-builts shall be provided to the Instrumentation & Controls department at the completion of the project.

1.8 RECORD DOCUMENTATION

- A. Operation and Maintenance Manuals
 1. Four (4) printed hard copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project.
 2. The entire Operation and Maintenance Manual shall also be uploaded to the BMS server/operator workstation in PDF format, accessible via a graphical link. The Operation and Maintenance Manual link and the printed hard copies shall include the following in an organized, tabulated fashion:
 - a. Table of contents.
 - b. As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
 - c. Manufacturer's product data sheets or catalog pages for all products including software.
 - d. System Operator's manuals.
 - e. Archive copy of all site-specific databases and sequences.
 - f. BMS network diagrams.
 - g. Final record of BMS sequence of operations.
 - h. Interfaces to all third-party products and work by other trades.
- B. All As-Built drawings and documentation shall be uploaded to the BMS server/operator workstation in PDF format. Each equipment graphic shall contain a link to a copy of the as-built documents associated with the system including, at a minimum, the controls flow diagram, controller wiring diagrams, sequence of operation and cut sheets for applicable control devices.
- C. Digital copies of the Operation and Maintenance Manual and As-built documents shall be provided in PDF format, on a USB flash drive, and turned over to the Owner at the completion of the project. The USB flash drive shall include all necessary software required to access and view the documents. A logically organized table of contents shall provide dynamic links to view and print all documents. Viewer software shall provide the ability to display, zoom, and search all documents.

1.9 WARRANTY

- A. Standard Material and Labor Warranty:
 - 1. Provide an eighteen (18) month labor and material warranty on the BMS from substantial completion.
 - 2. If within eighteen (18) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the BMS Contractor at the cost of the BMS Contractor.
 - 3. Maintain an adequate supply of materials within 50 miles of the Project site such that replacement of key parts and labor support, including programming are readily available. Warranty work shall be done during BMS Contractor's normal business hours.

PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION

- A. The controls system is an extension of the existing Alerton controls system serving the building.
- B. The Building Management System shall consist of the following:
 - 1. All components required for a complete and working BMS
 - 2. All components required for complete integration of any packaged equipment such as chillers, boilers, dedicated outdoor air units, variable refrigerant volume heat pumps, air handling units, etc.
- C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.
- D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
- E. Controls contractor shall have a meeting with the architect, engineer, and owner prior to programming to discuss capabilities, schedules and sequences.
- F. Controls contractor shall allocate all required programming hours and re-programming hours during Cx (not less than 30 hours for re-programming) for programming of the Facilities schedules and complete sequences.
- G. The BMS shall be coordinated with the Facilities standards and system requirements.
- H. All Building Automation System materials shall be new, the best of their respective kinds without imperfections or blemishes and shall not be damaged in any way, and shall consist of the manufacturer's latest technology at the time of equipment submittal.
- I. The work under this Section shall include furnishing all labor, materials, equipment and services necessary to provide the control systems as specified herein, and on the contract documents, including all required input/output and miscellaneous electrical appurtenances necessary for a complete and operational system.
- J. Equipment connections involving magnetic controllers:
 - 1. All wiring associated with automatic controls from any BMS panel required to energize the controller holding coil shall be under this division.
- K. Equipment connections involving three phase or single phase 208 volt or 480-volt manual motor controllers:
 - 1. The provisions for the branch circuit, the unit disconnect, connections (line and load) to the controller, and final connection to the equipment shall be as specified under Division 26.
- L. Equipment connections involving single-phase 120-volt equipment:
 - 1. Connections and the provisions for the branch circuit, the unit disconnect, unless supplied with equipment, and final connections to the equipment shall be as specified under Division 26.
- M. All wiring from the unit disconnect to automatic controls from any BMS panel shall be under this division.

- N. All BMS component hardware will be new, and will consist of the manufacturer's latest technology.
- O. System shall support Web services data exchange with any other system that complies with XML (extensible markup language) and SOAP (simple object access protocol) standards. Web services support shall as a minimum be provided at the workstation or web server level and shall enable data to be read from or written to the system.
- P. Acceptable Manufacturers
 - 1. Subject to compliance with requirements, all controllers and workstation software shall be manufactured by:
 - a. Alerton

2.2 BMS ARCHITECTURE

- A. Control Network
 - 1. Provide supervisory control over the control network and shall support both (2) of the following communication protocols:
 - a. BACnet Standard MS/TP.
 - 2. Control networks shall provide either "Peer-to-Peer," Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
 - 3. BMS Controllers shall reside on the control network.
 - 4. Control network communication protocol shall be BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135.
 - 5. A BACnet Protocol Implementation Conformance Statement shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.
 - 6. The Conformance Statements shall be submitted 10 days prior to bidding.
- B. Integration
 - 1. Hardwired
 - a. Analog and digital signal values shall be passed from one system to another via hardwired connections.
 - b. There will be one separate physical point on each system for each point to be integrated between the systems.
 - 2. Direct Protocol (Integrator Panel)
 - a. The BMS system shall include appropriate hardware equipment and software to allow bi-directional data communications between the BMS system and 3rd party manufacturers' control panels. The BMS shall receive, react to, and return information from multiple building systems, including but not limited to the chillers, boilers, variable frequency drives, power monitoring system.
 - b. All data required by the application shall be mapped into the controller's database, and shall be transparent to the operator.
 - c. Point inputs and outputs from the third-party controllers shall have real-time interoperability with BMS software features such as: Control Software, Energy Management, Custom Process Programming, Alarm Management, Historical Data and Trend Analysis, Totalization, and Local Area Network Communications.
 - 3. BACnet Protocol Integration - BACnet
 - a. The neutral protocol used between systems will be BACnet and comply with the ASHRAE BACnet standard 135-2010.
 - b. A complete Protocol Implementation Conformance Statement (PICS) shall be provided for all BACnet system devices.
 - c. The ability to command, share point object data, change of state (COS) data and schedules between the host and BACnet systems shall be provided.

2.3 USER INTERFACE

- A. Existing user interface shall be utilized for this application.
- B. User Interface Application Components
 - 1. Operator Interface
 - a. An integrated browser based client application shall be used as the user operator interface program.
 - b. All Inputs, Outputs, Setpoints, and all other parameters as defined within Part 3, shown on the design drawings, or required as part of the system software, shall

- be displayed for operator viewing and modification from the operator interface software.
- c. The user interface software shall provide help menus and instructions for each operation and/or application.
 - d. All controller software operating parameters shall be displayed for the operator to view/modify from the user interface. These include: setpoints, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.
 - e. The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:
 - 1) User access for selective information retrieval and control command execution
 - 2) Monitoring and reporting
 - 3) Alarm, non-normal, and return to normal condition annunciation
 - 4) Selective operator override and other control actions
 - 5) Information archiving, manipulation, formatting, display and reporting
 - 6) FMS internal performance supervision and diagnostics
 - 7) On-line access to user HELP menus
 - 8) On-line access to current BMS as-built records and documentation
 - 9) Means for the controlled re-programming, re-configuration of BMS operation and for the manipulation of BMS database information in compliance with the prevailing codes, approvals and regulations for individual BMS applications.
 - f. The operation of the control system shall be independent of the user interface, which shall be used for operator communications only. Systems that rely on an operator workstation to provide supervisory control over controller execution of the sequences of operations or system communications shall not be acceptable.
2. Navigation Trees
- a. The system will have the capability to display multiple navigation trees that will aid the operator in navigating throughout all systems and points connected. At minimum provide a tree that identifies all systems on the networks.
 - b. Provide the ability for the operator to add custom trees. The operator will be able to define any logical grouping of systems or points and arrange them on the tree in any order. It shall be possible to nest groups within other groups. Provide at minimum 5 levels of nesting.
 - c. The navigation trees shall be "dockable" to other displays in the user interface such as graphics. This means that the trees will appear as part of the display, but can be detached and then minimized to the Windows task bar or closed altogether. A simple keystroke will reattach the navigation to the primary display of the user interface.
3. Alarms
- a. Alarms shall be routed directly from controllers to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the user interface shall, at the minimum, provide the following functions:
 - 1) Log date and time of alarm occurrence.
 - 2) Generate a "Pop-Up" window, with audible alarm, informing a user that an alarm has been received.
 - 3) Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
 - 4) Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.
 - 5) Provide the ability to direct alarms to an e-mail address or alphanumeric pager. This must be provided in addition to the pop up window described above. Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.
 - 6) Any attribute of any object in the system may be designated to report an alarm.
 - b. The BMS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions

- c. The BMS shall annunciate application alarms at minimum, as required by Part 3.
- 4. Reports and Summaries
 - a. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:
 - 1) All points in the BMS
 - 2) All points in each BMS application
 - 3) All points in a specific controller
 - 4) All points in a user-defined group of points
 - 5) All points currently in alarm
 - 6) All points locked out
 - 7) All BMS schedules
 - 8) All user defined and adjustable variables, schedules, interlocks and the like.
 - b. Summaries and Reports shall be accessible via standard UI functions and not dependent upon custom programming or user defined HTML pages.
 - c. Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report or summary on the system printer for use as a building management and diagnostics tool.
 - d. The system shall allow for the creation of custom reports and queries via a standard web services XML interface and commercial off-the-shelf software such as Microsoft Access, Microsoft Excel, or Crystal Reports.
- 5. Schedules
 - a. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:
 - 1) Weekly schedules
 - 2) Exception Schedules
 - 3) Monthly calendars.
 - b. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.
 - c. It shall be possible to define one or more exception schedules for each schedule including references to calendars
 - d. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days for a minimum of five years in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the exception schedules.
 - e. Changes to schedules made from the User Interface shall directly modify the schedule database.
 - f. Schedules and Calendars shall comply with ASHRAE SP135/2003 BACnet Standard.
 - g. Selection of a single menu item or tool bar button shall print any displayed schedule on the system printer for use as a building management and diagnostics tool.
- 6. Historical trending and data collection
 - a. Each controller shall store trend and point history data for all analog and digital inputs and outputs, as follows:
 - 1) Any point, physical or calculated, may be designated for trending. A minimum of three methods of collection shall be allowed:
 - a) Defined time interval
 - b) Upon a change of value
 - 2) Each controller shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.
 - b. Trend and change of value data shall be stored within the controller and uploaded to a dedicated trend database or exported in a selectable data format via a provided data export utility. Uploads to a dedicated database shall occur based upon one of the following: user-defined interval, manual command, or

- when the trend buffers are full. Exports shall be as requested by the user or on a time scheduled basis.
- c. The system shall provide a configurable data storage subsystem for the collection of historical data. Data can be stored in either Microsoft Access or SQL database format.
7. Trend data viewing and analysis
- a. Provide a trend viewing utility that shall have access to all database points.
 - b. It shall be possible to retrieve any historical database point for use in displays and reports by specifying the point name and associated trend name.
 - c. The trend viewing utility shall have the capability to define trend study displays to include multiple trends
 - d. Displays shall be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style.
 - e. Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.
 - f. Display magnitude shall automatically be scaled to show full graphic resolution of the data being displayed.
 - g. Trend studies shall be capable of calculating and displaying calculated variables including highest value, lowest value and time based accumulation.

2.4 DDC SYSTEM CONTROLLERS

- A. Controller
- 1. The Controller shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.
 - 2. The controllers shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
 - 3. Controllers shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable.
 - 4. The controller shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
 - 5. The controller shall include a removable base to allow pre-wiring without the controller.
 - 6. The controller shall include troubleshooting LED indicators to identify the following conditions:
 - a. Power On
 - b. Power Off
 - c. Download or Startup in progress, not ready for normal operation
 - d. No Faults
 - e. Device Fault
 - f. Field Bus - Normal Data Transmission
 - g. Field Bus - No Data Transmission
 - h. Field Bus - No Communication
 - i. Sensor-Actuator Bus - Normal Data Transmission
 - j. Sensor-Actuator Bus - No Data Transmission
 - k. Sensor-Actuator Bus - No Communication
 - 7. The controller shall accommodate the direct wiring of analog and binary I/O field points.
 - 8. The controller shall support the following types of inputs and outputs:
 - a. Universal Inputs - shall be configured to monitor any of the following:
 - 1) Analog Input, Voltage Mode
 - 2) Analog Input, Current Mode
 - 3) Analog Input, Resistive Mode
 - 4) Binary Input, Dry Contact Maintained Mode
 - 5) Binary Input, Pulse Counter Mode
 - b. Binary Inputs - shall be configured to monitor either of the following:
 - 1) Dry Contact Maintained Mode
 - 2) Pulse Counter Mode
 - c. Analog Outputs - shall be configured to output either of the following

- 1) Analog Output, Voltage Mode
 - 2) Analog Output, current Mode
 - d. Binary Outputs - shall output the following:
 - 1) 24 VAC Triac
 - e. Configurable Outputs - shall be capable of the following:
 - 1) Analog Output, Voltage Mode
 - 2) Binary Output Mode
9. The controller shall have the ability to reside on a Controller Bus
 - a. The controller Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
 - b. The controller Bus shall support communications between the controllers.
 - c. The controller Bus shall also support Input/Output Module (IOM) communications with the controllers.
 - d. The controller Bus shall support a minimum of 100 IOMs and controller in any combination.
 - e. The controller Bus shall operate at a maximum distance of 15,000 Ft. between the FEC and the furthest connected device.
10. The controller shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).
 - a. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
 - b. The SA Bus shall support a minimum of 10 devices per trunk.
 - c. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the controller and the furthest connected device.
11. The controller shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the Controller Bus or the SA Bus.
12. The Controller shall support, but not be limited to, the following:
 - a. Hot water, chilled water/central plant applications
 - b. Built-up air handling units for special applications
 - c. Terminal units
 - d. Special programs as required for systems control

2.5 FIELD DEVICES

- A. Input/Output Module
 1. The Input/Output Module (IOM) provides additional inputs and outputs for use in the Controller.
 2. The IOM shall communicate with the Controller over either the Controller Bus or the SA Bus using BACnet Standard protocol SSPC-135, Clause 9.
 3. The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
 4. The IOM shall have a minimum of 4 points to a maximum of 17 points.
 5. The IOM shall support the following types of inputs and outputs:
 - a. Universal Inputs - shall be configured to monitor any of the following:
 - 1) Analog Input, Voltage Mode
 - 2) Analog Input, Current Mode
 - 3) Analog Input, Resistive Mode
 - 4) Binary Input, Dry Contact Maintained Mode
 - 5) Binary Input, Pulse Counter Mode
 - b. Binary Inputs - shall be configured to monitor either of the following:
 - 1) Dry Contact Maintained Mode
 - 2) Pulse Counter Mode
 - c. Analog Outputs - shall be configured to output either of the following:
 - 1) Analog Output, Voltage Mode
 - 2) Analog Output, current Mode
 - d. Binary Outputs - shall output the following:
 - 1) 24 VAC Triac
 - e. Configurable Outputs - shall be capable of the following:
 - 1) Analog Output, Voltage Mode
 - 2) Binary Output Mode
 6. The IOM shall include troubleshooting LED indicators to identify the following conditions:

- a. Power On
 - b. Power Off
 - c. Download or Startup in progress, not ready for normal operation
 - d. No Faults
 - e. Device Fault
 - f. Normal Data Transmission
 - g. No Data Transmission
 - h. No Communication
- B. Networked Thermostat
- 1. The Networked Thermostat
 - a. shall be capable of controlling any piece of equipment scheduled on the contract documents.
 - b. shall communicate over the Field Controller Bus using BACnet Standard protocol SSPC-135, Clause 9.
 - c. shall support remote read/write and parameter adjustment from the web based User Interfaceable through a Network Automation Engine.
 - d. shall provide an occupancy override function. Activation of timed override switch on zone thermostats shall only reset zone heating and cooling setpoints to "occupied" values, but shall not affect otherwise scheduled Unoccupied operating mode of air handling unit. This allows the user to override the Unoccupied scheduled setpoints and put the system into an occupied setpoints mode for set duration and reset to normal operation at the end of the period or whenever the override button is held for more than 5 seconds (adjustable). The override duration is individually adjustable for each thermostat through the BMS or the same range can be applied to all thermostats globally.
 - e. shall provide local temperature adjustment via a knob, slider bar, or touch screen adjustment. The temperature adjustment range shall be individually adjustable for each thermostat, programmed through the BMS or the same range can be applied to all thermostats globally.
 - f. shall provide the flexibility to support any one of the following inputs:
 - 1) Integral Indoor Air Temperature Sensor
 - 2) Duct Mount Air Temperature Sensor
 - 3) Remote Indoor Air Temperature Sensor with Occupancy Override and LED Indicator.
 - 4) Two configurable binary inputs
 - g. shall provide the flexibility to support any one of the following outputs:
 - 1) Three Speed Fan Control
 - 2) Two On/Off
 - 3) Two Floating
 - 4) Two Proportional (0 to 10V)
 - h. shall provide a minimum of six (6) levels of keypad lockout.
 - i. shall employ nonvolatile electrically erasable programmable read-only memory for all adjustable parameters.
 - j. shall have backlit LCD digital display.
 - k. shall not include the manufacturer's name or logo exposed to view.
- C. Network Sensors
- 1. shall have the ability to monitor the following variable as required by the systems sequence of operations:
 - a. One sensor for Zone Temperature and Zone setpoint
 - b. One sensor for Zone Humidity
 - 2. shall transmit the zone information back to the controller on the Sensor-Actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135, Clause 9.
 - 3. shall include the following items:
 - a. Plain space mounted sensors with temperature sensing only.
 - b. Space mounted sensors with humidity sensing only.
 - 4. shall be available with either screw terminals or phone jack.
 - 5. shall be available in either surface mount or wall mount styles.
 - 6. shall not include the manufacturer's name or logo exposed to view.

