Central Power Building

Specifications

Construction Set

August 2, 2017

PROJECT MANUAL

Wilmot/Sanz, Inc.

ARCHITECTURE/PLANNING
18310 Montgomery Village Avenue
Gaithersburg, MD 20879
301-590-2900

Scheeser Buckley Mayfield LLC

MECHANICAL ENGINEER
1540 Corporate Woods Parkway
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Section 00100 - INVITATION TO BID

SALEM REGIONAL MEDICAL CENTER

Central Power Building

1. INVITATION

You are hereby invited to bid on a Lump Sum contract including Architectural, Mechanical and Electrical work for the Salem Regional Medical Center Central Power Building Project. The bid shall include as an attachment a listing of HVAC, Plumbing and Electrical subcontractors by name and amount of bid.

NOTE:

A. Mechanical, Electrical, Fire protection, and Plumbing sub-contractors are required To solicit bids from attached list.

2. **TIME AND PLACE**

Salem Regional Medical Center will receive sealed bids until 12:00 PM Eastern time, on August 25, 2017 at the office of:

Mr. Jerry P Wheeler II
Director- Plant Operations
Salem Regional Medical Center
1995 E State Street, Salem Ohio, 44460
Tel: (330) 332-7109

There will be a closed bid opening, and the successful bidder will be notified. Proposals received after this time will not be accepted.

3. DRAWINGS AND SPECIFICATIONS

Pre-selected bidders will receive PDF files. The Contractor may use PDF files for bid documents. The completeness of these documents is the responsibly of the contractor. Please notify the Architect for any discrepancies.

4. ACCEPTANCE OR REJECTION

The Owner reserves the right to reject any or all bids, reject incomplete bids or bids not conforming to this Invitation and to waive informalities or irregularities in any bid and to accept the bid which, in the Owner's judgment, is in their best interest.

5. BID SECURITY

Bidders will be required to provide bid security in the form of a bid bond of a sum no less than 10 percent of the bid Amount. Bid bonds may be submitted as a bid bond or certified check.

6. PERFORMANCE BOND

A performance bond will be required from the successful bidder after Contract Award.

7. PRE-BID CONFERENCE

A Pre-Bid Conference will be held at the construction site, for all Contractors, Subcontractors and Suppliers on August 10, 2017.
The meeting will start at 2:00 PM in the PDR Conference room located on the ground floor at the rear of the cafeteria.

8. TAX EXEMPTION

Please use the federal tax exemption number 34-1041385 when purchasing supplies and materials for the project.

9. BUILDING PERMIT

Owner will be responsible for obtaining the building permit and fee only. The contractor shall pay all other permit fees as required for the construction including but not limited to, Plumbing, Water, Sewer, Electric, Gas, County highway, etc.

END OF SECTION

DOCUMENT 00200

INSTRUCTIONS TO BIDDERS

AIA Document A701, 1997 Edition – Instructions to Bidders, Articles 1 through 8, is by reference hereby made a part of this Project Manual as though set out at length herein.

END OF DOCUMENT 00200

SECTION 00400 - BID FORM

SALEM REGIONAL MEDICAT CENTER

1995 E State Street
Salem Ohio, 44460

Contractor _____
_____
_____

Contact/telephone: _____

Re: Salem Regional Medical Center
Central Power Building

Base Bid

In preparation of this proposal, the Undersigned certifies that he has visited the site and carefully examined the Construction Documents, including the Invitation to Bid, Bid Form, and General Conditions of the Contract for Construction, Project Manual and Drawings, dated August 2017, for the Central Power Building Expansion. The Undersigned propose to furnish all labor, material, and equipment necessary for completion of the work, without exception, for the stipulated sum of:

This project shall be non-taxable for material. See invitation to bid for tax number.

Total Base Bid of _____Dollars ($_____)

If awarded a contract for the work described by the Contract Documents, the Undersigned will complete the work, without exception, in the following number of calendar days, from the time of issuance of the Notice to Proceed:

Total Number of Calendar Days to Complete the Work: _____ Days

Receipt of the following addenda to the Contract Documents is hereby acknowledged, and all costs for labor and material required by same are included in the lump sum base bid.

Addendum No. 1, dated _____
Addendum No. 2, dated _____
Addendum No. 3, dated _____
Addendum No. 4, dated _____

The Undersigned will submit a breakdown of the base bid cost of the work as defined in the attached Bid Schedule within 48 hours following the bid submission. The Bid Schedule cost breakdown, as modified by Owner's decisions, will be utilized as the basis of the Requisition for Payment, Schedule of Values (G703-1992).

LIST OF UNIT PRICES

A. Not required

ALTERNATES

The following list of alternates are included for consideration and information. Alternates prices shall be all-inclusive of tax, overhead and profit, etc.

ALT -1 Add/Deduct to base bid _____ Dollars $_____

ALT -2 Add/Deduct to base bid _____ Dollars$_____

Proposed Team:

The Undersigned agrees to provide company description and qualifications, commit the staff identified in this bid proposal to this project, and recommends that the Owner approve the following subcontractors.

Company Description and Qualifications:
Staff Assignments:
Project Manager _____
Superintendent _____

Subcontractors:
Plumbing _____
HVAC _____
Electrical _____
Fire Protection _____

The Undersigned further agrees that this proposal shall not be withdrawn for a period of 60 days from the bid date.

_____
Signature Date

_____
Printed Name Title

_____
Company Name/Address

DOCUMENT 00420
BID BOND

AIA Document A310, 1970 Edition – Bid Bond, is by reference hereby made a part of this Project Manual as though set out at length herein.

END OF DOCUMENT 00420

DOCUMENT 00500
AGREEMENT FORM

AIA Document A101, 1997 Edition - The Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Articles 1 through 9, is by reference hereby made a part of this Project Manual as though set out at length herein attached.

END OF DOCUMENT 00500

DOCUMENT 00600
PERFORMANCE/PAYMENT BOND

AIA Document A312, 1984 Edition – Performance/Payment Bond, is by reference hereby made a part of this Project Manual as though set out at length herein.

END OF DOCUMENT 00600

SALEM REGIONAL MEDICAL CENTER

RECOMMENDED BIDDERS LIST

General Contractors			
Adolph Johnson	3497 Union St.	Mineral Ridge, OH 44440	330/544-8900
Alex Downie & Sons Co.	19 West Heights Avenue	Youngstown, OH 44509	330/799-6418
DeSalvo Construction	1491 West Liberty Street	Hubbard OH 44425	330/759-8145
Jack Gibson	2460 Parkman Road N.W.	Warren, OH 44485	330/394-5280
Stitle Construction	819 Georgetown Rd.	Salem, OH 44460	330/332-9901
Plumbing Contractors			
Conti Corp.	527 West Wood St.	Lowellville, OH 44436	330/536-6241
Ellyson Plumbing/Htg.	411 West State St.	Salem, OH 44460	330/337-3124
Prout Boiler Htg./Welding	3124 Temple Street	Youngstown, OH 44510	330/744-0293
Sprinkler System Contractors			
Aven Fire Systems Inc	10 East Clayton Street	New Castle, PA 16102	724/658-3751
Fire-Foe	999 Trumbull Ave.	Girard, OH 44420	330/759-9834
Grunau Company	8302 Southern Blvd., #4	Boardman, OH 44512	330/758-3500
Firestop Contractors			
Dalton Protection Inc	706 W. Xenia Dr.	Fairborn, OH 45324	937/318-8053
Life Safety Enterprises	38238 Glenn Ave	Willoughby, OH 44094	440/918-1641
Multicon Fire Containment	1320-C McKinley Ave	Columbus, OH 43222	614/351-2683
HVAC Contractors			
Roth Bros. Inc.	3847 Crum Road	Austintown, OH 44515	330/793-5571
Cahill Corporation	480 Baltimore Ave	Akron, OH 44306	330/724-1224
Metal Masters	125 Williams Dr NW	Dover, OH	330/343-3515
York Mahoning	724 Canfield Road	Youngstown, OH 44511	330/788-7011
Electrical Contractors			
Joe Dickey Electric	180 W. So. Range Rd.	North Lima, OH 44452	330/549-3976
Zenith Geller Electric, Inc.	621 East Main Street	Canfield, OH 44406	330/533-4200
W.T. Leon's Tri Area Electric	37 Wayne Avenue	Youngstown, OH 44502	330/744-0151
Paving Contractors			
Pag's Excavating, Inc.	141 Homeworth Rd.	Alliance, OH 44601	330/821-9721
RT Vernal & Excavating	11299 South Ave.	North Lima, OH 44452	330/549-2852

Revised: January 2017

SECTION 01032 – HOSPITAL PROCEDURES

1. GENERAL

1.1 PUBLISHED REGULATIONS

A. All personnel employed by the Contractor, including subcontractors and their employees, shall be instructed by the Contractor to abide by all published regulations, and all directives of the Owner's Representative.

1.2 OWNER'S REPRESENTATIVE

A. The Contractor shall abide by the directions of the Owner's Representative in matters affecting the operation, safety, and security of the Hospital, its patients and its visitors.

B. All oral instructions given to the Contractor by the Owner's Representative shall be implemented by the Contractor immediately. Confirmation or explanation of oral instruction will be made by the Owner by written notice or at the next scheduled progress meeting.

1.3 NOISE CONTROL

A. The Contractor shall execute the Work in this Contract as quietly as practicable to avoid unnecessary disturbances to patients within the Hospital premises. Noise vibration and fume producing operations will be coordinated as similar to utility outage procedures.

B. Any complaints duly registered by the Owner of unacceptable noise levels shall be cause for the use of special precautions and methods of operation by the Contractor to reduce noises to acceptable levels. All disrupted work will cease immediately until alternative arrangements are made.

C. The Owner shall be the sole judge of the tolerability of noise levels. The Owner will establish noise and vibration hours for construction operations that may affect work and should be anticipated by the Contractor.

D. No radios, ipods, or other music playing devices will be allowed on construction site.

1.4 PERSONNEL IDENTIFICATION

A. All employees of the Contractor and all subcontractors shall be required to wear photo identification badges furnished by the CM while on the Hospital premises. The Contractor will be responsible for control assurance and recovery of identification badges for the duration of the project. Hospital security will issue a limited number of temporary access control badges as deemed necessary to enter the secured premises of the hospital

B. The identification badges shall be conspicuously fixed to outer garment above elbow level.
   1. Loaning or borrowing badges for the purpose of gaining access to the Hospital is strictly forbidden.

C. Any of the Contractor's personnel or subcontractor's personnel who do not comply with this requirement at all times will be denied access to the Hospital or will be escorted off the premises by Hospital Security Guards.