2.6 INPUT DEVICES

- A. General Requirements
1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.
 2. Finished space wall mounted room sensors shall not include the manufactures name or logo exposed to view.
- B. Temperature Sensors
1. General Requirements:
 - a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
 - b. The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.
 - c. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	Accuracy
Water Temperature	± .5°F
Room Temperature	± .5°F
Duct Temperature	± .5°F
All Others	+ .75°F

2. Room Temperature Sensors
 - a. Room sensors shall be constructed for either surface or wall box mounting.
3. Thermo wells
 - a. When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and Greenfield fitting.
 - b. Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.
 - c. Thermo wells and sensors shall be mounted in a threadolet or 1/2" NPT saddle and allow easy access to the sensor for repair or replacement.
 - d. Thermo wells shall be constructed of 316 stainless steel.
4. Outside Air Sensors
 - a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
 - b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
 - c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.
5. Duct Mount Sensors
 - a. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
 - b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
 - c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.
6. Averaging Sensors
 - a. For ductwork greater in any dimension than 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
 - b. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
 - c. Capillary supports at the sides of the duct shall be provided to support the sensing string.
7. Acceptable Manufacturers: Alerton Controls, Setra.

- C. Humidity Sensors
1. The sensor shall be a solid-state type, relative humidity sensor of the Bulk Polymer Design. The sensor element shall resist service contamination.
 2. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
 3. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 deg F unless specified elsewhere.
 4. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.
 5. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
 6. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.
 7. Acceptable Manufacturers: Veris Industries, and Mamac.
- D. Differential Pressure Transmitters
1. General Air and Water Pressure Transmitter Requirements:
 - a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
 - b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
 - c. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.
 - d. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.
 2. Low Differential Water Pressure Applications (0" - 20" w.c.)
 - a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points.
 - b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
 - 1) .01-20" w.c. input differential pressure range.
 - 2) 4-20 mA output.
 - 3) Maintain accuracy up to 20 to 1 ratio turndown.
 - 4) Reference Accuracy: +0.2% of full span.
 - c. Acceptable Manufacturers: Setra and Mamac.
 3. Medium to High Differential Water Pressure Applications (Over 21" w.c.)
 - a. The differential pressure transmitter shall meet the low pressure transmitter specifications with the following exceptions:
 - 1) Differential pressure range 10" w.c. to 300 PSI.
 - 2) Reference Accuracy: +1% of full span (includes non-linearity, hysteresis, and repeatability).
 - b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
 - c. Acceptable Manufacturers: Setra and Mamac.
 4. Building Differential Air Pressure Applications (-1" to +1" w.c.)
 - a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.

- b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
 - 1) -1.00 to +1.00 w.c. input differential pressure ranges. (Select range appropriate for system application)
 - 2) 4-20 mA output.
 - 3) Maintain accuracy up to 20 to 1 ratio turndown.
 - 4) Reference Accuracy: +0.2% of full span.
 - c. Acceptable Manufacturers: BAPI and Setra.
 - 5. Low Differential Air Pressure Applications (0" to 5" w.c.)
 - a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
 - b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
 - 1) (0.00 - 1.00" to 5.00") w.c. input differential pressure ranges. (Select range appropriate for system application.)
 - 2) 4-20 mA output.
 - 3) Maintain accuracy up to 20 to 1 ratio turndown.
 - 4) Reference Accuracy: +0.2% of full span.
 - c. Acceptable Manufacturers: BAPI and Setra.
 - 6. Medium Differential Air Pressure Applications (5" to 21" w.c.)
 - a. The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressure transmitters shall be provided that meet the following performance requirements:
 - 1) Zero & span: (c/o F.S./Deg. F): .04% including linearity, hysteresis and repeatability.
 - 2) Accuracy: 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100 PSIG.
 - 3) Thermal Effects: <+.033 F.S./Deg. F. over 40°F. to 100°F. (calibrated at 70°F.).
 - b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
 - c. Acceptable manufacturers: BAPI and Setra.
- E. Flow Monitoring
 - 1. Air Flow Monitoring
 - a. Fan Inlet Air Flow Measuring Stations
 - 1) At the inlet of each fan and near the exit of the inlet sound trap, airflow traverse probes shall be provided that shall continuously monitor the fan air volumes and system velocity pressure.
 - 2) Each traverse probe shall be of a dual manifolded, cylindrical, type 3003 extruded aluminum configuration, having an anodized finish to eliminate surface pitting and unnecessary air friction. The multiple total pressure manifold shall have sensors located along the stagnation plane of the approaching airflow. The manifold should not have forward projecting sensors into the air stream. The static pressure manifold shall incorporate dual offset static tops on the opposing sides of the averaging manifold so as to be insensitive to flow-angle variations of as much as + 20° in the approaching air stream.
 - 3) The airflow traverse probe shall not induce a measurable pressure drop, nor shall the sound level within the duct be amplified by its singular or multiple presences in the air stream. Each airflow-measuring probe shall contain multiple total and static pressure sensors placed at equal distances along the probe length. The number of sensors on each probe and the quantity of probes utilized at each installation shall comply with the ASHRAE Standards for duct traversing.

- 4) Airflow measuring stations shall be manufactured by Air Monitor Corp., Tek-Air Systems, Inc., Ebtron, or Dietrich Standard.
- b. Single Probe Air Flow Measuring Sensor
 - 1) The single probe airflow-measuring sensor shall be duct mounted with an adjustable sensor insertion length of up to eight inches. The transmitter shall produce a 4-20 mA or 0-10 VDC signal linear to air velocity. The sensor shall be a hot wire anemometer and utilize two temperature sensors and a heater element temperature. The other sensor shall measure the downstream air temperature. The temperature differential shall be directly related to airflow velocity.
 - 2) Acceptable manufacturers: Air Monitor Corp., Tek-Air, Ebtron Model GOLD (basis of design). Provide full 3 year warranty.
- c. Duct Air Flow Measuring Stations
 - 1) Each device shall be designed and built to comply with, and provide results in accordance with, accepted practice as defined for system testing in the ASHRAE Handbook of fundamentals, as well as in the Industrial Ventilation Handbook.
 - 2) Airflow measuring stations shall be fabricated of 14-gauge galvanized steel welded casing with 90 Deg. connecting flanges in configuration and size equal to that of the duct into which it is mounted. Each station shall be complete with an air directionalizer and parallel cell profile suppressor (3/4" maximum cell) across the entering air stream and mechanically fastened to the casing in such a way to withstand velocities up to 6000 feet per minute. This air directionalizer and parallel cell honeycomb suppressor shall provide 98% free area, equalize the velocity profile, and eliminate turbulent and rotational flow from the air stream prior to the measuring point.
 - 3) The total pressure measurement side (high side) will be designed and spaced to the Industrial Ventilation Manual 16th Edition, Page 9-5. The self-averaging manifolding will be manufactured of brass and copper components.
 - 4) The static pressure sensing probes (low side) shall be bullet-nosed shaped, per detailed radius, as illustrated in Industrial Ventilation Manual 16th Edition, Page 9-5.
 - 5) The main take-off point from both the total pressure and the static pressure manifolds must be symmetrical.
 - 6) Total and static pressure manifolds shall terminate with external ports for connection to control tubing. An identification label shall be placed on each unit casing, listing model number, size, area, and specified airflow capacity.
 - 7) Installation Considerations
 - a) The maximum allowable pressure loss through the Flow and Static Pressure elements shall not exceed .065" w.c. at 1000 feet per minute, or .23" w.c. at 2000 feet per minute. Each unit shall measure the airflow rate within an accuracy of plus 2% as determined by U.S. - GSA certification tests, and shall contain a minimum of one total pressure sensor per 36 square inches of unit measuring area.
 - b) The units shall have a self-generated sound rating of less than NC40, and the sound level within the duct shall not be amplified nor shall additional sound be generated.
 - c) Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct. Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.
 - d) Where control dampers are shown as part of the airflow measuring station, opposed blade precision controlled volume dampers integral to the station and complete with actuator, pilot positioner, and linkage shall be provided.
 - e) Stations shall be installed in strict accordance with the manufacturer's published requirements, and in accordance

- with ASME Guidelines affecting non-standard approach conditions.
- 8) Acceptable manufacturers: Air Monitor Corp., Tek-Air, Ebtron Model GTx116-P and GTx116-F (basis of design). Provide full 3 year warranty.
 - d. Static Pressure Traverse Probe
 - 1) Duct static traverse probes shall be provided where required to monitor duct static pressure. The probe shall contain multiple static pressure sensors located along exterior surface of the cylindrical probe.
 - 2) Acceptable manufacturers: Cleveland Controls
 - e. Shielded Static Air Probe
 - 1) A shielded static pressure probe shall be provided at each end of the building. The probe shall have multiple sensing ports, an impulse suppression chamber, and airflow shielding. A suitable probe for indoor and outdoor locations shall be provided.
2. Water Flow Monitoring (1" and larger: chilled water, hot water, condenser water; 3" and larger: domestic cold water, domestic hot water, make up water)
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) ONICON Incorporate, F-3100 series
 - 2) Siemens
 - 3) SeaMetrics Inc.
 - 4) Niagara Meters.
 - b. Description: Inline electromagnetic flow meter.
 - c. Construction: Carbon steel body, PTFE liner, ANSI Class 150 flange and Class 300 flange.
 - d. Pressure Rating: 580 psig minimum.
 - e. Temperature Rating: 400 deg F minimum.
 - f. Display: Remote mounted electronics, visual instantaneous rate of flow, with register to indicate total volume in gallons.
 - g. BMS input for rate of flow and total volume.
 - h. Accuracy: minimum 1 percent.
3. Water Flow Monitoring (3/4": chilled water, hot water, condenser water; 3/4"-2 1/2": domestic cold water, domestic hot water, irrigation, backwash, blow down drains, make-up water)
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) ONICON Incorporate, F-4600 series
 - 2) Siemens
 - 3) SeaMetrics Inc.
 - 4) Niagara Meters.
 - b. Description: direct beam wetted ultrasonic transducers, temperature sensor, mounting hardware and calibration certificate.
 - c. Construction: Flowmeter shall consist of a drop forged corrosion resistant metal flow body with process connections, integral transducers and a processor / transmitter. All wetted materials shall be NSF 372 compliant.
 - d. Pressure Rating: 450 psig minimum.
 - e. Temperature Rating: 200 deg F minimum.
 - f. Display: Remote mounted electronics, visual instantaneous rate of flow, with register to indicate total volume in gallons.
 - g. BMS input for rate of flow and total volume.
 - h. Accuracy: minimum 2 percent.
4. Natural Gas Flow Monitoring
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Onicon
 - 2) Sierra Model: QuadraTherm 780i
 - 3) Sage
 - b. Description: Thermal Mass Flow
 - c. Construction: Insertion
 - d. Display: integral controller, visual instantaneous rate of mass flow and mass total.

- e. BMS input for rate of mass flow and mass total
 - f. Accuracy: minimum 1 percent.
- F. Power Monitoring Devices
 - 1. Current Measurement (Amps)
 - a. Current measurement shall be by a combination current transformer and a current transducer. The current transformer shall be sized to reduce the full amperage of the monitored circuit to a maximum 5 Amp signal, which will be converted to a 4-20 mA DDC compatible signal for use by the Facility Management System.
 - b. Current Transformer - A split core current transformer shall be provided to monitor motor amps.
 - 1) Operating frequency - 50 - 400 Hz.
 - 2) Insulation - 0.6 Kv class 10Kv BIL.
 - 3) UL recognized.
 - 4) Five Amp secondary.
 - 5) Select current ration as appropriate for application.
 - 6) Acceptable manufacturers: Veris Industries
 - 2. Current Transducer - A current to voltage or current to mA transducer shall be provided. The current transducer shall include:
 - a. 6X input over amp rating for AC inrushes of up to 120 amps.
 - b. Manufactured to UL 1244.
 - c. Accuracy: +.5%, Ripple +1%.
 - d. Minimum load resistance 30kOhm.
 - e. Input 0-20 Amps.
 - f. Output 4-20 mA.
 - g. Transducer shall be powered by a 24VDC regulated power supply (24 VDC +5%).
 - h. Acceptable manufacturers: Veris Industries
- G. Smoke Detectors
 - 1. Duct detectors shall be furnished as specified elsewhere in Division 26 for installation under Division 23. All wiring for air duct detectors shall be provided under Division 26.
- H. Status and Safety Switches
 - 1. General Requirements
 - a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BMS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.
 - 2. Current Sensing Switches
 - a. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
 - b. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.
 - c. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
 - 3. Current Sensor/Transducer
 - a. The current sensors shall be loop or self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
 - b. Analog output current sensors providing a signal corresponding to actual amperage draw of the monitored load. Current sensors shall be used for fans, pumps, and other miscellaneous motor loads.

- c. Current sensors shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.
- 4. Air Filter Status Switches
 - a. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.
 - b. A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.
 - c. Provide appropriate scale range and differential adjustment for intended service.
 - d. Acceptable manufacturers: Dwyer, Cleveland Controls
- 5. Air Flow Switches
 - a. Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range and differential adjustment for intended service.
 - b. Acceptable manufacturers: Dwyer, Cleveland Controls
- 6. Air Pressure Safety Switches
 - a. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.
 - b. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.
 - c. Acceptable manufacturers: Dwyer, Cleveland Controls
- 7. Water Flow Switches
 - a. Water flow switches shall be equal to the Johnson Controls P74.
- 8. Low Temperature Limit Switches
 - a. The low temperature limit switch shall be of the automatic reset type.
 - b. The sensing element shall react to the coldest 16-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
 - c. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.
 - d. The low temperature limit switch shall be equal to Intech NTF-US, Automation Components, Inc. A/FS-A, Honeywell L480B.
 - e. Temperature sensing range shall be a minimum of 20°F-50°F.
- 9. Gas Detection Equipment
 - a. Manufacturers:
 - 1) Veris Industries
 - 2) Vaisala
 - 3) Honeywell
 - 4) Intec Controls
 - b. Carbon Monoxide Detectors: Single or multichannel, dual-level detectors using solid-state plug-in sensors with a 3-year minimum life.
 - 1) Operating temperature range: 32 to 104 deg F.
 - 2) Accuracy @ 70°F: + 40 ppm +3% of reading.
 - 3) Operating humidity range: 5% to 100% rh.
 - 4) Housing: ABS Plastic
 - 5) Emergency shut off shall be push button and labeled.
 - 6) Meet or exceed UL 2075
 - 7) CO detectors shall be located as remotely as possible from the heating appliance.
 - c. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output, for wall mounting.
 - d. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment; for flush mounting. Sensor shall be furnished with HVAC relay.
 - e. Carbon Monoxide Alarm: Meet or exceed UL 2034.