1.5 PERSONNEL PARKING

A. Construction staff shall park in areas designated by the Owner, if available. Contractor employees will not park in employee lots reserved for staff and visitors. Construction staff shall make other arrangements for parking if none is available on site.

1.6 LIMIT OF OPERATIONS

A. NORMAL LIMIT OF OPERATIONS
   1. The Contractor's normal limit of operations shall be confined within the Limits of Work Area as designated on the drawings.
   2. The Owner will prohibit his personnel, patients, and visitors from using these areas.

3. The Owner, Architect, and other contractors performing work within these limits of operation shall be allowed access at all times.

1.7 PERIODIC OPERATIONS OUTSIDE LIMITS OF OPERATION

A. Use of certain loading docks, passage ways, elevators, and other areas, outside of the limits of operation as defined, will be granted to the Contractor by the Owner on an intermittent basis as required and requested in advance by the Contractor. The Owner will judge the proper time and extent of such use.

1.8 HOSPITAL PROPERTY

A. EXISTING UNATTACHED EQUIPMENT
1. All existing equipment to be salvaged or reused will be removed from the Limits of Operation by the Owner prior to start of construction by the Contractor.

1.9 SCHEDULING AND COORDINATION

A. SUPERVISION
1. In order to insure proper coordination of work between trades, the general contractor will be required to have a full-time superintendent on the job site at all times. The Superintendent shall not be changed except with the consent or at the insistence of the Owner. The Superintendent shall represent the Contractor in his absence, and all directions given to him shall be as binding as if given to the Contractor. On Written Request, such directions will be confirmed in writing to the Contractor.
2. Observation by the Architect, the Owner, or his representative does not make them responsible for defective work, unsafe procedures or the consequences of same. Responsibility for defective work discovered prior to final payment or subsequent thereto is the responsibility of the contractor.

1.10 SPECIFICATIONS AND WORKING DRAWINGS

A. Titles to divisions and paragraphs in the specifications are introduced merely for convenience and are not to be taken as part of the specifications or as a segregation of the several units of material and labor. No responsibility, either direct or implied is assumed by the Architect or Owner for omission or duplications by the Contractor or Subcontractor, due to real or alleged error in arrangements of matter in these Contract Documents.

B. The Drawings and Specifications are complementary. Anything shown either by drawings or described in specifications shall be done as if called for by both.

C. No extra charge or compensation will be allowed on account of differences between actual measurements and the dimensions indicated on the drawings.

D. When the word "approved", "satisfactory", "equal", "acceptance", "proper", or "as directed" are used, prior approval by the Architect shall be required.

E. Should the Drawings disagree in themselves or with the specifications, or should the Specifications disagree in themselves, the better quality or greater quantity of work or materials shall be estimated upon, and unless otherwise ordered in writing, shall be provided.

F. Measured dimensions shall take precedence over scale measurements and large scale drawings over small scale drawings.

1.11 SCHEDULING

A. All arrangements for work which will involve interference with normal Hospital functioning, particularly in occupied patient areas, or adjacent thereto, shall be scheduled in advance with the Owner to provide for a minimum of disruption and inconvenience.

B. The Owner will schedule such interferences so as to cause a minimum of disruption to normal Hospital functioning.

C. The Contractor's request for use of docks, corridors, elevators, and other spaces shall be limited to an hour-by-hour basis and shall be approved by the Owner.

1.12 OUTAGES

A. Utility and service outages shall be kept to a minimum, and will be permitted only with written approval of the Owner.

B. Forms for outage requests are available from the Owner. Requests for outages will not be considered unless they include an identification of all areas which will be affected by the proposed outage.

C. All requests for outages shall be made a minimum of ten working days in advance of their need. Major hospital systems outages shall be coordinated at least four weeks in advance of the required date.

D. The Contractor shall also be responsible for searching out utility and service lines to determine the effect of any outage upon Hospital operations outside of the Limit of Contract. Approval shall be obtained from the Owner to execute such searches ahead of their need.

1.13 WORKING HOURS AND OVERTIME NOTIFICATION

A. The Contractor shall notify the Owner and receive permission from the Owner for the Contractor's personnel to work outside of normal daytime working hours either within or outside the Limits of Contract. "Normal working hours shall be 7:00 A.M. to 3:30 P.M., Monday through Friday."

B. The Owner and the Contractor may agree on revised hours for specific tasks.

1.14 SECURITY

A. KEYS
   1. When necessary to perform the Work, the Contractor will be issued keys to existing mechanical/electrical equipment spaces by the Hospital.
   2. These keys shall be returned at the end of each work day on which they are issued, and redrawn on succeeding days, if necessary.
   3. Contractor will be responsible for paying any re-keying costs due to lost or stolen keys for which they are responsible.

1.15 BURNING AND WELDING PERMITS

A. Open-flame burning shall be prohibited. Neither welding nor arc-welding will be permitted without having secured an appropriate permit from the Owner’s Representative by the Contractor. The Owner’s Representative has the right to stop any work at any time if he determines that unsafe conditions exist. The Contractor shall correct all such unsafe conditions as directed by the Owner’s Representative and obtain his approval of such corrections prior to commencing further work.

B. The Contractor shall keep a portable hand fire extinguisher of the appropriate class within reach at all times during welding. The Contractor shall also keep all required exit corridors, and the like, clear and unobstructed at all times when working in such areas. All flammable materials shall be removed to a location no closer than 35 feet from all welding operations. All workmen shall be instructed as to the location of the nearest fire alarm. All fixed flammable items shall be completely covered with non-asbestos flameproof blankets. Arc-welding shall be screened from vision of all passers-by.

C. The Contractor shall be required to maintain a "Fire Watch" security effort for a minimum of thirty (30) minutes at the completion of each welding operation.

1.16 OVERNIGHT STORAGE

A. Do not store materials and equipment in public areas such as docks, corridors, and unfenced yards.

END OF SECTION 01032

SECTION 01100 - SUMMARY

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Work covered by the Contract Documents.
   2. Type of Contract.
   3. Work phases.
   4. Work under other contracts.
   5. Owner-furnished products.
   6. Use of premises.
   7. Owner's occupancy requirements.
   8. Work restrictions.
   9. Specification formats and conventions.

B. Related Sections include the following:
   1. Division 1 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: Salem Regional Medical Center – Central Power building Renovation
   1. Project Location: 1995 East State St., Salem OHIO

B. Owner: Salem Regional Medical Center
   1. Owner's Representative: Director, Plant Operations, Jerry Wheeler

C. The Work consists of the following: Expansion of (117 s f.) of the Central power building as shown on the drawings and described in the specifications.

1.4 TYPE OF CONTRACT

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

B. CONTRACT DOCUMENTS:
   1. The contract documents for the central power building will be issued in one package:
      a. Project Manual & Drawings:

C. WORK PHASES
   1. The Work shall be conducted in one phase.

1.5 WORK UNDER OTHER CONTRACTS

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.

1.6 OWNER-FURNISHED PRODUCTS

A. Products indicated "NIC" (Not in contract) or "OFOI" (Owner Furnished Owner Installed) will be furnished and installed by the Owner. Products listed OFCI (Owner Furnished Contractor Installed) will be furnished by Owner and installed by Contractor. Products listed CFCI (Contractor Furnished Contractor Installed) shall be purchased and installed by the Contractor. Final connections from service lines to equipment will be by the Contractor, unless otherwise indicated.
   1. Owner will arrange for and deliver Shop Drawings, Product Data, and Samples to Contractor.

2. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.
3. After delivery, Owner will inspect delivered items for damage. Contractor shall be present for and assist in Owner's inspection.
4. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.
5. Owner will arrange for manufacturer's field services and for delivery of manufacturer's warranties to Contractor.
6. Owner will furnish Contractor the earliest possible delivery date for Owner-furnished products. Using Owner-furnished earliest possible delivery dates, Contractor shall designate delivery dates of Owner-furnished items in Contractor's Construction Schedule.
7. Contractor shall review Shop Drawings, Product Data, and Samples and return them to Architect noting discrepancies or anticipated problems in use of product.
8. Contractor is responsible for receiving, Owner-furnished items at Project site, at location agreed to by the Owner and Contractor.
9. Contractor is responsible for protecting Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.
10. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.
11. Contractor shall install and otherwise incorporate Owner-furnished items into the Work.

B. See Hospital Equipment List for items furnished by the Owner.

1.7 USE OF PREMISES

A. General: Contractor shall have limited use of premises for construction operations as indicated on Drawings by the Contract limits.

B. Use of Site: Limit use of premises to work in areas as defined by the owner. Do not disturb portions of Project site beyond areas in which the Work is indicated.
1. Owner Occupancy: Allow for Owner occupancy of Project site and existing buildings and use by the public.
2. Driveways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, Patients and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
   a. Schedule deliveries to minimize use of driveways, parking lots, and entrances.
   b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Protection of Existing Building: Maintain existing building in a weather tight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

D. The Contractor shall confer with the Owner's representatives and agree on sequences, procedures, means of access to the premises and buildings and spaces for temporary storage of materials and equipment sixty days prior to commencing work.

E. The Contractor shall submit to the Owner's Representative for approval, a schedule of construction sequencing. Where construction activity occurs in area of patient care, the Contractor shall coordinate hours of construction activity with the Owner's Representative. All areas within the existing Hospital must continue operating throughout the entire project. To accommodate this requirement, some of the work will have to be performed at night or on weekends.

F. The Contractor shall at the end of each work session, or when work is finished, return surrounding areas to original condition. The Contractor, shall, on a daily basis or as required by the Owner's Representative, remove all debris generated from the work to the Contractor's dumpster. Dumpster location shall be coordinated with the Owner's Representative.

G. The Contractor shall not unreasonably encumber site with materials or equipment. All staging of equipment and material, including deliveries, shall be coordinated with the Owner's Representative. Stockpiling of material and storage of tools within the Hospital will be as approved by Owner's Representative.

H. The Contractor shall not load any structure with weight that will endanger structure.

I. Each Contractor is responsible for protection and safekeeping of his products stored on the premises or incorporated into the construction, until his contract is completed and accepted by the Owner. Security of the Contractor's equipment and material shall be sole responsibility of each contractor.

J. The Contractor shall interrupt any drilling, hammering and other noise-producing, dust raising, or odor producing operations at any time when directed by the Owner's Representative.

K. Existing air conditioning, heating, ventilating, plumbing, medical gas and electrical systems must be maintained in operation and serve the existing buildings. At least 14 days prior to a proposed interruption of essential services, consult with the Owner's Representative to establish a mutually satisfactory schedule for cut-over, cut-off or other changes in the operation of these systems. A shut-down notice will be required.

L. Protect outside air intakes with filters during construction. Monitor, maintain and replace filters during construction as needed.