2.7 OUTPUT DEVICES

- A. Actuators
 - 1. General Requirements
 - a. Damper and valve actuators shall be electronic as specified in the System Description section.
 - 2. Electronic Damper Actuators
 - a. Electronic damper actuators shall be direct shaft mount.
 - b. Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized Based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.
 - c. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to the BMS head end and indicate damper position.
 - d. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as "quick acting," shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.
 - e. Provide 5-year warranty.
 - f. Acceptable manufacturers: Belimo.
 - 3. Electronic Valve Actuators
 - a. Electronic valve actuators shall be manufactured by the valve manufacturer.
 - b. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.
 - c. Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized based on valve manufacturer's recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves, as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.
 - d. Modulating Actuators shall accept 24 VAC or VDC and 120 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. . The feedback signal shall be independent of the input signal, and may be used to parallel other actuators and provide true position indication. The feedback signal of each valve actuator shall be wired back to the BMS head end and display valve position.
 - e. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop the associated piece of equipment.
 - f. Acceptable manufacturers: Belimo

- B. Control Dampers
1. The BMS Contractor shall furnish all automatic dampers. All automatic dampers shall be sized for the application by the BMS Contractor.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ruskin Company CD50, CD60, CDTI-50
 - b. Greenheck Fan Corporation. VCD-33, ICD-45
 - c. Tamco 9000BF
 3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
 4. Frames:
 - a. Hat shaped.
 - b. Galvanized-steel channels, 0.0625 inch thick except outside air dampers shall be 0.125 thick extruded aluminum and required to be thermally broken.
 - c. Mitered and welded corners.
 5. Blades:
 - a. Airfoil shape, multiple blade with maximum blade width of 8 inches.
 - b. Parallel- and opposed-blade design.
 - c. Galvanized steel except outdoor air damper blades shall be aluminum.
 - d. 16 gauge thickness (steel) or 0.063 inch thickness (aluminum).
 - e. Blade Axles: 1/2-inch- diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
 - f. Operating Temperature Range: From minus 40 to plus 200 deg F.
 6. Bearings:
 - a. Molded synthetic or stainless steel.
 - b. All dampers shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - c. Thrust bearings at each end of every blade.
 7. Performance Data:
 - a. Temperature Rating: Withstand -72 to 275 degrees F (-58 to 135 degrees C).
 - b. Closed Position: Maximum pressure of 13 inches w.g. (3.2 kPa) @ a 12 inch blade length.
 - c. Open Position: Maximum air velocity of 6,000 feet per minute (1,829 m/min).
 - d. Leakage: Maximum 5.2 cubic feet per minute per square foot (0.6 m³/min/m²) at 4 inches w.g. (1 kPa) for size 48 x 48 inches (1219 x 1219 mm).
 - e. Pressure Drop: Maximum 0.03 inch w.g. (0.01 kPa) at 1,500 feet per minute (457 m/min) across 24 inch x 24 inch (610 x 610 mm) damper.
- C. Control Dampers W/ Integral Airflow Monitor
1. Control dampers shall be of low leakage design. Dampers shall be opposed blade type except where parallel blades are required for air mixing.
 2. The integral air monitor/damper shall incorporate measuring ports built into the damper blades and shall control the minimum amount of outside air as scheduled on the Drawings. The acceptable range of operation shall be 300 to 2000 feet per minute face velocity. Airflow measurement and reporting shall be within an accuracy of 5%.
 3. The integral damper/monitor assembly shall incorporate an air straightener section to ensure proper airflow readings. The air straightener section shall be flanged as required by the application.
 4. Frames shall be constructed of 60663T5 extruded aluminum hat channel with hat mounting flanges on both sides of the frame. Each corner shall be reinforced with two die formed internal braces and machine staked for maximum rigidity.
 5. Damper blades shall be 6" wide 6063T5 extruded aluminum airfoil type. Blade edge seals shall be Ruskiprene or approved equal. Jamb seals shall be flexible metal compression type.
 6. Bearings shall be non-corrosive molded synthetic. Axles shall be square or hexagon to provide positive locking connection to blades and linkage.
 7. Damper leakage through a 48" x 48" damper at 1 in. w.g. pressure difference shall not exceed 2.0 cfm per square foot. Damper manufacturer's data shall include performance data developed from testing in accordance with AMCA Standard 500 in an AMCA approved laboratory showing pressure drop for all sizes of dampers required at all anticipated flow rates.

8. Damper linkage arrangement shall be equal percentage and shall match the damper operator.
 9. Each air monitor/damper shall include a 24VAC electric modulating motor and an application specific controller designed for this application furnished by the damper manufacturer. Each integral air monitor/damper shall be calibrated in an AMCA registered laboratory and a certification chart shall accompany the air monitor/damper.
 10. Air tubing/piping connections shall terminate in a control panel housing the differential pressure transducer and controller. The controller shall monitor the control blade position using a feedback signal from the damper actuator. With the signal from the pressure transducer and the blade position signal, the controller shall convert the pressure differential into an accurate CFM value. Based on the difference between the actual CFM reading and the CFM setpoint, the controller will adjust the damper position to maintain the desired outside air quantity.
 11. Application: Outside Air
 12. Dampers shall be in all respects equivalent to Ruskin Model IAQ50.
- D. Control Relays
1. Control Pilot Relays
 - a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
 - b. Mounting Bases shall be snap-mount.
 - c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
 - d. Contacts shall be rated for 10 amps at 120VAC.
 - e. Relays shall have an integral indicator light and check button.
 - f. Acceptable manufacturers: Alerton Controls, Lectro
- E. Control Valves: Factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of the piping system, unless otherwise indicated.
1. Pressure Independent Control Valves
 - a. Manufacturers:
 - 1) BELIMO AIRCONTROLS (USA), INC.
 - 2) GRISWOLD CONTROLS
 - 3) Hydronic Components Inc.
 - 4) Honeywell
 - b. All terminal equipment and two position valves; including but not limited to all terminal box reheat coils, all hot water and glycol heating coils, all chilled water and glycol cooling coils, all cabinet unit heaters, all unit heaters, all fan coil units, all air curtains, shall utilize pressure independent control valves.
 - c. The modulating control valves shall also be pressure independent.
 - d. The control valves shall accurately control the flow from 0 to 100% full rated flow with an equal percentage flow characteristic. The flow shall not vary more than +/- 5% due to system pressure fluctuations across the valve with a minimum of 5 PSID across the valve.
 - e. Forged brass body rated at no less than 400 PSI, chrome plated brass ball and stem, female NPT union ends, dual EPDM lubricated O-rings and TEFZEL characterizing disc.
 - f. Combination of actuator and valve shall provide a minimum close-off pressure rating of 200 PSID.
 - g. All actuators shall be electronically programmed by use of a handheld programming device or external computer software. Programming using actuator mounted switches or multi-turn actuators are NOT acceptable. Actuators for 3-wire floating (tri-state) on 1/2" - 1" pressure independent control valves shall fail in place and have a mechanical device inserted between the valve and the actuator for the adjustment of flow. Actuators for two-position 1/2"-1" pressure independent control valves shall fail in place and have a mechanical device inserted between the valve and the actuator for the adjustment of flow. Actuators shall be provided with an auxiliary switch to prove valve position.
 - h. The actuator shall be the same manufacturer as the valve, integrally mounted to the valve at the factory via a single screw on a four-way DIN mounting-base.
 - i. The control valve shall require no maintenance.
 - j. The manufacturer shall warrant all components for a period of 5 years from the date of production, with the first two years unconditional.

- k. The use of pressure independent valves piped in parallel to achieve the rated coil flow shall be permitted. Actuators shall be electronically programmed to permit sequencing the flow with a single control output point. The use of external devices to permit sequencing is NOT acceptable.
 - l. Provide 5-year warranty.
 - 2. Hydronic system globe valves shall have the following characteristics: Used for modulating, bypass, and three way valves:
 - a. Manufacturers:
 - 1) Belimo
 - b. NPS 2 and Smaller: Class 150 bronze body, stainless steel trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
 - c. NPS 2-1/2 and Larger: Class 150 iron body, stainless steel trim, rising stem, plug-type disc, flanged ends, seat and disc.
 - d. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
 - 1) Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
 - 2) Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
 - e. Flow Characteristics: Three-way valves shall have linear characteristics.
 - f. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 300 psid.
 - g. Provide 5-year warranty.
 - 3. Hydronic system ball valves shall have the following characteristics: Used for NPS 2 and smaller: two position valves, modulating, bypass, and three-way valves.
 - a. Manufacturers:
 - 1) Belimo
 - b. Factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
 - c. The control valve assembly shall be provided and delivered from a single manufacturer as a complete assembly.
 - d. The manufacturer shall warrant all components for a period of 5 years from the date of production, with the first two years unconditional.
 - e. Bronze body rated at no less than 300 psi, stainless steel ball and stem.
 - f. The manufacturer shall warrant all components for a period of 2 years from the date of substantial completion.
 - g. Flow Characteristics: Valves shall have equal percentage characteristics.
 - h. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 1 1/2 times the maximum system pressure.
 - 4. Butterfly valves: Used for NPS 2-1/2 and larger: bypass, automatic isolation and three way valves.
 - a. Same valve selection as required in Section 23 05 23.
 - b. Sizing: 1-psig maximum pressure drop at design flow rate.
 - c. Electronic Signal Isolation Transducers
 - d. A signal isolation transducer shall be provided whenever an analog output signal from the BMS is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input signal from a remote system.
 - e. The signal isolation transducer shall provide ground plane isolation between systems.
 - f. Signals shall provide optical isolation between systems.
 - g. External Manual Override Stations
 - h. External manual override stations shall provide the following:
 - i. An integral HAND/OFF/AUTO switch shall override the controlled device pilot relay.
 - j. A status input to the BMS shall indicate whenever the switch is not in the automatic position.
 - k. A Status LED shall illuminate whenever the output is ON.
 - l. An Override LED shall illuminate whenever the HOA switch is in either the HAND or OFF position.

- m. Contacts shall be rated for a minimum of 1 amp at 24 VAC.
- n. Butterfly valves shall be rated for dead-end service and have a minimum close-off pressure (differential) Pressure Rating of 1 1/2 times the maximum system pressure.

2.8 MISCELLANEOUS DEVICES

- A. Local Control Panels
 - 1. All control panels shall be factory constructed, incorporating the BMS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch and lock.
 - 2. In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.
 - 3. All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals. All I/O connections shall be wired to a terminal strip within the control panel and not direct to the DDC controller.
 - 4. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
 - 5. All wiring shall be neatly installed in plastic trays or tie-wrapped.
 - 6. A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.
- B. Power Supplies
 - 1. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.
 - 2. Input: 120 VAC +10%, 60Hz.
 - 3. Output: 24 VDC.
 - 4. Line Regulation: +0.05% for 10% line change.
 - 5. Load Regulation: +0.05% for 50% load change.
 - 6. Ripple and Noise: 1 mV rms, 5 mV peak to peak.
 - 7. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.
 - 8. A power disconnect switch shall be provided next to the power supply.
 - 9. All control power shall be provided from a standby panel board.

PART 3 - PERFORMANCE / EXECUTION

3.1 EXAMINATION

- A. Verify that conditioned power supply is available to control units and operator workstation.
- B. Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Architect or Engineer for resolution before starting rough-in work.
- C. Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.
- D. Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer and obtain written instructions for changes necessary to accommodate of this section and with work of others. Controls Contractor shall perform at his expense necessary changes in specified work caused by failure or neglect to report discrepancies.

3.2 PROTECTION

- A. Controls Contractor shall protect against and be liable for damage to work and to material caused by Contractor's work or employees.
- B. Controls Contractor shall be responsible for work and equipment until inspected, tested, and accepted. Protect material not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.3 COORDINATION

- A. Site.
 - 1. Assist in coordinating space conditions to accommodate the work of each trade where work will be installed near or will interfere with work of other trades. If installation without coordination causes interference with work of other trades, Contractor shall correct conditions without extra charge.
 - 2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.
- B. Test and Balance.
 - 1. Provide Test and Balance Contractor a single set of necessary tools to interface to control system for testing and balancing.
 - 2. Train Test and Balance Contractor to use control system interface tools.
 - 3. Provide a qualified technician to assist with testing and balancing the first 20 terminal units.
 - 4. Test and Balance Contractor shall return tools undamaged and in working condition at completion of testing and balancing.
- C. Life Safety.
 - 1. Duct smoke detectors required for air handler shutdown are provided under Division 26. Interlock smoke detectors to air handlers for shutdown as specified in Sequences of Operation.
 - 2. Smoke dampers and actuators required for duct smoke isolation are provided under division 23. Interlock smoke dampers to air handlers as specified in Sequences of Operation.
 - 3. Fire and smoke dampers and actuators required for fire-rated walls are provided under Division 23.
- D. Coordination with Other Controls. Integrate with and coordinate controls and control devices furnished or installed by others as follows.
 - 1. Each supplier of a controls product shall configure, program, start up, and test that product to meet the sequences of operation regardless of where within the contract documents those products are described.
 - 2. Coordinate and resolve incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.
 - 3. Controls Contractor shall be responsible for integration of control products provided by multiple suppliers regardless of where integration is described within the contract documents.

3.4 BMS SPECIFIC REQUIREMENTS

- A. Graphic Displays
 - 1. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list, flow and control diagrams and indicated in specification section 23 09 93 sequences. All terminal unit graphic displays shall be from a standard design library.
 - 2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection.
- B. Actuation / Control Type
 - 1. Primary Equipment
 - a. Equipment shall be controlled with a HVAC-DDC Controller
 - b. All damper and valve actuation shall be electric.
 - 2. Air Handling Equipment
 - a. All air handlers shall be controlled with a HVAC-DDC Controller
 - b. All damper and valve actuation shall be electric.
 - 3. Terminal Equipment:
 - a. Terminal Units (VAV, UH, etc.) shall have electric damper and valve actuation.
 - b. All Terminal Units shall be controlled with HVAC-DDC Controller.

3.5 INSTALLATION PRACTICES

- A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- B. Connect and configure equipment and software to achieve sequence of operation specified.
- C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation.
- D. **BMS Wiring**
 - 1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, as herein specified, shall be provided by the BMS Contractor unless specifically shown on the Electrical Drawings under Division 26 Electrical. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this section.
 - 2. All BMS wiring materials and installation methods shall comply with BMS manufacturer recommendations.
 - 3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BMS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BMS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
 - 4. **Class 2 Wiring**
 - a. All controls wiring (including wiring for meters) shall be plenum rated, shielded cable.
 - b. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
 - c. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
 - 5. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
 - 6. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.
- E. **BMS Line Voltage Power Source**
 - 1. 120-volt AC circuits used for the Building Management System shall be taken from panel boards and circuit breakers provided by Division 26.
 - 2. Circuits used for the BMS shall be dedicated to the BMS and shall not be used for any other purposes.
 - 3. DDC terminal unit controllers may not use AC power from motor power circuits.
 - 4. All control power shall be provided from a standby panel board.
- F. **BMS Raceway**
 - 1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2".
 - 2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
 - 3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
 - 4. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.
- G. **BMS Identification Standards**
 - 1. **Node Identification.** All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.
 - 2. Cable types specified in Item A shall be color coded for easy identification and troubleshooting.

- H. BMS Panel Installation
 - 1. The BMS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
 - 2. The BMS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.
- I. Input Devices
 - 1. All Input devices shall be installed per the manufacturer recommendation
 - 2. Locate components of the BMS in accessible local control panels wherever possible.
- J. HVAC Input Devices - General
 - 1. All Input devices shall be installed per the manufacturer recommendation
 - 2. Locate components of the BMS in accessible local control panels wherever possible.
 - 3. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
 - 4. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.
 - 5. Mount sensors rigidly and adequately for operating environment.
 - 6. Outside Air Sensors
 - a. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.
 - b. Sensors shall be installed with a rain proof, perforated cover.
 - 7. Water Differential Pressure Sensors
 - a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
 - b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
 - c. The transmitters shall be installed in an accessible location wherever possible.
 - 8. Medium to High Differential Water Pressure Applications (Over 21" w.c.):
 - a. Air bleed units, bypass valves and compression fittings shall be provided.
 - 9. Building Differential Air Pressure Applications (-1" to +1" w.c.):
 - a. Transmitters exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
 - b. The interior tip shall be inconspicuous.
 - 10. Duct Temperature Sensors:
 - a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
 - b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
 - c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
 - 1) Use averaging sensors in mixing plenums and hot and cold decks.
 - Install averaging sensors in a serpentine manner vertically across duct.
 - Support each bend with a capillary clip.
 - d. The sensor shall be mounted to suitable supports using factory approved element holders.
 - 11. Space Thermostats:
 - a. Install room thermostats on concealed junction boxes properly supported by wall framing.
 - b. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.
 - c. Shall be mounted per ADA requirements, maximum 48" above finished floor.
 - d. Each thermostat located within a Gymnasium shall have a protective guard.
 - 12. Combination Space Thermostats, Humidity, Carbon Dioxide:
 - a. Install combination devices on concealed junction boxes properly supported by wall framing.
 - b. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.
 - c. Shall be mounted per ADA requirements, maximum 48" above finished floor.
 - d. Each thermostat located within a Gymnasium shall have a protective guard.