M. Contractor's CPM Schedule should indicate anticipated dates for shutdowns.

1.8 OWNER'S OCCUPANCY REQUIREMENTS

A. Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits, unless otherwise indicated.
   1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
   2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

B. Owner Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.
   1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
   2. Obtain a Final Inspection from authorities having jurisdiction before Owner occupancy.
   3. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems.
   4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

1.9 WORK RESTRICTIONS

A. On-Site Work Hours: Work shall be generally performed during normal business working hours within the limits of the City of Salem Noise Ordinance.

B. Work to be performed outside of normal business hours to include weekend work must be identified and submitted to owner at least 2 days in advance of work.

C. Work to be performed on Ground Floor and First Floor of North Building: Occupied area shall be performed after 5 PM and Area to be cleaned to original state and turned back to Hospital for use by next day at 6 AM. Note: all Infection Control Prevention protocols shall be followed.

D. NO use of any hospital facilities, Cafeteria, Elevators, or Bathrooms, for any contractor or subcontractor labor. Only properly badged managers are allowed into the Hospital.

E. No existing hospital elevators may be used for labor or materials unless the Owner gives specific written permission. The elevator that is used for construction must be clean, repaired if necessary, and reinspected after building turnover and accepted by the Owner. This elevator must also carry an additional year of warranty. Written authorization required from Owner for any elevator use.

F. No smoking, tobacco chewing (dipping) or vaping on campus or on properties adjacent to the campus.

G. There will be a limited number of onsite parking spaces available to the Contractor. The Contractor should research off-site parking opportunities and develop a parking plan for submission and approval by the owner.

H. Contractor Staging Areas: The drawings will show limits of clearing and grading and note that the Contractor must work within that space. Contractors should plan "just-in-time" deliveries- parking lots are not staging areas. Contractor should include plan for staging, deliveries and site usage. Contractor’s plan to coordinate with Owner’s vehicles, Contactor’s vehicles, and pedestrians.

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

J. Temporary Facilities and controls: Contractors are responsible for establishing all temporary water, electric and sewer connections and must work directly with Owner to coordinate tie-ins.
   1. Notify Architect and Owner not less than 14 days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Owner's written permission, and a shut-down notice.

1.10 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 16-division format and CSI/CSC's "MasterFormat" 1995 numbering system.
   1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
   2. Division 1: Sections in Division 1 govern the execution of the Work of all Sections in the Specifications.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
   1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
   2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
      a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

2 PRODUCTS (Not Used)

3 EXECUTION (Not Used)

END OF SECTION **01100**

SECTION 01230 - ALTERNATES

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

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

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

1.4 PROCEDURES

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

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

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

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

2 PRODUCTS (Not Used)

3 EXECUTION

3.1 SCHEDULE OF ALTERNATES:

Alternate 001: More Efficient HVAC units to serve Ground Floor Electrical Room. Reference detailed information on Mechanical Drawings

Add $ _____

Alternate 002: Insulated Metal Panel in lieu of Masonry: Contract Drawings and details show brick veneer cavity walls with insulation and CMU backup at the short end walls at the East and West ends of the New Addition. This alternate would delete the brick veneer cavity walls with insulation and CMU backup and instead provide a 4” insulated metal panel. Include perimeter trim for metal panels as required. Backup wall for metal panels to be 6” Cold Formed Studs: 18 ga. Provide fiberglass faced gypsum board at inside of Cold Formed Metal Studs. Basis of Design for Insulated

Metal Panels is Centria: Versawall 4". Exterior Finish: Flat.

Add/Deduct $ _____

END OF SECTION **01230**

SECTION 01290 - PAYMENT PROCEDURES

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Sections include the following:
   1. Division 1 Section "Unit Prices" for administrative requirements governing use of unit prices.
   2. Division 1 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
   1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
      a. Application for Payment forms with Continuation Sheets.
      b. Submittals Schedule.
      c. Contractor's Construction Schedule.
   2. Submit the Schedule of Values to Owner and Architect within one week of Notice of Award.
   3. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
   1. Identification: Include the following Project identification on the Schedule of Values:
      a. Project name and location.
      b. Name of Architect.
      c. Contractor's name and address.
      d. Date of submittal.
   2. Submit draft of AIA Document G703 Continuation Sheets.
   3. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
      a. Description of the Work.
      b. Change Orders (numbers) that affect value.
      c. Dollar value.
         1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
   4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.

5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
    a. Differentiate between items stored on-site and items stored off-site. If specified, include evidence of insurance or bonded warehousing.
7. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
9. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
    1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements. A Payment Application review meeting will be held each month following a regular Progress Meeting. Submit draft copy of Payment Application to Architect and Owner at least 24 hours prior to the meeting.

B. Payment Application Times: Progress Payment Applications shall be submitted by the 25th day of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

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

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
    1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.

E. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application. Include amounts for stored material on the site. If material is to be stored off site, include copy of insurance for the stored material. Owner will determine amount allowed for stored material. Transmittal: Include waivers of lien and similar attachments. See A201 General Conditions document.
    1. Transmit with a transmittal form listing attachments and recording appropriate information about application.

F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
    1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
    2. When an application shows completion of an item, submit final or full waivers.
    3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
    4. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
   1. List of subcontractors.
   2. Schedule of Values.
   3. Contractor's Construction Schedule (preliminary if not final).
   4. Schedule of unit prices.
   5. Submittals Schedule (preliminary if not final).
   6. List of Contractor's staff assignments.
   7. Report of preconstruction conference.
   8. Certificates of insurance and insurance policies.
   9. Performance and payment bonds. (If required by the Contract)

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

I. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
   1. Evidence of completion of Project closeout requirements.
   2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
   3. Updated final statement, accounting for final changes to the Contract Sum.
   4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
   5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
   6. AIA Document G707, "Consent of Surety to Final Payment." (If required by Contract)

2 PRODUCTS (Not Used)

3 EXECUTION (Not Used)

END OF SECTION **01290**

SECTION 01310 - PROJECT MANAGEMENT AND COORDINATION

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. Coordination Drawings.
   2. Administrative and supervisory personnel.
   3. Project meetings.

B. Related Sections include the following:
   1. Division 1 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
   2. Division 1 Section "Closeout Procedures" for coordinating closeout of the Contract.
   3. Division 1 Section “Project Communication”

1.3 DEFINITIONS

A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.4 COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.
   4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical. Coordinate installation of Owner Furnished Equipment.
   5. Reference ICRA Section for temporary partition requirements. Provide plastic Zip walls during construction of heavier construction barriers.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
   1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of Contractor's Construction Schedule.
   2. Preparation of the Schedule of Values.

3. Preparation of Construction Waste Management Forms
4. Installation and removal of temporary facilities and controls.
5. Delivery and processing of submittals.
6. Progress meetings.
7. Preinstallation conferences.
8. Receiving and installation of owner furnished equipment.
9. Project closeout activities.
10. Startup and adjustment of systems.
11. Project closeout activities.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
   1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

E. Layout and Measurement of Construction
   1. The General Contractor shall, immediately upon entering project site for purposes of beginning work, locate all general reference points and take such action as is necessary to prevent their destruction, lay out his own work and be responsible for all lines, elevations and measurements of buildings, grading, paving, utilities, and other work executed by him under the contract. He must exercise proper precaution to verify figures shown on drawings before laying out work, and will be held responsible for any errors resulting from his failure to exercise such precaution.
   2. After this preliminary layout, any deviations, irregularities or conflicts with the information or intent of the drawings shall be promptly reported to the Owner's Representative and the Architect, and work shall not proceed until such problems are resolved to the satisfaction of the Owner's Representative and the Architect.
   3. Before ordering any material or doing any work, the General Contractor or Trade Contractor shall verify all measurements at the building and shall be responsible for correctness of same. No extra charge or compensation will be allowed on account of difference between actual dimensions and the measurements indicated on the drawing; any difference which may be found shall be submitted to the Architect for consideration, before proceeding with the work.
   4. Building Projects that include an addition to an existing structure shall require review of existing lines and grades. The location and column lines of the new structure as well as the elevation of the new building floors shall be verified against similar lines and levels of the existing building. Verify existing slab elevations at all point of connections between new and existing. Any conflicts shall be reported to the Owner's Representative and the Architect. Contractor shall not proceed with the work until all conflicts have been resolved. Following this review of the lines and levels, the contractor shall be responsible for same.
   5. Verify locations and elevations of existing utilities that the new project will connect to.
   6. Verify existing slab elevations and utilities within sixty days of contract award.

F. Drawings for Mechanical and Electrical Work:
   1. Drawings contain diagrammatic information and indicate general arrangement of systems, and other work.
   2. Prior to installation of material and equipment, develop coordinated shop drawings and coordinate work with the contract documents for exact locations; where not definitely indicated, request information from Architect before proceeding. Each subcontractor shall provide information and layout his equipment on coordinated shop drawings.
   3. Coordinate Drawings with all other trades to verify spaces in which work will be installed.
   4. Maintain maximum headroom at all locations.
   5. Modifications in layout for services above ceiling and behind walls shall be coordinated with other trades and mechanical/electrical engineers to prevent conflict.

6. Above ceiling coordination drawings shall be prepared using Building Information Modeling (BIM) software and then coordinated using Navisworks or similar program to identify clashes. BIM models shall include and coordinate with the building structure, ceiling systems and all above ceiling systems and components including systems provided and installed by the Owner's vendors. Such systems shall include, but are not limited to, pneumatic tube systems, equipment supports and IT/Telecom/Security systems. Prior to proceeding with the fabrication of any above ceiling components the Contractor shall provide the Owner with a Clash Detection report for each floor that confirms all the conflicts have been resolved.

G. Priority of Construction Space:
1. Following is the Order of Priority for Construction Space:
   a. First: Equipment Support Work
   b. Second: Heating, Ventilating and Air Conditioning Work
   c. Third: Plumbing and Drainage Work
   d. Fourth: Electrical Work
   e. Where conflicts occur with placement of materials of various trades, the General Contractor shall be responsible to coordinate the available space to accommodate all trades.

1.5 SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
   a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
   b. Indicate required installation sequences.
   c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
2. Sheet Size: At least 8-1/2 by 11 inches but no larger than 30 by 42 inches.
3. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.
4. Provide BIM document to Owner at end of project in live format and also in PDF format.

B. Key Personnel Names: Within 7 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.6 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

1.7 PROJECT MEETINGS

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

indicated.