13. Space Sensors:
 - a. Install room sensors on concealed junction boxes properly supported by wall framing.
 - b. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.
 - c. Shall be mounted 54" (typical) above finished floor to center of sensor. Coordinate exact height with architect prior to installing back box.
 - d. Each sensor located within a Gymnasium shall have a protective guard.
14. Carbon Dioxide Sensors:
 - a. Install room sensors on concealed junction boxes properly supported by wall framing.
 - b. Shall be mounted 36"-72" (54" typical) above finished floor to center of sensor. Coordinate exact height with architect prior to installing back box.
 - c. Each sensor located within a Gymnasium shall have a protective guard.
15. Low Temperature Limit Switches:
 - a. Install on the discharge side of the first water coil in the air stream.
 - b. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide 1 ft of sensing element for each 1 ft² of coil area.
 - c. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.
16. Air Differential Pressure Status Switches:
 - a. Install with static pressure tips, tubing, fittings, and air filter.
17. Water Differential Pressure Status Switches:
 - a. Install with shut off valves for isolation.
18. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.
19. Air and Water Flow Meters:
 - a. Install flowmeter elements in accessible positions in piping systems.
 - b. Install flow meter displays in an accessible location for easy reference and reading, between 4 ft and 6 ft above the floor.
 - c. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions and installation book.
- K. HVAC Output Devices
 1. All output devices shall be installed per the manufacturer's recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.
 2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.
 3. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.
 4. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI.
 5. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Management System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems.
- L. All electric actuators, valves and dampers specified on the contract documents or necessary for the control system to function as specified under Division 23 are to be furnished and installed under this section.
- M. Automatic control dampers shall be furnished and installed under this division unless they are part of factory-assembled equipment.

- N. All conduit, wiring, etc., to accomplish the sequence of operation in this section, shall be provided under this section. All electrical work performed under this section shall comply with the National Electric Code and Underwriters Laboratories where applicable, and shall be installed by licensed journeyman electricians.
- O. Furnish to the Division 23 Contractor for installation, wells for any sensors that are to monitor water temperatures. Provide stainless steel separable wells.
- P. Furnish to the Division 23 Contractor for installation, any sensors such as flow sensors, or flow meters which are to be installed in water lines.
- Q. All virtual system alarm points shall be displayed visually on each associated equipment graphic as text or flashing light indicator that clearly identifies the alarm condition in a red color as to draw attention to the alarming condition. The graphical alarm text or indicator light shall either be hidden when the alarm condition does not exist or it shall change to a color (white or green) indicative of normal conditions.

3.6 ACTUATORS

- A. General. Mount actuators and adapters according to manufacturer's recommendations.
- B. Electric and Electronic Damper Actuators. Mount actuators directly on damper shaft or jackshaft unless shown as a linkage installation. Link actuators according to manufacturer's recommendations.
 - 1. For low-leakage dampers with seals, mount actuator with a minimum 5° travel available for damper seal tightening.
 - 2. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, then tighten linkage.
 - 3. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - 4. Provide necessary mounting hardware and linkages for actuator installation.
- C. Valve Actuators. Connect actuators to valves with adapters approved by actuator manufacturer.
- D. Actuators shall produce sufficient power and torque to close off against the maximum system pressures encountered. Actuators shall be sized to close off against the fan shutoff pressure as a minimum requirement.
- E. The total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.
- F. Provide one actuator for each damper assembly where possible. Multiple actuators required to drive a single damper assembly shall operate in unison.
- G. Avoid the use of excessively oversized actuators which could overdrive and cause linkage failure when the damper blade has reached either its full open or closed position.
- H. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.
- I. Provide mounting hardware and linkages for connecting actuator to damper.
- J. Provide (1) spare actuator of each type being used for control valves and control dampers.

3.7 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Section 26 05 33 "Raceways and Boxes for Electrical Systems."
- B. Install building wire and cable according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- C. Install signal and communication cable according to Division 26,
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Install exposed cable in raceway.
 - 3. Install concealed cable in raceway.

4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.8 WARNING LABELS

- A. Affix permanent warning labels to equipment that can be automatically started by the control system.
1. Labels shall use white lettering (12-point type or larger) on a red background.
 2. Warning labels shall read as follows.
CAUTION
This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to "Off" position before servicing.
- B. Affix permanent warning labels to motor starters and control panels that are connected to multiple power sources utilizing separate disconnects.
1. Labels shall use white lettering (12-point type or larger) on a red background.
 2. Warning labels shall read as follows.
CAUTION
This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

3.9 PROGRAMMING

- A. Point Naming. Name points based the sequence of operations and when applicable conform to the existing standards set up by the clients control systems.
- B. Software Programming. Programming shall provide actions for each possible situation. Graphic- or parameter-based programs shall be documented. Text-based programs shall be modular, structured, and commented to clearly describe each section of the program.
1. Application Programming. Provide application programming that adheres to sequences of operation. Program documentation or comment statements shall reflect language used in sequences of operation.
 2. System Programming. Provide system programming necessary for system operation.
- C. Operator Interface.
1. Standard Graphics. Provide graphics as specified in System Graphics. Show on each equipment graphic input and output points and relevant calculated points such as indicated on the applicable Points List. Point information on graphics shall dynamically update.
 2. Install, initialize, start up, and troubleshoot operator interface software and functions (including operating system software, operator interface database, and third-party software installation and integration required for successful operator interface operation) as described in this section.

3.10 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Startup Testing. Complete startup testing to verify operational control system before notifying Owner of system demonstration. Provide Owner with schedule for startup testing. Owner may have representative present during any or all startup testing.
1. Calibrate and prepare for service each instrument, control, and accessory equipment furnished under this section.
 2. Verify that control wiring is properly connected and free of shorts and ground faults. Verify that terminations are tight.
 3. Enable control systems and verify each input device's calibration. Calibrate each device

4. according to manufacturer's recommendations. Verify that binary output devices such as relays, solenoid valves, two-position actuators and control valves, and magnetic starters, operate properly and that normal positions are correct.
 5. Verify that analog output devices such as I/Ps and actuators are functional, that start and span are correct, and that direction and normal positions are correct. Check control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.
 6. Prepare a log documenting startup testing of each input and output device, with technician's initials certifying each device has been tested and calibrated.
 7. Verify that system operates according to sequences of operation. Simulate and observe each operational mode by overriding and varying inputs and schedules. Tune PID loops and each control routine that requires tuning.
 8. Alarms and Interlocks.
 - a. Check each alarm with an appropriate signal at a value that will trip the alarm.
 - b. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction.
 - c. Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.
 9. CO detection system components shall be installed, tested and maintained in accordance with the manufacturers' published instructions and NFPA 720.
- B. Acceptance Log Sheet
1. Submit the log sheets to the Engineer for review and acceptance.
- C. Promptly rectify all listed deficiencies and submit to the Engineer that this has been done.

3.11 FINAL REVIEW

- A. Submit written request to Architect and Construction Manager when DDC system is ready for final review. Written request shall state the following:
1. DDC system has been thoroughly inspected for compliance with contract documents and found to be in full compliance.
 2. DDC system has been calibrated, adjusted and tested and found to comply with requirements of operational stability, accuracy, speed and other performance requirements indicated.
 3. DDC system monitoring and control of HVAC systems results in operation according to sequences of operation indicated.
 4. DDC system is complete and ready for final review.
- B. Review by Architect and Construction Manager shall be made after receipt of written request. A field report shall be issued to document observations and deficiencies.
- C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.
- D. Should more than two reviews be required, DDC system manufacturer and Installer shall compensate entity performing review for total costs, labor and expenses, associated with third and subsequent reviews. Estimated cost of each review shall be submitted and approved by DDC system manufacturer and Installer before making the review.
- E. Prepare and submit closeout submittals when no deficiencies are reported.
- F. A part of DDC system final review shall include a demonstration to parties participating in final review.
1. Provide staff familiar with DDC system installed to demonstrate operation of DDC system during final review.
 2. Provide testing equipment to demonstrate accuracy and other performance requirements of DDC system that is requested by reviewers during final review.

3. Demonstration shall include, but not be limited to, the following:
- a. Accuracy and calibration of 10 I/O points randomly selected by reviewers. If review finds that some I/O points are not properly calibrated and not satisfying performance requirements indicated, additional I/O points may be selected by reviewers until total I/O points being reviewed that satisfy requirements equals quantity indicated.
 - b. HVAC equipment and system hardwired and software safeties and life-safety functions are operating according to sequence of operation. Up to 10 I/O points shall be randomly selected by reviewers. Additional I/O points may be selected by reviewers to discover problems with operation.
 - c. Correct sequence of operation after electrical power interruption and resumption after electrical power is restored for randomly selected HVAC systems.
 - d. Operation of randomly selected dampers and valves in normal-on, normal-off and failed positions.
 - e. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and operator workstations.
 - f. Trends, summaries, logs and reports set-up for Project.
 - g. For up to three HVAC systems randomly selected by reviewers, use graph trends to show that sequence of operation is executed in correct manner and that HVAC systems operate properly through complete sequence of operation including different modes of operations indicated. Show that control loops are stable and operating at set points and respond to changes in set point of 20 percent or more.
 - h. Software's ability to communicate with controllers, operator workstations, uploading and downloading of control programs.
 - i. Software's ability to edit control programs off-line.
 - j. Data entry to show Project-specific customizing capability including parameter changes.
 - k. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.
 - l. Execution of digital and analog commands in graphic mode.
 - m. Spreadsheet and curve plot software and its integration with database.
 - n. Online user guide and help functions.
 - o. Multitasking by showing different operations occurring simultaneously on four quadrants of split screen.
 - p. System speed of response compared to requirements indicated.
 - q. For Each Network and Programmable Application Controller:
 - 1) Memory: Programmed data, parameters, trend and alarm history collected during normal operation is not lost during power failure.
 - 2) Operator Interface: Ability to connect directly to each type of digital controller with a portable workstation and mobile device. Show that maintenance personnel interface tools perform as indicated in manufacturer's technical literature.
 - 3) Standalone Ability: Demonstrate that controllers provide stable and reliable standalone operation using default values or other method for values normally read over network.
 - 4) Electric Power: Ability to disconnect any controller safely from its power source.
 - 5) Wiring Labels: Match control drawings.
 - 6) Network Communication: Ability to locate a controller's location on network and communication architecture matches Shop Drawings.
 - 7) Nameplates and Tags: Accurate and permanently attached to control panel doors, instrument, actuators, and devices.
 - r. For Each Operator Workstation:
 - 1) I/O points lists agree with naming conventions.
 - 2) Graphics are complete.
 - 3) UPS unit, if applicable, operates.
 - s. Communications and Interoperability: Demonstrate proper interoperability of data sharing, alarm and event management, trending, scheduling, and device and

network management. Requirements must be met even if only one manufacturer's equipment is installed.

- 1) Data Presentation: On each operator workstation, demonstrate graphic display capabilities.
- 2) Reading of Any Property: Demonstrate ability to read and display any used readable object property of any device on network.
- 3) Set Point and Parameter Modifications: Show ability to modify set points and tuning parameters indicated.
- 4) Peer-to-Peer Data Exchange: Network devices are installed and configured to perform without need for operator intervention to implement Project sequence of operation and to share global data.
- 5) Alarm and Event Management: Alarms and events are installed and prioritized according to Owner. Demonstrate that time delays and other logic are set up to avoid nuisance tripping. Show that operators with sufficient privileges are permitted.
- 6) Schedule Lists: Schedules are configured for start and stop, mode change, occupant overrides, and night setback as defined in sequence of operations.
- 7) Schedule Display and Modification: Ability to display any schedule with start and stop times for calendar year. Show that all calendar entries and schedules are modifiable from any connected operator workstation by an operator with sufficient privilege.
- 8) Archival Storage of Data: Data archiving is handled by operator workstation and server and local trend archiving and display is accomplished.
- 9) Modification of Trend Log Object Parameters: Operator with sufficient privilege can change logged data points, sampling rate, and trend duration.
- 10) Device and Network Management:
 - a) Display of network device status.
 - b) Display of BACnet Object Information.
 - c) Silencing devices transmitting erroneous data.
 - d) Time synchronization.
 - e) Remote device re-initialization.
 - f) Backup and restore network device programming and master database(s).
 - g) Configuration management of routers.

3.12 TRAINING

- A. The BMS contractor shall provide the following training services:
1. Provide 4 hours of training by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the BMS software layout and naming conventions, schedule modification, and a walk through of the facility to identify panel and device locations.

3.13 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

3.14 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 2. Test and adjust controls and safeties.

3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 6. Test each system for compliance with sequence of operation.
 7. Test software and hardware interlocks.
- C. DDC Verification:
1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 2. Check instruments for proper location and accessibility.
 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 4. Check instrument tubing for proper fittings, slope, material, and support.
 5. Check installation of air supply for each instrument.
 6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
 7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 8. Check temperature instruments and material and length of sensing elements.
 9. Check control valves. Verify that they are in correct direction.
 10. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.15 WORK RELATING TO CONTROLS AND INSTRUMENTS

- A. Under Sections 230900 as applicable, provide control wiring for the following:
1. All circuits actuated by a temperature control system component.
 2. All circuits which actuate a temperature control component.
 3. All control panel wiring to terminal strips and field wiring from terminal strips to field mounted devices.
 4. All wiring from the "AUTO" side of hand-off-auto switches on units being controlled by Sections 230900.
 5. Wiring of electro-mechanical devices required to be located on or in temperature control panels.
 6. Wiring of DDC trunk, communication, and sensor cable wiring.
 7. Wiring shall comply with material and workmanship standards of Division 26.
 8. Wiring of damper and valve actuators, VAV box actuators, relays, transformers, PE switches and all other control apparatus.
 9. All 120 volt power wiring to vav boxes, damper actuators, line voltage thermostats, valve actuators, relay's, etc. not powered by 24 volt power is work of this division. Wiring shall comply with material and workmanship standards of Division 26. Obtain 120 volt from local electrical panels or junction box. Coordinate with Division 26 contractor.
 10. Wiring of line voltage fan isolation dampers located within fan curbs regardless of voltage in order to achieve specified sequence of operations.
 11. Smoke detectors installed at transfer ducts to close associated dampers.
 12. All control wiring associated with variable refrigerant flow system including but not limited to BMS interface, sensor wiring, and communication.
- B. Under Division 26, perform the following work under supervision of Sections 230900:
1. Wiring of all devices and circuits carrying voltages greater than 110 volts unless otherwise noted.
 2. Wiring of line and load power feeds to all disconnects, starters, and electric motors.
 3. Wiring of 115 volt power feeds to all temperature control panels.
 4. Power wiring to all motors 110 volt to 480 volt unless otherwise noted.

5. Furnish smoke detectors for mounting in ducts used for shutting down of air handling equipment. Smoke detectors installed at transfer ducts shall be provided by temperature control contractor.
6. Specific power feeds shown or specified in Div 26 documents.

3.16 GENERAL WORKMANSHIP

- A. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.
- B. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.
- C. Install equipment in readily accessible locations as defined by National Electrical Code (NEC) Chapter 1 Article 100 Part A.
- D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.
- E. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.

END OF SECTION 26 09 00

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 control sequences for HVAC systems, subsystems, and equipment.
- B. Related Sections include the following:
 - 1. Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.
 - 2. Floor plans.
 - 3. Flow and Control Diagrams.

1.3 DEFINITIONS

- A. DDC: Direct digital control; interchangeable with BMS
- B. BMS: Building Management System; interchangeable with DDC
- C. VFD: Variable Frequency Drive

1.4 GENERAL

- A. Controls contractor shall have a meeting with the architect, engineer, and owner prior to programming to discuss capabilities, schedules and sequences.
- B. Controls contractor shall allocate programming hours (not less than 4 hours) for programming of the facilities program schedules.
- C. Contractor shall provide all required control devices, meters, hardware and software to achieve the specified sequences of operation as outlined in these specifications and as detailed on drawings whether indicated and/or implied. Refer to drawing for general I/O points. All points may not be listed and are indicated for general description.
- D. BMS shall monitor and report all control function alarm points.
- E. BMS shall monitor and report status of all equipment for use in sequence of operations, trending and verification.
- F. BMS shall monitor all modulating valve and damper positions.
- G. All setpoints including but not limited to temperature, time, CO, CO2, enthalpy, wet bulb, pressure, etc. shall be adjustable.
- H. All safeties shall operate whether the starters or VFD's are in the hand or automatic mode.
- I. Thermostats shall provide local temperature adjustment via a knob or slider bar. The temperature adjustment range shall be individually adjustable for each thermostat, programmed through the BMS or the same range can be applied to all thermostats globally.
- J. Thermostats shall also provide an occupancy override function. Activation of timed override switch on zone thermostats shall only reset zone heating and cooling setpoints to "occupied" values, but shall not affect otherwise scheduled Unoccupied operating mode of air handling unit. This allows the user to override the Unoccupied scheduled setpoints and put the system into an occupied setpoints mode for set duration and reset to normal operation at the end of the period or whenever the override button is held for more than 5 seconds (adjustable). The override duration is individually adjustable for each thermostat through the BMS or the same range can be applied to all thermostats globally.
- K. The temperature controls contractor, equipment manufacturers, and mechanical contractor shall provide all parts, sensors, hardware and accessories for a complete and operational system. If alternate/additional sensors/relays or hardware is required by deviating from the basis of design, the control contractor is to provide all required hardware, installation and communication wiring for these devices.