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

B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Contractor Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:
    a. Tentative construction schedule.
    b. Phasing.
    c. Critical work sequencing and long-lead items.
    d. Designation of key personnel and their duties.
    e. Procedures for processing field decisions and Change Orders.
    f. Procedures for RFIs.
    g. Procedures for testing and inspecting.
    h. Procedures for processing Applications for Payment.
    i. Distribution of the Contract Documents.
    j. Submittal procedures.
    k. Preparation of Record Documents.
    l. Use of the premises and existing building.
    m. Work restrictions.
    n. Owner's occupancy requirements.
    o. Responsibility for temporary facilities and controls.
    p. Construction waste management, salvaging and recycling.
    q. Parking availability.
    r. Office, work, and storage areas.
    s. Equipment deliveries and priorities.
    t. First aid.
    u. Security.
    v. Progress cleaning.
    w. Working hours.
3. Minutes: Contractor will Record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site 7 days before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Owner and Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    a. The Contract Documents.
    b. Options.

c. Related RFIs.
d. Deliveries.
e. Submittals.
f. Review of mockups.
g. Possible conflicts.
h. Time schedules.
i. Weather limitations.
j. Manufacturer's written recommendations.
k. Warranty requirements.
l. Compatibility of materials.
m. Acceptability of substrates.
n. Temporary facilities and controls.
o. Regulations of authorities having jurisdiction.
p. Testing and inspecting requirements.
q. Installation procedures.
r. Coordination with other work.
s. Required performance results.
t. Protection of adjacent work.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Conduct progress meetings at weekly intervals. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of Owner, Contractor and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
1. Review schedule for next period.
b. Review present and future needs of each entity present, including the following:
1. Sequence of operations.
2. Status of submittals.
3. Deliveries.
4. Access.
5. Site utilization.
6. Temporary facilities and controls.
7. Work hours.
8. Progress cleaning.

9. Quality and work standards.
10. Status of correction of deficient items.
11. Field observations.
12. RFIs.
13. Status of proposal requests.
14. Pending changes.
15. Status of Change Orders.
16. Documentation of information for payment requests.

3. Minutes: The contractor will Record the meeting minutes.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
5. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

1.8 REQUESTS FOR INTERPRETATION (RFIs)

A. Refer to Section 01312 – Project Communications.

2 PRODUCTS (Not Used)

3 EXECUTION (Not Used)

END OF SECTION **01310**

SECTION 01312 – PROJECT COMMUNICATIONS

1. GENERAL

1.1 SUMMARY

A. This Section specifies administrative procedures for preparation and submission of project communications documents.

1.2 DEFINITIONS

A. Project communications documents shall be defined as the following:
   1. Letters.
   2. Memoranda.
   3. Fax Communications.
   4. E-Mail communications / Internet Communications / Project Management Software Communications.
   5. RFI (Request for Information – Contractor).

1.3 FORMAT

A. Letters, Memoranda, and Fax Communications: Submit in formats acceptable to the Architect.

B. E-Mail Communications / Internet Communications / Project Management Software Communications: Submit in forms and formats acceptable to and as approved by the Architect.

C. RFI (Request for Information): Submit on forms as approved by the Architect.

2. PRODUCTS

A. Not Applicable

3. EXECUTION

3.1 PROJECT COMMUNICATIONS DOCUMENTS

A. Letters, Memoranda, and Fax communications documents shall be submitted in a timely manner so as to facilitate project delivery and coordination. Routing of communications shall be as established in the Contract, the Contract Documents and the Pre-Construction Conference. Communications documents shall be transmitted or forwarded in a manner consistent with the schedule and progress of the work.

B. E-Mail Communications, Internet Communications, and Project Management Software programs must be compatible with the Architect's and Owner's computer systems and equipment. The responsibility for all costs for management of these systems, including, but not limited to, licensing, on site training or other training necessary for the proper operation of such systems, shall be by the Contractor. The Contractor shall keep written records and hard file copies of all electronic communications. Failure of the Contractor to keep such records shall waive the Contractor's right to rely on such communications and such communications shall be deemed to have not taken place.

3.2 REQUEST FOR INFORMATION (RFI)

A. RFI shall be defined and limited to a request from the Contractor seeking interpretation or clarification of the requirements of the Contract Documents. Such requests shall comply with the following requirements:
   1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
   2. Coordinate and submit RFI requests shall be submitted in a prompt/timely manner so as to avoid delays in Contractor's work or work of subcontractors,
      a) Submit well in advance of related work
      b) Allow sufficient time for the resolution of issues relating to the request for interpretation/information or clarification

c) Contractor shall schedule the submission of RFI's so as to moderate and manage the flow of RFI requests.
d) RFI's shall be submitted in a manner consistent with the schedule and progress of the work, and shall not be submitted in a sporadic and/or excessive manner.

3. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
   a) Project name
   b) Date
   c) Name of Contractor
   d) Name of Architect
   e) RFI number, numbered sequentially
   f) Indicate whether RFI is routine or high priority
   g) Specification Section number and title and related paragraphs, as appropriate
   h) Drawing number and detail references, as appropriate
   i) Field dimensions and conditions, as appropriate
   j) Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
   k) Contractor's signature
   l) Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
      1) Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.
4. RFI's submitted to the Contractor by Sub-Contractors, vendors, suppliers, or other parties to the work shall be reviewed by the Contractor prior to submission to the Architect. If the Architect deems that such RFI requests have not been adequately reviewed by the Contractor, such requests will be returned to the Contractor for further action. Sub Contractor's RFI shall contain a "Proposed Solution".
5. RFI requests shall not contain submittals, substitutions requests, routine communications, correspondence, memos, claims, or any information required by other areas of the Contract Documents. RFI requests containing such information will be returned to the Contractor without action by the Architect. A response to an RFI that contains any of the above mentioned items does not constitute acceptance by the architect. Contractor should submit items listed per the contract Document requirements.
6. The response to RFIs shall not relieve the Contractor from his responsibility to furnish material, equipment and systems and to perform the Work required by the Contract Documents. Neither the Owner nor the Architect will be responsible for errors or omissions on RFIs furnished by the Contractor even though such RFIs containing errors or omissions are inadvertently responded to/accepted/reviewed.
7. RFI requests are limited to a request for interpretation or clarification of the requirements of the Contract Documents. Interpretations provided by the Architect shall not change the requirements of the Contract or the Contract Documents.