1.5 SAFETIES (ALL AIR HANDLING UNITS AND DUCTWORK)

- A. The BMS shall monitor all fans status via a current sensor. If anytime the fan is enabled and current is not sensed, an alarm shall be initiated at the BMS central computer and at the local panel.
- B. The BMS shall monitor the discharge air temperature via a temperature sensor located in the duct.
- C. It is intended that, in general, the Division 23 Contractor will be responsible for all control sequences. Critical safety interlocks which are not directly wired by the Division 26 sub-contractor, such as freezestats, high limit protectors, end switches etc., shall be directly connected, through wire, so as not to depend on any digital control system "Sequence of Operation" to perform their safety function.

1.6 COMPRESSOR ROOM VENTILATION

- A. Existing unit heater and controls to remain.
- B. Existing roof exhaust fan temperature dependent control shall remain.
- C. Outside air is controlled to satisfy the ventilation air requirements of the compressors.
- D. Room thermostat set to maintain 55 deg(adj)
- E. Upon a signal from main compressor unit, and the room space thermostat is above minimum setpoint of 55 deg(adj):
 - 1. OA damper shall energize open. End switch shall prove status
 - 2. Exhaust air damper shall energize open. End switch shall prove status.
 - 3. Bypass air damper shall be closed. End switch shall prove status.
- F. Upon a signal from main compressor unit, and the room space thermostat is below or falls below setpoint of 55 deg(adj) during compressor operation:
 - 1. OA damper shall energize closed. End switch shall prove status
 - 2. Exhaust air damper shall energize closed. End switch shall prove status.
 - 3. Bypass air damper shall open. End switch shall prove status.
 - 4. Upon a rise in space temperature 5 deg(adj) above setpoint the reverse shall occur.
- G. During all compressors off cycle existing unit heaters fan shall maintain minimum heating setpoint.
- H. During all compressors off cycle existing exhaust fan shall energize at a room temperature setpoint of 80 deg(adj). Upon a drop in temperature or compressor on signal, the fan shall deenergize.

1.7 COMPRESSOR STATUS AND ALARMS

- A. BMS shall monitor compressors via each panel and associated contacts.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 09 93

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section Includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Sheet metal materials.
 - 3. Sealants and gaskets.
 - 4. Hangers and supports.
- C. Related Sections:
 - 1. Section 23 33 00 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

- A. Comply with all requirements of the International Mechanical Code, latest adopted version.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
 - 3. Seismic-restraint devices.
- B. Shop Drawings:
 - 1. Electronic drawing files shall be generated by the Contractor.
 - 2. Drawings shall be submitted in both hard copy and electronic (AutoCAD or Revit version as required by the Owner) version or AutoCAD Version 2010 if not specified.
 - 3. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 4. Factory- and shop-fabricated ducts and fittings, and sheet metal shop standards. Edited to specification and job specific requirements. Sheet metal shop standards shall be submitted for review prior to the submission of sheet metal shop drawings. Any sheet metal shop drawings submitted prior to the submission and review of the sheet metal shop standards shall be returned "not reviewed."
 - 5. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 - 6. Shop drawings shall be submitted in 3/8" scale.
 - 7. Elevation of top and bottom of ducts.
 - 8. Dimensions of main duct runs from building grid lines.
 - 9. Fittings and fitting construction edited to specification and job specific requirements.
 - 10. Reinforcement and spacing.
 - 11. Seam and joint construction.
 - 12. Penetrations through fire-rated and other partitions.
 - 13. Equipment installation based on equipment being used on Project.
 - 14. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 - 15. Hangers and supports, including methods for duct and building attachment and vibration isolation.
 - 16. Schedule indicating ductwork material, service, location (interior, exterior), and sealing method.
 - 17. Submittals with multiple manufacturers listed for a single product will not be reviewed shall be returned "not reviewed."

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 - 2. Suspended ceiling components.

3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Sprinklers.
 - d. Access panels.
- B. Welding certificates.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports, AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 STANDARDS

- A. SMACNA "HVAC Duct Construction Standards - Metal and Flexible" Latest Edition.
- B. Minimum duct gauge shall be 24 for all rigid round, flat oval, and rectangular ductwork.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." Refer to specification sections below and the details on the drawings for more information regarding acceptable elbows, transitions, offsets, branch connections, and other duct construction.
- E. Sheet metal shop duct identification labels/tags shall not be installed on the inside surface of ductwork or fittings.

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 1. Galvanized Coating Designation: G90.

2. Finishes for Surfaces Exposed to View: G60
- C. Galvannealed or Mill Phosphatized: Comply with ASTM A 653/A 653M.
 1. Finished for surfaces indicated to be field painted: galvannealed or mill phosphatized: A60.
- D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; galvanized.
 1. Where galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- E. Tie Rods: Tie rod material shall match the duct material. 3/8-inch minimum diameter.

2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 2. Tape Width: 6 inches.
 3. Sealant: Modified styrene acrylic.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 7. Service: Indoor and outdoor.
 8. Service Temperature: Minus 40 to plus 200 deg F.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Water-Based Joint and Seam Sealant:
 1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
 1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Electrogalvanized steel rods, washers and nuts.
- B. Hanger Rods for Corrosive/Moist Environments: Hot dipped galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct." Minimum threaded rod shall be 3/8".

- D. Wire, steel cables and cable clutches are not acceptable for hanging ductwork.
- E. Duct Attachments: Sheet metal screws or self-tapping metal screws; compatible with duct materials and of appropriate length.
- F. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Electrogalvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.
- G. All hanger rod and channel ends; exposed and 12' or less above finished floor; shall be provided with plastic caps and plastic channel safety end caps. Color shall be same throughout the project; yellow, orange or red.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system.- Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and indicated on the Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round and flat-oval ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated, smoke rated interior partitions and exterior walls, install fire dampers or smoke dampers. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines." using "Advance Level" protection requirements.

3.2 INSTALLATION OF ALL (NON-EXTERNALLY INSULATED) EXPOSED DUCTWORK/FITTINGS

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. For acoustically lined ductwork, trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

- E. Repair or replace damaged sections and finished work that does not comply with these requirements.
- F. Wire, steel cables and cable clutches are not acceptable for hanging ductwork.
- G. Sheet metal shop duct identification labels/tags shall be removed. Sheet metal shop duct identification labels/tags shall not be installed on the inside surface of ductwork or fittings.
- H. Provide flush seam ductwork for all ductwork where un-insulated and exposed in finished spaces or where required to maintain clearances.
- I. Non-acoustically lined ductwork shall be internally sealed.

3.3 DUCT SEALING

- A. Seal all duct seams and joints to comply with ASHRAE 90.1-2010 6.4.4.2.1 (unless otherwise noted) which is more stringent than SMACNA requirements. All duct types shall be sealed at a minimum seal class per the table below:

B. DUCT SEAL CLASS

Duct location	Duct Type			
	Supply		Exhaust (Positive and Negative side of fan)	Return
	≤2 in.wc	>2" in.wc		
Outdoors	A	A	A	A
Unconditioned Space	A	A	A	A
Conditioned Space (includes return air plenums)	A	A	A	A

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports." Refer to specification sections and drawings for all acceptable hanging and support methods.
- B. Building Attachments: Stud wedge type expansion, female wedge type expansion or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Do not use powder-actuated concrete fasteners for seismic restraints or ductwork hangers.
 - 3. Pin/nail anchors, spikes, expansion shields, expansion anchors, dropin anchors, wedge bolts, self tapping screw anchors, and friction clamps are not acceptable.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 12inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Wire, steel cables and cable clutches are not acceptable for hanging ductwork.
- F. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- G. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- H. All hanger rod and channel ends; exposed and ≤ 12' above finished floor; shall be provided with plastic caps and plastic channel safety end caps. Color shall be same throughout the project; yellow, orange or red.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."

- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Pressure Class:
1. Refer to schedule on drawings.
- C. Leakage Class:
1. Supply Ducts:
- a. Pressure Class: Positive 1, 2, 3 inch wg.
- 1) Seal Class: A.
- 2) SMACNA Leakage Class for Rectangular: 6.
- 3) SMACNA Leakage Class for Round and Flat Oval: 4.
- b. Pressure Class: Positive 4, 6, 10 inch wg.
- 1) Seal Class: A.
- 2) SMACNA Leakage Class for Rectangular: 4.
- 3) SMACNA Leakage Class for Round and Flat Oval: 2.
2. Return Ducts:
- a. Pressure Class: Positive or negative 1, 2, 3 inch wg.
- 1) Seal Class: A.
- 2) SMACNA Leakage Class for Rectangular: 6.
- 3) SMACNA Leakage Class for Round and Flat Oval: 4.
- b. Pressure Class: Positive or negative 4, 6, 10 inch wg.
- 1) Seal Class: A.
- 2) SMACNA Leakage Class for Rectangular: 4.
- 3) SMACNA Leakage Class for Round and Flat Oval: 2.
3. Exhaust Ducts:
- a. Ducts Connected to Fans and Air Handling Units Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
- 1) Pressure Class: Positive or negative 1, 2, 3 inch wg.
- 2) Seal Class: A if negative pressure, and A if positive pressure.
- 3) SMACNA Leakage Class for Rectangular: 6.
- 4) SMACNA Leakage Class for Round and Flat Oval: 4.
- b. Ducts Connected to Fans and Air Handling Units Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
- 1) Pressure Class: Positive or negative 4, 6, 10 inch wg.
- 2) Seal Class: A if negative pressure, and A if positive pressure.
- 3) SMACNA Leakage Class for Rectangular: 4.
- 4) SMACNA Leakage Class for Round and Flat Oval: 2.
- 5) SMACNA Leakage Class for Round and Flat Oval: 2.
- D. Duct System Cleanliness Tests:
1. Following duct cleaning indicated in the sections below Under "DUCT CLEANING":
- a. Visually inspect duct system to ensure that no visible contaminants are present.
- b. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
- 1) Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- E. Duct system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.7 DUCT SCHEDULE

- A. Fabricate ducts with G90 galvanized sheet steel except as otherwise indicated on the Duct Material Schedule on the drawings.
- B. Static Pressure Classes:
1. Refer to Duct Pressure Class schedule on drawings.
- a.

- C. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
- D. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows" and the requirements indicated in specification section 233300 Air Duct Accessories. Single wall vanes are not acceptable. RE 2 is only acceptable where space does not permit the use of radius type RE 1 elbows.
 - c. Elbow types RE 4, 6, 7, 8, 9, and 10 are not acceptable.
- E. Branch Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch:
 - 1) Radius entry with clinch lock.
 - 2) Self-adhesive and "high efficiency" duct takeoffs are not acceptable.
 - b. Rectangular Main to Round Branch:
 - 1) Spin-in bellmouth
 - 2) Self-adhesive and "high efficiency" duct takeoffs are not acceptable.
 - 3) Rectangular radius entry with clinch lock with transition to round attached.
 - 4) Transitioning rectangular to round tap with and without integral volume dampers and gasket are not acceptable.
- F. Offset, Transition and Obstruction Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-7, "Offsets and Transitions and Figure 4-8 "Obstructions"
 - a. Offsets type 1 is not acceptable.
 - b. All offsets shall be use radius elbows; mitered elbow offsets are not acceptable.
 - c. Concentric transitions shall be limited to 40°. Angle may need to be greater based on job conditions. Each instance shall be reviewed.
 - d. Eccentric transitions shall be limited to 20°. Angle may need to be greater based on job conditions. Each instance shall be reviewed.
 - e. Obstruction Figure D is not acceptable; Figure B shall be utilized as space allows. If space does not allow radius elbow offsets, each instance shall be reviewed.

END OF SECTION 23 31 13

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Backdraft and pressure relief dampers.
 - 2. Barometric relief dampers.
 - 3. Fire dampers.
 - 4. Flange connectors.
 - 5. Turning vanes.
 - 6. Duct-mounted access doors.
 - 7. Flexible connectors.
 - 8. Duct accessory hardware.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control-damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" latest edition for acceptable materials, material thicknesses, and duct construction methods unless otherwise

indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

- C. Comply with International Mechanical Code.

2.2 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" latest edition for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G90.
 2. Finishes for Surfaces Exposed to View: G60
 3. Finished for surfaces indicated to be field painted: galvanized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Material shall match components, minimum 3/8-inch.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Greenheck Fan Corporation.
 2. Nailor Industries Inc.
 3. Pottorff.
 4. Ruskin Company.
- B. Description: Gravity balanced.
- C. Frame: Hat-shaped, 0.063-inch-thick extruded aluminum, with welded corners or mechanically attached and mounting flange.
- D. Blades: Multiple single-piece blades, maximum 6-inch width, 0.050-inch-thick aluminum sheet with sealed edges.
- E. Blade Action: Parallel.
- F. Blade Seals: Neoprene, mechanically locked.
- G. Blade Axles:
1. Material: Aluminum.
 2. Diameter: 0.20 inch.
- H. Tie Bars and Brackets: Aluminum.
- I. Return Spring: Adjustable tension.
- J. Bearings: Steel ball or synthetic pivot bushings.
- K. Accessories:
1. Adjustment device to permit setting for varying differential static pressure.
 2. Counterweights and spring-assist kits for vertical airflow installations.
 3. Chain pulls.
 4. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20 gage minimum.
 - b. Sleeve Length: 6 inches minimum.
 5. Screen Material: Aluminum.
 6. Screen Type: Insect.
 7. 90-degree stops.

2.4 BAROMETRIC RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Greenheck Fan Corporation.
 - 2. Nailor Industries Inc.
 - 3. Pottorff.
 - 4. Ruskin Company.
- B. Suitable for horizontal or vertical mounting.
- C. Frame: Hat-shaped, 0.063-inch-thick extruded aluminum, with welded corners or mechanically attached and mounting flange.
- D. Blades:
 - 1. Multiple, 0.050-inch-thick aluminum sheet.
 - 2. Maximum Width: 6 inches.
 - 3. Action: Parallel.
 - 4. Balance: Gravity.
- E. Blade Seals: Neoprene.
- F. Blade Axles: Nonferrous metal.
- G. Tie Bars and Brackets:
 - 1. Material: Aluminum .
 - 2. Rattle free with 90-degree stop.
- H. Return Spring: Adjustable tension.
- I. Bearings: Synthetic, Stainless steel or Bronze.
- J. Accessories:
 - 1. Flange on intake.
 - 2. Adjustment device to permit setting for varying differential static pressures.
 - 3. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20 gage minimum.
 - b. Sleeve Length: 6 inches minimum.
 - 4. Screen Material: Aluminum.
 - 5. Screen Type: Insect.

2.5 MANUAL VOLUME DAMPERS

- A. Single Blade Dampers. Maximum width of single blade shall be 14", use opposed blade damper for height exceeding 14". Pre-manufactured dampers shall be part of an assembly complete with damper, frame, axle and bearings. The damper frame shall be installed internal to the duct and fastened with the appropriate hardware. The installation shall not interfere with the operation of the damper blade(s). Approved products shall be pre-manufactured devices.
- B. Multiple Blade Dampers. Opposed blade damper shall be used where duct height exceeds 14". Approved products shall be pre-manufactured devices.
- C. Steel, Manual Volume Dampers: Except for outdoor air, shower exhaust, toilet exhaust
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Rectangular	Air Balance	AC-111
	Greenheck	MBD-10
	Ruskin	MD25
Round	Air Balance	AC-112
	Greenheck	MBDR50
	Ruskin	MDRS25, CDRS15
Opposed Blade	Air Balance	AC-2
	Greenheck	MBD-15
	Ruskin	MD35OB
 - 2. Linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Hat shaped.

- b. Galvanized-steel channels, 0.064 inch thick.
 - c. Mitered and welded corners.
 - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Parallel- or opposed-blade design.
 - b. Stiffen damper blades for stability.
 - c. Galvanized, roll-formed steel, 0.064 inch thick.
 - 6. Blade Axles: Galvanized steel.
 - 7. Bearings:
 - a. Provide zero leak open end bearing and closed end bearing on the operating shaft.
 - b. Zero leak bearings shall be by DuroDyne model SB, Ventlok 607/609, or Elgen.
 - c. Dampers in ducts shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 8. Jamb Seals: Cambered aluminum.
 - 9. Tie Bars and Brackets: Aluminum.
 - 10. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
 - 1) Locking quadrants shall be equivalent to Rossi Megalock, Windgate SURE-LOC HD, Durodyne Dyna-Click with cast metal handle.
 - b. Include standoffs for insulated ductwork.
- D. Aluminum, Manual Volume Dampers: For outdoor air, shower exhaust, toilet exhaust
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McGill AirFlow LLC.
 - b. Pottorff; a division of PCI Industries, Inc.
 - c. Ruskin Company. CD51, CD35
 - 2. Linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Parallel- or opposed-blade design.
 - b. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
 - c. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
 - 6. Blade Axles: Galvanized steel.
 - 7. Bearings:
 - a. Provide zero leak open end bearing and closed end bearing on the operating shaft.
 - 1) Zero leak bearings shall be by DuroDyne model SB, Ventlok 607/609, or Elgen.
 - b. Dampers in ducts shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 8. Jamb Seals: Cambered aluminum.
 - 9. Tie Bars and Brackets: Aluminum.
 - 10. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
 - 1) Locking quadrants shall be equivalent to Rossi Megalock, Windgate SURE-LOC HD, Durodyne Dyna-Click with cast metal handle.
 - b. Include standoffs for insulated ductwork.
- E. Jackshaft:
 - 1. Size: 1-inch diameter.
 - 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- F. All dampers shall be furnished with an elevated platform/standoff for insulated duct mounting.

- G. Provide dampers in all branch ducts and duct splits whether indicated or not on the drawings.

2.6 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Greenheck Fan Corporation.
 2. Nailor Industries Inc.
 3. Ruskin Company DIBDX, IBDT, DIBDXGA
- B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours.
- E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.060-inch thick and of length to suit application. Sleeve thickness shall not be less than the gauge of the connecting duct.
 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as necessary for proper installation.
- H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165°F rated, fusible links.
- K. Grille Access Fire Dampers shall be provided where sidewall grilles are mounted to a fire rated wall.
- L. Provide dampers; as required by all local and state codes; in ducts whether indicated or not on the drawings.

2.7 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
 2. Nexus PDQ; Division of Shilco Holdings Inc.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.8 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufacturers Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows" unless otherwise noted.
- D. Vane Construction: Turning vanes shall be double wall construction of minimum 24 gauge galvanized metal for 4 1/2" radius vanes and minimum 26 gauge galvanized metal for 2" radius

vanes. Each vane shall be securely riveted or welded to minimum 22 gauge runner or directly to duct.

- E. Turning vanes shall have 2" inside radius spaced 2-1/8" apart through 24" wide duct. Vanes in elbows larger than 24" shall have a 4 1/2" radius and be spaced 3 1/4" apart.
- F. Vanes shall be installed in sections to reduce unsupported length for ducts exceeding 60" in height.

2.9 DUCT AND PLENUM MOUNTED ACCESS DOORS (0.5-2.0 in w.g.)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acudor
 - 2. KEES Incorporated
 - 3. Ruskin
 - 4. Ventfabrics Incorporated
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct" unless otherwise noted.
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Door material shall match the duct/plenum material it is installed in.
 - c. Door shall be double wall with insulation fill.
 - d. Insulation thickness shall meet the insulation thickness of the duct/plenum the access door is installed in. Provide 2" thick insulation double wall access door unless otherwise noted.
 - e. Latches: equivalent to Ventfabrics, Inc. No. 100 for small doors and No. 310 where physical access is possible. Window latch/sash type hardware is specifically prohibited. Use multiple latches (minimum 4) where the door swing for a hinged door is restricted by the hung ceiling or some other obstruction.
 - f. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Number of Hinges and Locks:
 - a. Access Doors less than 12 inches: Two hinges and one latch.
 - b. Access Doors 12 inches up to 20 Inches: Two hinges and two latches.
 - c. Access Doors 22 inches up to 24 Inches: Three hinges and two latches with outside and inside handles.
 - d. Access Doors larger than 24 Inches: Three hinges and two latches with outside and inside handles.
 - 4. Access doors shall be rated to maintain the fire/smoke rating of the equipment/duct in which they are installed.

2.10 DUCT AND PLENUM MOUNTED ACCESS DOORS (3.0 in w.g.)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acudor
 - 2. KEES Incorporated
 - 3. Ruskin
 - 4. Ventfabrics Incorporated
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct" unless otherwise noted.
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Door material shall match the duct/plenum material it is installed in.
 - c. Door shall be double wall with insulation fill.
 - d. Insulation thickness shall meet the insulation thickness of the duct/plenum the access door is installed in. Provide 2" thick insulation double wall access door unless otherwise noted.
 - e. Latches: equivalent to Ventfabrics, Inc. No. 100 for small doors and No. 310 where physical access is possible. Window latch/sash type hardware is specifically prohibited. Use multiple latches (minimum 4) where the door swing for a hinged door is restricted by the hung ceiling or some other obstruction.
 - f. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
 - a. Access Doors less than 12 inches: Two hinges and one latch.
 - b. Access Doors 12 inches up to 20 Inches: Two hinges and two latches.
 - c. Access Doors 22 inches up to 24 Inches: Three hinges and four latches with outside and inside handles.
 - d. Access Doors larger than 24 Inches: Three hinges and four latches with outside and inside handles.
4. Access doors shall be rated to maintain the fire/smoke rating of the equipment/duct in which they are installed.

2.11 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Ventfabrics, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 1. Minimum Weight: 26 oz./sq. yd..
 2. Tensile Strength: 480 lbf/inch in the wrap and 360 lbf/inch in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 1. Minimum Weight: 24 oz./sq. yd..
 2. Tensile Strength: 530 lbf/inch in the wrap and 440 lbf/inch in the filling.
 3. Service Temperature: Minus 50 to plus 250 deg F.
- G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
 1. Minimum Weight: 16 oz./sq. yd..
 2. Tensile Strength: 285 lbf/inch in the wrap and 185 lbf/inch in the filling.
 3. Service Temperature: Minus 67 to plus 500 deg F.
- H. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.12 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ventlok	#699
b. DuroDyne	IP-2, IP4

- c. Or approved equal
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install motorized dampers at the discharge of exhaust fans or exhaust ducts as close as possible to the exhaust outlet unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts whether indicated or not. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel. Install damper in acoustically lined ducts in such a manner to avoid damage to liner and to avoid erosion of duct liner.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Provide volume dampers in each branch duct serving all inlets and outlets whether indicated or not.
- G. Install volume damper as close to main as possible, maximum 2 duct widths from branch takeoff.
- H. Install ribbon tag tied on to air control device for the purpose of visibly identifying control device locations.
- I. Install test holes at fan inlets and outlets and elsewhere as indicated and as required.
- J. Install fire, fire /smoke and smoke dampers according to UL listing.
- K. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 7. At each change in direction and at maximum 50-foot spacing.
 - 8. Upstream and downstream from turning vanes.
 - 9. Upstream or downstream from duct silencers.
 - 10. Control devices requiring inspection.
 - 11. Elsewhere as indicated.
- L. Install access doors with swing against duct static pressure.
- M. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 12 by 12 inches.
 - 2. Two-Hand Access: 12 by 12 inches.
 - 3. Head and Hand Access: 20 by 16 inches.
 - 4. Head and Shoulders Access: 24 by 24 inches.
 - 5. Body Access: 24 by 24 inches.
 - 6. Body plus Ladder Access: 24 by 24 inches.

- N. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- O. Locate all duct balancing dampers above accessible ceilings, or provide cable operated dampers.
- P. Install flexible connectors to connect ducts to equipment.
- Q. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- R. Install duct test holes where required for testing and balancing purposes.
- S. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.
 - 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 33 00

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Division shall be governed by the Contract Documents. Provide materials, labor, equipment, and services necessary to furnish, deliver and install all work of this Division as shown on the drawings, as specified herein, and/or as required by job conditions.
- B. This Section 26 01 00 governs general procedures, materials and workmanship as applicable to the electrical work specified in the other Division 26 sections. Refer to Division 1 sections for additional general requirements.
- C. Perform the work in accordance with the requirements and provisions of all applicable codes and laws.
- D. Equipment, materials, and installation shall conform to applicable standards and requirements of the following organizations and documents:
 - ANSI American National Standards Institute
 - ASTM American Society for Testing and Materials
 - AWS American Welding Society
 - CBM Certified Ballast Manufacturers Association
 - ETL ETL Testing Laboratories
 - FCC Federal Communications Commission
 - FM Factory Mutual
 - FS Federal Specifications
 - ICEA Insulated Cable Engineers Association
 - IEEE Institute of Electrical and Electronic Engineers
 - IESNA Illuminating Engineering Society of North America
 - NEC National Electrical Code
 - NECA National Electrical Contractors Association
 - NEMA National Electrical Manufacturers Association
 - NESC National Electric Safety Code
 - NETA International Electrical Testing Association
 - NFPA National Fire Protection Association
 - OSHA Occupational Safety and Health Administration
 - UL Underwriters Laboratories, Inc.

1.2 INTENT

- A. It is the intention of the specifications and drawings to obtain finished work, clean, tested, and ready for operation.
- B. Items and services not shown on drawings, but mentioned in specifications, or vice versa, or items and services necessary to render the work complete and ready for operation, even if not specified or indicated on the drawings, shall be provided without additional cost.
- C. Where conflicts occur between drawings and specifications, or within either document, the Contractor shall ask for and obtain a written clarification from the Engineer prior to submitting his bid. Otherwise, the items or arrangements of superior quality, greater quantity or higher cost shall prevail and be included in the contract price.

1.3 WORK INCLUDED

- A. The work under this Division shall include all labor, material, equipment, services and administrative tasks required to complete and make operable the electrical work shown on the drawings and specified herein, and including, but not limited to, the following:
 - 1. Preparation and submission of shop drawings, diagrams and illustrations.
 - 2. Procuring all necessary permits and approvals, and paying all required fees and charges in connection with the work of this Division.
 - 3. Coordinating with, and complying with requirements of, the local electric utility, telephone company, and other franchised utility and service companies as applicable to the scope of this work.

4. Record drawings.
5. Operating and maintenance instructions and manuals.
6. Identification labels, tags, charts and diagrams.
7. Final connections to all electrical equipment and devices.
8. All cutting, drilling, and patching required for the work of this Division.
9. Concrete housekeeping pads for floor-mounted electrical equipment.
10. Testing and adjustment of all systems and equipment furnished, installed, and/or connected under this Division.

1.4 APPROVALS

- A. See General Conditions and Division 1 sections, in addition to the following requirements.
- B. Submit for approval a list of manufacturers of equipment proposed for the work. Contractor's intent to use exact make specified does not relieve him of responsibility for submitting such a list.
- C. Where any specific material, process or method of construction, or manufactured article is specified by name or by reference to catalog number of a manufacturer, or other standards, the intent is not to take precedence over the basic duty and performance specified, noted on drawings, or as required for intended results. In all cases, the Contractor shall verify the duty specified with the specific characteristics of the equipment offered for approval.
- D. If material or equipment is installed before it is approved, the Contractor shall be liable for its removal and replacement with no additional cost.

1.5 SUBMITTALS

- A. See Division 26 equipment sections for specific submittals required. Unless otherwise indicated, submittals are required for all electrical devices, equipment, and systems including basic construction materials such as conduit, 600 volt building wire, and standard fittings and boxes.
- B. Manufacturers' Data
 1. If catalog cuts of standard manufactured items show different types, options, finishes, performance requirements, or other variations, those features that the Contractor proposes to furnish shall be clearly identified. If any variations from the catalog description are proposed or required, such variations must be clearly noted on the cut.
- C. Shop Drawings
 1. Shop drawings shall clearly indicate all details, sectional views, arrangements, working and erection dimensions, kinds and quality of materials and their finishes, and other information necessary for proper checking and for fabrication and installation of the items, and shall include all information required for making connections to other work.
 2. Shop drawings shall be numbered consecutively, and drawings related to various units comprising a proposed assembly shall be submitted simultaneously so that such units may be checked both individually and as an assembly.
 3. Contractor shall keep on the site, in good order, a complete up-to-date set of approved shop drawings. Shop drawings shall be made available for inspection by the Engineer.
 4. The approval of shop drawings will be for general conformance to drawings and specifications, and shall not be construed as permitting any departure from the contract requirements. If the shop drawings show any variations from contract requirements because of standard shop practices or other reasons, such variations shall be clearly identified on the drawings or specifically noted in the letter of transmittal, in order that, if acceptable, suitable action may be taken for proper adjustment in other work affected thereby. If the Contractor fails to so identify such variations, he will not be relieved of responsibility for executing the work in accordance with the contract, even though such shop drawings have been approved and the work installed. Approval shall not relieve the Contractor of responsibility for any error in details, dimensions, etc. that may exist on shop drawings, nor for the furnishing of materials or work required by the contract and not indicated on the shop drawings. Approval shall not be construed as approved departure from details or instructions previously furnished by the Engineer.
 5. No work for which shop drawings are required shall be executed until the Engineer's approval is obtained.

- D. Shop Drawing Schedule
1. The Contractor shall submit, within 30 days of the award of his contract, a schedule of all proposed shop drawing submissions.
 2. The schedule shall include the following information.
 - a. Item to be submitted
 - b. Date of submission
 - c. Latest date for review
 - d. Manufacturers of the specified item.
 3. Items not specifically listed as "approved equal" should be listed for consideration at this time.
 4. Shop drawings require a minimum of 10 business days from the date they have been received by the Consulting Engineer's office to adequately review the submittal. If there is any submittal which requires to be expedited sooner than the 10 business days, the Engineer shall be informed in writing at the beginning of construction with a list of those submittals.
- E. Operating and Maintenance Instructions
1. Furnish manufacturer's operating and maintenance instructions, parts lists, and sources of supply for replacements.
- F. Submittals will be reviewed for conformance with the contract drawings and specifications. The engineer's review stamp will be affixed to submittals. One of the following actions will be taken:
1. Reviewed:
 - a. No comments, corrections, or marks have been made to the submittal. Re-review by the engineer is not required. The submittal is in general conformance with the design concept. Construction, fabrication and/or manufacture can proceed subject to the provision that the work shall be in accordance with the requirements of the Contract Documents. Final acceptance of the work shall be contingent upon such compliance.
 2. Furnish As Corrected
 - a. Comments, corrections, or marks made. Re-review is not required. Submission is in general conformance with the design concept subject to notations on the returned Submittal. Construction, fabrication, and/or manufacturer can proceed subject to the provisions that the work shall be carried out in compliance with all annotations and/or corrections indicated on the returned Submittal and in accordance with the Contract Documents. Final acceptance of the work shall be contingent on such compliance.
 3. Revise and Resubmit
 - a. Significant issues/discrepancies/incomplete information was provided in the Submittal. Revise or prepare a new submittal in accordance with the notations and Contract Documents. Resubmit without delay.
 4. Rejected
 - a. Submittal does not meet Contract document intent. Revise or prepare a new submittal in accordance with the notations and Contract Documents. Resubmit without delay.
- G. A submittal review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections or comments made on the shop drawings during this review do not relieve the contractor from Compliance with the requirements of the plans and specifications. Approval of a specific item shall not include approval of an assembly of which the item is a component. The contractor is responsible for: dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences and procedures of construction; coordination of his or her work with that of all other trades; and for performing all work in a safe and satisfactory manner.

1.6 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Upon installation of back boxes for devices but prior to installation of raceway to same the contractor shall notify the Owner and Engineer at least two weeks prior so that a site visit for review of back box locations may be performed. Contractor shall promptly be given marked up directions indicating which back boxes are to be relocated. Relocation of back boxes as a result of the site review shall be performed at no additional cost to the Owner.

1.7 RECORD DRAWINGS

- A. Provide record drawings in accordance with contract requirements, indicating in a neat and accurate manner a complete record of all revisions to the original design of the work. Include all changes and an accurate record, on reproductions of the contract drawings or appropriate shop drawings, of all deviations between the work shown and the work installed.
- B. The contractor shall provide a complete set of as-built drawings. Drawings shall be submitted in both hard copy and electronic (AutoCAD and Revit version as required by the Owner) version or AutoCAD Version 2018 if not specified. Number of copies of each as requested by the Owner. PDFs inserted into an AutoCad file are not acceptable.
- C. The as-built drawings shall reflect as installed conditions including all addenda, and miscellaneous revisions. The contractor shall make necessary modifications to the as-built drawings based upon the review submission comments. The final product shall include a copy of all electronic files of all as-built drawings of size and format consistent with the project standards.

1.8 GUARANTEES AND SERVICES

- A. All workmanship, installation materials, and equipment shall be guaranteed as specified in the General Conditions and Division 1.
- B. Contractor shall leave entire system installed under this Contract in proper working order, and shall replace any work or material which develops defects within the guarantee period, including all other work damaged as a result of such defects, without additional cost.

1.9 PERMITS AND CERTIFICATES

- A. Prior to proceeding with any installation, the Contractor shall prepare and submit to the proper authorities for their approval all working drawings required by them, and shall give all necessary notices, obtain all permits, and pay all local, state and federal taxes, fees and other costs in connection with this work.

1.10 EQUIPMENT MANUALS AND OPERATING INSTRUCTIONS

- A. Provide the following:
 - 1. Three complete sets of final and correct shop drawings, maintenance and replacement parts manuals, and operating instructions for the equipment supplied. Bind each set within a common binder. Index, number, and organize with a table of contents to permit quick and convenient reference.

2. Three days of instruction in operation and maintenance of equipment to Owner's maintenance force during a 2-week period. Designate a 2-week period, convenient to the Owner, during which qualified personnel, including manufacturers' technicians and engineers, will be available for Owner's instructions.

1.11 SHORT CIRCUIT, OVERCURRENT PROTECTION SELECTIVE COORDINATION, AND ARC FLASH STUDY

- A. The contractor shall perform and submit for review and approval (1) a short circuit study, (2) an overcurrent protection selective coordination study, (3) an arc flash study in accordance with IEEE "Red Book" Standard 141 for all service and distribution equipment supplied, including, but not limited to, equipment specified in Sections 262416 Panelboards. Study reports shall accompany submittals for above equipment. **Submittals for the above items submitted without study reports shall be rejected.** If the report is not submitted with the equipment submittals, then the contractor shall replace any overcurrent protection device or equipment as required to meet the short circuit and selective coordination requirements at no additional cost to the Owner.
- B. Manufacturer shall document that overcurrent protection devices will perform in accordance with their U.L. listings and ANSI/IEEE Standard 242.
- C. The contractor shall be responsible for final field adjustment of ground fault, overload and short circuit settings of adjustable circuit breakers and fused devices in compliance with the short circuit and coordination study recommendations.

PART 2 - PRODUCTS

2.1 MATERIALS, EQUIPMENT AND SYSTEMS

- A. Materials and equipment and systems shall be new, bear manufacturer's name and trademark, and comply with applicable standards specified.
- B. The UL label shall be borne on each piece of applicable material or equipment.
- C. Equipment shall be provided with all required hardware for proper installation, assembly, and operation.
- D. The descriptions cover basic equipment and operation but not all the details of design and construction. The use of singular in descriptions does not limit the quantities of items to be furnished to provide the operation specified. Furnish all equipment required to produce specified performance under installed conditions. Provide all trim, enclosures and accessories required to make a complete installation.
- E. Follow manufacturers' directions in delivery, storage, protection and installation of equipment and materials. Notify Engineer promptly, in writing, of any conflict between requirements of the contract documents and manufacturers' directions, and obtain Engineer's written instructions before proceeding with work. Bear all costs to correct deficiencies arising from failure to comply with the manufacturers' directions and instructions.
- F. Deliver equipment and materials to the site and store in original containers, suitably sheltered from the elements. Store items subject to moisture damage in dry, heated spaces. Tightly cover and protect equipment against dirt, water, chemical, and mechanical injury, and against theft.
- G. Equipment and materials of the same general type shall be of the same manufacturer, make and model throughout the work to provide uniform appearance, operation and maintenance.
- H. Where new products or components are indicated to be installed or connected to existing systems or equipment, verify compatibility and performance with the manufacturer of the existing systems or equipment prior to purchase and installation.
- I. Where devices and/or equipment are indicated to be relocated, conductors and raceway shall be extended to the new location and reconnected to provide a complete working system. If there are associated devices with the relocated equipment they shall be relocated as well, unless otherwise noted, and connected into the system.

2.2 EQUIPMENT DEVIATIONS

- A. Where Contractor proposes to use an item of equipment other than that specified or detailed on the drawings, and which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical or electrical layouts, such redesign and new drawings required thereby, with approval of the Engineer, shall be prepared by the Contractor without additional cost.
- B. Where such approved deviation requires a different quantity or arrangement of equipment from that specified or indicated on the drawings, the Contractor shall provide any structural supports, controllers, motors, starters, wiring, conduit, and any other additional equipment required by the deviation, at no additional cost.
- C. It is the intent of these specifications that wherever a manufacturer of a product or a catalog number is specified, and terms "or equal" or "or approved equal" are used, a substituted item must conform in all essential respects to the specified item. Consideration will not be given to claims that a substituted item meets performance requirements with lesser construction. Performance as indicated in schedules and in specifications shall be interpreted as minimum acceptable performance.

PART 3 - EXECUTION

3.1 SITE INVESTIGATION

- A. Examine drawings, specifications, and site, and be responsible for the nature and location of work and the general and local conditions, particularly those bearing upon transportation, disposal, handling and storage of materials, availability of labor, electric power, roads, etc.

3.2 DRAWINGS

- A. Drawings are diagrammatic and indicate the general arrangement of systems and work required. Do not scale the drawings. Consult the Mechanical drawings and details for exact locations of equipment.
- B. Drawings shall be used in layout of work. Check reference drawings to verify spaces in which work will be installed, and maintain maximum headroom and space conditions. Where headroom, working clearances or space conditions appear inadequate, Engineer shall be notified before proceeding with installation.
- C. If directed by the Engineer, make minor modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

3.3 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Equipment Mounting: Install floor mounted equipment on concrete base, 4" height with 1" 45-degree chamfer extended 3" from equipment footprint. Comply with requirements for concrete bases.
- F. Right of Way: Give to piping systems installed at a required slope.

3.4 COORDINATION WITH OTHER TRADES

- A. Closely schedule the work so that the work will be installed at the proper time and without delaying the project's completion.

- B. Where the work of this Division is to be installed in close proximity to the work of other trades, or where there is evidence that the work will interfere with the work of other trades, assist in working out space conditions to make a satisfactory arrangement. If the work is installed before such coordination with other trades, make necessary changes in the work as directed by the Engineer to correct any conflicts or interferences, without additional cost.

3.5 COORDINATION AND LAYOUT

- A. Study drawings and specifications to ensure completeness of work required. Include supplementary items normal to manufacturers' requirements or standard accepted trade practices as necessary to complete the work, even if not explicitly shown or specified.
- B. Verify measurements and conditions in field before starting work.
- C. Examine materials, surfaces, and structures to which work is to be applied and notify the Engineer, in writing, of any conditions which are detrimental to proper and expeditious installation of work. Starting of work shall be construed as acceptance of conditions.
- D. Confer with other trades to install work to avoid interference with other trades. The necessary adjustments to conform to structural conditions and work of other trades, particularly ductwork and piping layouts, is included under this section. Assist other trades in the preparation of coordinated layout drawings.

3.6 CONNECTIONS TO EQUIPMENT FURNISHED UNDER OTHER DIVISIONS OR BY OWNER

- A. Provide electrical connections to equipment and fixtures requiring such connections which are supplied by Owner or under other Divisions.
- B. Provide conduit, wire, fittings, accessories, and trim for final connection of each item of equipment as required for complete assembly and specified operation.
- C. Verify with approved project submittals that power conductor's meet both project as well as manufacturer requirements prior to conductor procurement and installation.
- D. Verify conductor material and specified size are compatible with equipment to be connected to.
- E. Notify engineer and design team of identified issues prior to conductor procurement and installation.
- F. Proceed with procurement and installation only after unsatisfactory conditions have been corrected.

3.7 WORKMANSHIP

- A. Perform work in practical, neat, and workmanlike manner, with electricians skilled in the work they are performing, and using the best generally recognized trade practices.
- B. No work shall be covered or hidden from view until it has been inspected and approved by the required Building Department personnel and the Engineer.
- C. Workmanship or materials not meeting with requirements of the specifications or drawings, or the satisfaction of the Engineer, shall be rejected and shall be immediately replaced in an acceptable manner without additional cost.

3.8 TESTS

- A. Test all wiring, switches, controllers, starters, motors, etc., wired under this Division. Leave free from grounds, crosses, shorts, opens, etc., and leave materials and apparatus in proper and satisfactory working condition. Perform additional tests as listed in the other Division 26 specification sections.
- B. Furnish necessary meters, instruments, temporary wiring, and skilled labor to perform tests and adjustments. Measuring instruments shall be properly calibrated.
- C. Prior to energizing, test insulation resistance of conductors as per the requirements of specification 260519 Conductors and Cables.

- D. Prior to energizing, test for continuity and identification of each conductor. Identify both ends of each conductor.
- E. Perform additional tests required by Owner, Engineer or any other authorities having jurisdiction.
- F. Correct or replace any circuit, material or equipment which is found to be defective by these tests. Correct defects, whether due to faulty workmanship or material furnished, in a manner acceptable to Engineer without additional cost.
- G. Test all distribution equipment, motors, and three phase receptacles for proper phase connections and phase rotation. Correct as required.
- H. Notify Engineer, in writing, at least one week prior to tests, of the proposed testing timetables. Perform tests with the approval of and in the presence of the Engineer or his representative.

3.9 IDENTIFICATION

- A. Equipment
 - 1. Identify each item and the system or area it serves. Provide an engraved multilayer, multicolor, plastic nameplate in a visible location on each disconnect, switch, control and similar accessory. Provide stencils on all major equipment.
 - 2. All switchboard devices, panels, cabinets, junction boxes, switches, controllers, etc., shall be identified as to systems, voltage, phases, etc., on their exteriors.
- B. Wiring
 - 1. Provide fiber tags for feeders and branch circuits in pull boxes, cabinets, and outlets to identify each feeder and circuit.
 - 2. All cables and branch wiring shall be identified showing phasing, system designations, and items served. Identity is required in switchboards, panels, junction boxes, switches, controllers, cabinets, etc.
- C. Provide complete, accurate, typewritten panelboard and switchboard directories mounted securely to panelboard doors and switchboard faces.

END OF SECTION 26 01 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Copper building wire rated 600 V or less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alpha Wire Company.
 - 2. Cerro Wire LLC.
 - 3. General Cable Technologies Corporation.
 - 4. Okonite Company (The).
 - 5. Southwire Company.
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Conductor Insulation:
 - 1. Type THHN and Type THWN-2: Comply with UL 83.

2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. 3M Electrical Products.
 - 2. ABB Installation Products
 - 3. AFC Cable Systems; a part of Atkore International.
 - 4. Hubbell Power Systems, Inc.
 - 5. ILSCO.
 - 6. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 7. Ideal Electrical.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Copper.
 - 2. Type: One hole with standard barrels.
 - 3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- C. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- E. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated. At exterior walls, cables shall not be routed outside of the air and water/vapor barrier, unless approved by the Engineer or routing cables horizontally to serve exterior devices.
- B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. 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.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- F. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."

3.4 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-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength, fire rating and insulation ratings than unspliced conductors.
 - 1. Use weatherproof connectors and terminals for all connections made at boxes on or in exterior surfaces, floor boxes located on grade, and boxes located outdoors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration. Do not energize any circuits with a reading of less than 50 megohms. Circuits under megger insulation test shall be connected to respective final terminals but with switches and breakers in the "OFF" position.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
 - 3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 - c. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 26 05 19

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency and testing agency's field supervisor.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA. NFPA 70 – National Electrical Code
- B. UL 467 – Grounding & Bonding Equipment
- C. UL 486A – Wire Connectors and Soldering Lugs for Use with Copper Conductors
- D. UL 1059 – Terminal Blocks
- E. IEEE / ANSI 142 – Latest edition Recommended Practice for Grounding of Industrial and Commercial Power Systems
- F. IEEE 837 – Standards for Qualifying Permanent Connections Used in Substation Grounding
- G. ASTM B3 - Solid Conductors
- H. ASTM B8 – Assembly of Stranded Conductors
- I. ASTM B33 – Tinned Conductors
- J. NEMA GR1 – Ground Rods and Ground Rod Couplings

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- 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 UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB Blackburn Installation Products.
 - 2. Burndy; Part of Hubbell Electrical Systems.
 - 3. ERICO; a brand of nVent.
 - 4. Harger Lightning & Grounding.
 - 5. ILSCO.
 - 6. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 7. Siemens Industry, Inc., Energy Management Division.
 - 8. VFC / Lyncole Lightning & Grounding.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Grounding Conductors: Green-colored insulation with continuous yellow stripe.
- C. Equipment Grounding Conductor Application: comply with NFPA 70, as amended by state and local codes, for sizes and quantities of equipment grounding conductors except where specific types, larger sizes or more conductors are indicated.
 - 1. Provide equipment grounding conductors with circuit conductors for all feeders and branch circuits.
- D. Provide supplementary ground bonding to maintain continuity of the equipment and raceway grounding system as follows:
 - 1. Bonding jumpers shall be applied where wiring devices (receptacles and switches) are not equipped with approved self-grounding features. Include any necessary field modifications for termination of the bonding jumpers to ensure grounding continuity.
 - 2. Bonding jumpers shall be applied to ensure that grounding continuity does not depend solely on the supporting screws fastening metallic enclosures together.
 - 3. Include any necessary field modifications for termination of the bonding jumpers to ensure grounding continuity.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Receptacle circuits.
 - 3. Single-phase motor and appliance branch circuits.
 - 4. Three-phase motor and appliance branch circuits.
 - 5. Flexible raceway runs.
 - 6. Metal-clad cable runs.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
- C. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.

3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).

END OF SECTION 26 05 26

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Equipment supports.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB Super Strut Installation Products.
 - b. Allied Tube & Conduit: a division of Eaton.
 - c. Cooper B-Line, Inc.; a division of Atkore
 - d. ERICO International Corporation. A division of nVent.
 - e. GS Metals Corp.; a division of Eaton.
 - f. Unistrut A; a division of Atkore.
 - g. Wesanco, Inc.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Channel Dimensions: Selected for applicable load criteria.

4. All channel ends; exposed and less than or equal to 12 ft above finished floor; shall be provided with plastic channel safety end caps. Color shall be consistent throughout the project.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Hot dipped galvanized steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 1. Powder-Actuated Fasteners: Shall not be acceptable.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Eaton.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded hot dipped galvanized steel.
 - a. All hanger rods; exposed and less than or equal to 12 ft above finished floor; shall be provided with plastic caps. Color shall be consistent throughout the project.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with single-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

- E. Environment Applications and Finishes
 - 1. Indoor locations: Dry non-corrosive areas channel framing shall be pre-galvanized -electro galvanized steel finished. All hardware shall be pre-galvanized zinc plated steel.
 - 2. Corrosive locations: In corrosive areas channel framing shall be 316 stainless steel as per drawings all hardware shall be 316 stainless steel.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 6. To Light Steel: Sheet metal screws.
 - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete.
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup paint field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

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

END OF SECTION 26 05 29

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Metal wireways and auxiliary gutters.
 - 3. Boxes, enclosures, and cabinets.
 - 4. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
- C. Samples: For wireways and for each color and texture specified, 12 inches long.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Metal Conduit:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB Installation Products
 - b. AFC Cable Systems; a part of Atkore International.
 - c. Allied Tube & Conduit; a part of Atkore International.
 - d. Electri-Flex Company.
 - e. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - f. Robroy Industries.
 - g. Southwire Company.
 - h. Wheatland Tube Company.
 - 2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 3. GRC: Comply with ANSI C80.1 and UL 6.
 - 4. ARC: Comply with ANSI C80.5 and UL 6A.
 - 5. FMC: Comply with UL 1; zinc-coated steel.
 - 6. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360. Select appropriate LFMC for each application environment.
- B. Metal Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB Installation Products.

- b. AFC Cable Systems; a part of Atkore International.
 - c. Allied Tube & Conduit; a part of Atkore International.
 - d. Anamet Electrical, Inc.
 - e. Electri-Flex Company.
 - f. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - g. Robroy Industries.
 - h. Southwire Company.
 - i. Wheatland Tube Company.
 - 2. Comply with NEMA FB 1 and UL 514B.
 - 3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 4. Fittings, General: Listed and labeled for type of conduit, location, and use.
 - 5. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- C. Joint Compound for GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. B-line, an Eaton business.
 - 2. Hoffman; a brand of nVent.
 - 3. MonoSystems, Inc.
 - 4. Square D.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
- 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.3 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. ABB Steel City & Carlon Installation Products.
 - 2. Crouse-Hinds, an Eaton business.
 - 3. Hoffman; a brand of nVent.
 - 4. Hubbell Incorporated.
 - 5. Hubbell Incorporated; Wiring Device-Kellems.
 - 6. Milbank Manufacturing Co.
 - 7. Oldcastle Enclosure Solutions.
 - 8. O-Z/Gedney; a brand of Emerson Industrial Automation.
 - 9. RACO; Hubbell.
 - 10. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- I. Cabinets:
 - 1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.
 - 6. location wire connectors, key, and mounting hardware.

2.4 Metallic Expansion/Deflection Coupling:

- A. Fittings shall be galvanized malleable iron or steel with an internal bonding jumper.
- B. Manufacturer:
 - 1. ABB XD & XJG Series Instillation Products.
 - 2. Crouse-Hinds Model XD & XJG a division of Eaton.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: All raceways routed outside of the air and water/vapor barrier shall be considered outdoors. Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: ARC.
 - 2. Concealed Conduit, Aboveground: ARC.
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: GRC.
 - 2. Exposed, Not Subject to Severe Physical Damage: GRC.
 - 3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
 - 4. Concealed in Ceilings and Interior Walls and Partitions: GRC.
 - 5. Concealed or exposed, installed in or under roof decking: GRC.
 - 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 7. Damp or Wet Locations: ARC.
 - 8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

3.2 INSTALLATION

- A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.

- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- I. Make bends in raceway using large-radius preformed elbows. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines. At exterior walls, conduits shall not be routed outside of the air and water/vapor barrier, unless approved by the Engineer or routing conduits horizontally to serve exterior devices.
- K. Support conduit within 12 inches of enclosures to which attached.
- L. Stub-Outs to Above Recessed Ceilings:
 - 1. Use RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-outs not terminated in hubs or in an enclosure.
- M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- S. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- T. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Conduit extending from interior to exterior of building.

4. Conduit extending into pressurized duct and equipment.
 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 6. Where otherwise required by NFPA 70.
- U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- V. Expansion-Joint Fittings:
1. Install in each run of aboveground RMC that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 3. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC in damp or wet locations not subject to severe physical damage.
- X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- Z. Outlet, device, pull, and junction boxes on or in exterior surfaces and boxes located outdoors shall be cast type, not stamped type. This shall also apply to locations under canopies where the boxes may not be exposed directly to rain but are exposed to moisture in the air.
- AA. Recessed junction and pull boxes in exterior surfaces shall be stainless steel type with stainless steel cover and hardware.
- BB. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- CC. Locate boxes so that cover or plate will not span different building finishes.
- DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- FF. Where the installation of backboxes occur in fire rated assemblies fire rated putty shall be installed on the exterior of the backbox. Refer to drawings for fire rated assembly locations.
- GG. Where the installation of backboxes occur in sound isolating walls the backboxes shall be separated by at least one stud bay to avoid the degradation of the sound isolation.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 26 05 33

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Round sleeves.
 - 2. Rectangular sleeves.
 - 3. Sleeve-seal systems.
 - 4. Grout.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

- A. Steel Wall Sleeves:
 - 1. General Characteristics: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

2.2 RECTANGULAR SLEEVES

- A. Rectangular, Galvanized-Steel, Sheet Metal Sleeves:
 - 1. General Characteristics:
 - a. Material: Galvanized sheet steel.
 - b. Minimum Metal Thickness:
 - 1) For sleeve cross-section rectangle perimeter less than 50 inch and with no side larger than 16 inch, thickness must be 0.052 inch.
 - 2) For sleeve cross-section rectangle perimeter not less than 50 inch or with one or more sides larger than 16 inches, thickness must be 0.138 inch.

2.3 SLEEVE-SEAL SYSTEMS

- A. General Characteristics: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Garlock, Inc.
- C. Options:
 - 1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Fiber-reinforced plastic. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.4 GROUT

- A. General Characteristics: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
 - 1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
 - 2. Design Mix: 5000 psi, 28-day compressive strength.

3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or floor and wall assemblies.
- B. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Install sleeves and seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and raceway or cable, unless sleeve-seal system is to be installed.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inch above finished floor level. Install sleeves during erection of floors.
- C. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for wall assemblies.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetrations with firestop materials.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve-seal systems. Size sleeves to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

- A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.
- B. Install conduits and cable with no crossings within the sleeve.
- C. Fill opening around conduits and cables with expanding foam without leaving voids.
- D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.3 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly.

END OF SECTION 26 05 44

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
 - 2. Labels. Labels located in plenum spaces shall be plenum rated.
 - 3. Bands and tubes.
 - 4. Tapes and stencils.
 - 5. Tags.
 - 6. Signs.
 - 7. Cable ties.
 - 8. Paint for identification.
 - 9. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with NFPA 70E requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for service, feeder and branch-circuit conductors.
 - 1. Color shall be factory applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.

3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
4. Color for Neutral: White for 208/120 or 120/240-volt systems and gray for 480/277-volt systems.
5. Color for Equipment Grounds: Green for 208/120-volt systems and Green with a yellow stripe for 480/277-volt systems.
- C. Warning Label Colors:
 1. Identify system voltage with black letters on an orange background.
- D. Warning labels and signs shall include, but are not limited to, the following legends:
 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES." for 208-volt systems and 48" for 480-volt systems.
- E. Equipment Identification Labels:
 1. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Not Permitted.
- F. Plastic Labels for Equipment Name Identification
 1. Engraved, multilayer, multicolor, plastic labels for engraving, 1/8" thick.
 2. Self-adhesive: Not Permitted.
 3. Predrilled holes for attachment hardware.
 4. Colors: White letters on black background, unless specified otherwise herein or elsewhere in contract documents.
 5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 6. Minimum letter height shall be 1/2".
 7. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2" by 1-1/2". Where multiple lines are required, add 1/2" in height per additional line.
 8. Fasteners: Stainless-steel rivets or self-tapping screws.

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Marking Services, Inc.
 - c. Panduit Corp.
 - d. Seton Identification Products.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Marking Services, Inc.
 - c. Panduit Corp.
 - d. Seton Identification Products.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Marking Services, Inc.
 - c. Panduit Corp.
 - d. Seton Identification Products.
 2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.

- 3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Marking Services, Inc.
 - c. Panduit Corp.
 - d. Seton Identification Products.
 - 2. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches for raceway and conductors.
 - b. 3-1/2 by 5 inches for equipment.
 - c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Marking Services, Inc.
 - c. Panduit Corp.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Panduit Corp.

2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ideal Industries, Inc.
 - b. Marking Services, Inc.
 - c. Panduit Corp.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. Marking Services, Inc.
- C. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.6 TAGS

- A. Nonmetallic Preprinted Tags: Polyethylene tags, 0.023 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Marking Services, Inc.
 - b. Panduit Corp.
 - c. Seton Identification Products.

2. Polyester Tags: 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment.
3. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.7 SIGNS

- A. Baked-Enamel Signs:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlton Industries, LP.
 - b. Emedco.
 - c. Marking Services, Inc.
 2. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 3. 1/4-inch grommets in corners for mounting.
 4. Nominal Size: 7 by 10 inches.
 - a. Engraved legend with white letters on a dark gray background.
 - b. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
 - c. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ideal Industries, Inc.
 2. Marking Services, Inc.
 3. Panduit Corp.
- B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black, except where used for color-coding.
- C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black.
- D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 Deg F according to ASTM D 638: 7000 psi.
 3. UL 94 Flame Rating: 94V-0.
 4. Temperature Range: Minus 50 to plus 284 deg F.
 5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side. Factory painted bands are acceptable.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- I. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- J. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- K. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- L. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- M. Self-Adhesive Labels:
 - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
- N. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate. When mounted on NEMA-4 or 4X cabinets or other equipment intended to prevent water intrusion, apply sealant/pad to back of label prior to fastening. Sealant shall be suitable for the label and cabinet materials as to not have adverse chemical reaction.
- O. Where manufacturer of equipment will void warranty for installation of fasteners in cabinet, provide stenciled legend on equipment in lieu of plastic engraved label.
- P. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- Q. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- R. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- S. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- T. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

- U. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- V. Nonmetallic Preprinted Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using general-purpose, UV-stabilized, plenum-rated cable ties as applicable.
- W. Baked-Enamel Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.
- X. Metal-Backed Butyrate Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.
- Y. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.
- Z. Cable Ties: General purpose, for attaching tags, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits: Identify with self-adhesive raceway labels, vinyl tape applied in bands.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 25-foot maximum intervals in straight runs, and at 15-foot maximum intervals in congested areas.
- D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage.
- E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels to identify the phase.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.
- H. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- I. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- J. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

- K. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
 - 1. Apply to exterior of door, cover, or other access.
 - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
- L. Arc Flash Warning Labeling: Self-adhesive labels.
- M. Operating Instruction Signs: Baked-enamel warning signs.
- N. Emergency Operating Instruction Signs: Baked-enamel warning signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- O. Equipment Identification Labels:
 - 1. Indoor Equipment: Baked-enamel signs.
 - 2. Outdoor Equipment: Stenciled legend 4 inches high.
 - 3. Equipment to be labeled: In addition to all requirements in this specification section, equipment below shall be labeled with its name, and the name and circuit number of the source equipment energizing it.
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of an engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Enclosed switches.
 - e. Enclosed controllers.
 - f. Variable-speed controllers.
 - g. Contactors.
 - h. Monitoring and control equipment.

END OF SECTION 26 05 53

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 computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.

1.3 SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.
- C. Qualification Data: For coordination-study specialist.
- D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall be in digital form.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and Equipment Evaluation Reports.
 - 3. Coordination-Study Report.

1.4 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.
- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
 - 1. CGI CYME.
 - 2. Power Analytics Corporation.
 - 3. EasyPower, LLC.
 - 4. Operation Technology, Inc.
 - 5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
 - 1. Optional Features:
 - a. Arcing faults.
 - b. Simultaneous faults.
 - c. Explicit negative sequence.
 - d. Mutual coupling in zero sequence.
- D. Computer software program shall be capable of printing arc-flash hazard warnings for equipment.

2.3 ARC-FLASH ANALYSIS

- A. Conduct arc flash analysis after acceptance by Engineer of short-circuit study and coordination study. Perform arc flash analysis for each operating mode of the system, in accordance with IEEE 1584 and NFPA 70E.
- B. Document the protection and calculation procedures and coordination review in testing report. Present analysis results in tabular format showing the following:
 - 1. Bus and protection device name.
 - 2. Bolted and arcing fault values.
 - 3. Protective device trip times.
 - 4. Arc flash boundary, working distance, and incident energy.
 - 5. Required protective flame-resistant (FR) clothing class.
- C. Arc-flash hazard warning labels for equipment shall be printed on vinyl, weather and UV-resistant, pressure-sensitive adhesive labels complying with NFPA 70E.
 - a. Label shall have orange header with wording, "WARNING, ARC-FLASH HAZARD," and must include the following information taken directly from arc-flash hazard study:
 - 1) Equipment designation.
 - 2) Nominal voltage.
 - 3) Protection boundaries.
 - a) Arc-flash boundary.
 - b) Restricted approach boundary.
 - c) Limited approach boundary.
 - 4) Arc-flash PPE category.
 - 5) Required minimum arc rating of PPE in Cal/cm squared.
 - 6) Available incident energy.
 - 7) Working distance.
 - 8) Engineering report number, revision number, and issue date.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
 - 1. Proceed with coordination study only after relevant equipment submittals have been assembled.

3.2 POWER SYSTEM DATA

- A. The contractor shall gather and tabulate the following input data, by performing field surveys and equipment investigation, to support coordination study:
 - 1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Impedance of utility service entrance.
 - 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.

- c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
- d. Generator kilovolt amperes, size, voltage, and source impedance.
- e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
- f. Busway ampacity and impedance.
- g. Motor horsepower and code letter designation according to NEMA MG 1.
- 4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
 - 1. Switchgear and switchboard bus.
 - 2. Distribution panelboard.
 - 3. Branch circuit panelboard.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141, IEEE 241 and IEEE 242.
 - 1. Transformers:
 - a. ANSI C57.12.10.
 - b. ANSI C57.12.22.
 - c. ANSI C57.12.40.
 - d. IEEE C57.12.00.
 - e. IEEE C57.96.
 - 2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
 - 3. Low-Voltage Fuses: IEEE C37.46.
- E. Study Report:
 - 1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
- F. Equipment Evaluation Report:
 - 1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 - 2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.

3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
 1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
 2. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 141, IEEE 241, IEEE 242 recommendations for fault currents and time intervals.
- C. The electrical distribution system's coordination shall be coordinated as best possible to 0.1s.
- D. Transformer Primary Overcurrent Protective Devices:
 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
 1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
 - a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
 2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
 - a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.
- G. Completed data sheets for setting of overcurrent protective devices.

END OF SECTION 26 05 73

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Lighting and appliance branch-circuit panelboards.
- B. Related Requirements
 - 1. Section 26 05 73 "Overcurrent Protective Device Coordination Study" for arc-flash analysis and arc-flash label requirements.

1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. SPD: Surge protective device.

1.4 SUBMITTALS

- A. Equipment shall be submitted with short circuit, overcurrent protection coordination, and arc flash studies as noted in specification 260100 General Electrical Requirements.
- B. Product Data: For each type of panelboard, switching and overcurrent protective device, surge protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- C. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 6. Include wiring diagrams for power, signal, and control wiring.
 - 7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
- D. Qualification Data: For qualified testing agency.
- E. Field Quality-Control Reports:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- F. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- G. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.
- H. Delegated Design Submittal: Arc Flash Study
 - 1. An arc flash study shall be performed on all new electrical switchgear, switchboards and panelboards and labels shall be affixed to the front of the equipment.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 1.
- F. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407, NEMA PB 1.

1.7 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace parts that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Two spares for each type of panelboard cabinet lock.
 - 2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.

PART 2 - PRODUCTS**2.1 GENERAL REQUIREMENTS FOR PANELBOARDS**

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 4. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

- b. Back Boxes: Galvanized steel.
- 5. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- C. Incoming Mains Location: As per project requirements.
- D. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 - 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 - 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings as manufactured by Square D; by Schneider Electric or comparable product by one of the following manufacturers in the next paragraph.
- B. Manufacturers: Subject to compliance with performance and site condition requirements, one of the manufacturers listed below may be provided in lieu of the Basis of Design manufacturer. Naming these products does not imply that their standard construction or configuration is acceptable or meets the specifications. Alternate equipment proposed must meet the specifications including all architectural, acoustic, mechanical, electrical, and structural details, all scheduled performance and the job design, plans and specifications, and space constraints.
 - 1. Eaton.
 - 2. ABB.
- C. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- D. Mains: As per the contract drawings.
- E. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings as manufactured by Square D; by Schneider Electric or comparable product by one of the following manufacturers in the next paragraph.
- B. Manufacturers: Subject to compliance with performance and site condition requirements, one of the manufacturers listed below may be provided in lieu of the Basis of Design manufacturer. Naming these products does not imply that their standard construction or configuration is acceptable or meets the specifications. Alternate equipment proposed must meet the specifications including all architectural, acoustic, mechanical, electrical, and structural details, all scheduled performance and the job design, plans and specifications, and space constraints.
 - 1. Eaton.
 - 2. ABB.

- C. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 100 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip circuit breakers with rms sensing: Refer to contract drawings for electronic trip circuit breakers; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 - 4. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (5-mA trip).
 - 5. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
 - 6. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
 - d. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NECA 407, NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NECA 407, NEMA PB 1.1.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- C. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Mount panelboards such that no overcurrent protection device actuating handle when in highest position is located more than 6'-7" above finished floor.
- E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- F. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- G. Install filler plates in unused spaces.
- H. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- I. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor shall perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- E. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- F. Panelboards will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 - 1. Measure as directed during period of normal system loading.

2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

END OF SECTION 26 24 16

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Snap switches.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. ABB Installation Products.
 - 2. Cooper Wiring Devices; a division of Eaton.
 - 3. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 4. Leviton Mfg. Company Inc. (Leviton).
 - 5. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Eaton; TRBR20.

- b. Hubbell; BR20__TR.
- c. Leviton; 8300-SGG.
- d. Pass & Seymour; 63H.

- 2. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.3 TAMPER RESISTANT GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Eaton; TRSGF20.
 - b. Hubbell; GFTRST20.
 - c. Leviton; GFTR2.
 - d. Pass & Seymour; 1595SWTTR.

2.4 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Eaton; CSB120 (single pole), CSB220 (two pole), CSB320 (three way), CSB420 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

2.5 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
 - 3. Material for Unfinished Spaces: Galvanized steel.
 - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

2.6 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: White or as selected by owner, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:
1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 8. Tighten unused terminal screws on the device.
 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. 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.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."
1. Receptacles: Identify panelboard and circuit number from which served. Use press on label, black lettering on white background on face of plate and in easily readable location inside device backbox, and durable wire markers or tags on conductors inside outlet boxes.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
1. Test Instruments: Use instruments that comply with UL 1436.
 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.

2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 26 27 26

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Nonfusible switches.
 - 2. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in electronic format.
- B. Shop Drawings: For enclosed switches and circuit breakers.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
 - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.

1.9 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace 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 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- C. Comply with NFPA 70.

2.2 NONFUSIBLE SWITCHES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings as manufactured by Square D; by Schneider Electric or comparable product by one of the following manufacturers in the next paragraph.
- B. Manufacturers: Subject to compliance with performance and site condition requirements, one of the manufacturers listed below may be provided in lieu of the Basis of Design manufacturer. Naming these products does not imply that their standard construction or configuration is acceptable or meets the specifications. Alternate equipment proposed must meet the specifications including all architectural, acoustic, mechanical, electrical, and structural details, all scheduled performance and the job design, plans and specifications, and space constraints.
 - 1. ABB.
 - 2. Eaton.
- C. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.

3.3 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Comply with NFPA 70 and NECA 1.

3.4 IDENTIFICATION

- A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Tests and Inspections for Switches:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
 - i. Verify correct phase barrier installation.
 - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
 - 2. Electrical Tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

- c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
 - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."
- C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.
 - 1. Test procedures used.
 - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 - 3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

END OF SECTION 26 28 16