B. Hard-Copy RFIs:
1. Identify each page of attachments with the RFI number and sequential page numbers.

C. If the Architect, after review, determines that any RFI has been submitted in an incomplete manner, is unnecessary, or does not otherwise comply with the requirements of this Section, the RFI will be returned without action to the Contractor. The Contractor shall delete the original submittal date from the RFI log and enter a new submittal date at the time of re-submittal.
1. Architect's action may include a request for additional information, in which case Architect's time for response will start again.

2. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow seven working days for Architect's response for each RFI.
   a) The following RFIs will be returned without action:
      1) Requests for approval of submittals
      2) Requests for approval of substitutions
      3) Requests for coordination information already indicated in the Contract Documents
      4) Requests for adjustments in the Contract Time or the Contract Sum
      5) Requests for interpretation of Architect's actions on submittals
      6) Incomplete RFIs or RFIs with numerous errors
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 1 Section "Contract Modification Procedures."
   a) If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing, by memo, letter or PCO, within 5 working days of receipt of the RFI response. The RFI form, RFI log, or meeting minutes are not considered to be an acceptable form of notification for a change in contract sum or time.
   b) Requests for adjustments to the Contract shall be submitted in writing in a manner consistent with the terms and conditions of the Contract Documents within 5 working days from notification/receipt of RFI response or as agreed to prior to 5 working days. Adjustments submitted after 5 workings days from notification, unless otherwise agreed to in writing shall be rejected and the work will be considered part of the original bid project.

D. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within 5 work days if Contractor disagrees with response. If the Contractor believes that a change in Contract Sum or Contract Time is involved contractor should not execute an RFI and a Change Order Proposal shall be submitted and approved prior to starting work, as noted above.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
   1. Project name
   2. Name and address of Contractor
   3. Name and address of Architect
   4. RFI number including RFIs that were dropped and not submitted
   5. RFI description
   6. Date the RFI was submitted
   7. Date Architect's response was received
   8. Identification of related ASI, PCO or Proposal Request, as appropriate

END OF SECTION 01312

SECTION 01320 - CONSTRUCTION PROGRESS DOCUMENTATION

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Sections include the following:
   1. Division 1 Section "Payment Procedures" for submitting the Schedule of Values.
   2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
   3. Division 1 Section "Submittal Procedures" for submitting schedules and reports.
   4. Division 1 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 SUBMITTALS

A. Preliminary Construction Schedule and Submittals Schedule. Submit two opaque copies.

B. Contractor's Construction Schedule: Submit two opaque copies of initial schedule, large enough to show entire schedule for entire construction period.

1.4 COORDINATION

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

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

2 PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
   1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

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

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

early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
   1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
   2. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
   3. Startup and Testing Time: Include not less than 10 days for startup and testing.
   4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
   1. Phasing: Arrange list of activities on schedule by phase.
   2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
   3. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 1 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
   4. Work Restrictions: Show the effect of the following items on the schedule:
      a. Coordination with existing construction.
      b. Limitations of continued occupancies.
      c. Uninterruptible services.
      d. Partial occupancy before Substantial Completion.
      e. Use of premises restrictions.
      f. Provisions for future construction.
   5. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
      a. Mockups.
      b. Deliveries.
      c. Installation.
      d. Tests and inspections.
      e. Startup and placement into final use and operation.

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

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

2.3 PRELIMINARY CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within 14 days of date established for commencement of the Work.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. Preliminary Network Diagram: Submit diagram within 14 days of date established for the Notice

to Proceed. Outline significant construction activities for the first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

C. CPM Schedule: Prepare Contractor's Construction Schedule using a computerized, time-scaled CPM network analysis diagram for the Work.
   1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for commencement of the Work.
      a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
   2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
   3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
   4. Use "one workday" as the unit of time. Include list of nonworking days and holidays incorporated into the schedule.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.
   1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
      a. Preparation and processing of submittals.
      b. Mobilization and demobilization.
      c. Purchase of materials.
      d. Delivery.
      e. Fabrication.
      f. Utility interruptions.
      g. Installation.
      h. Work by Owner that may affect or be affected by Contractor's activities.
      i. Testing and commissioning.
   2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
   3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
   4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
      a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

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

9. Average size of workforce.
10. Dollar value of activity (coordinated with the Schedule of Values).

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

G. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
   a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
   b. Submit value summary printouts one week before each regularly scheduled progress meeting.

2.5 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site: Contractor shall keep records of the following activities and make them available to the Owner or the Architect on request:
1. List of subcontractors at Project site.
2. Approximate count of personnel at Project site.
3. Equipment at Project site.
4. Material deliveries.
5. High and low temperatures and general weather conditions.
6. Accidents.
7. Unusual events (refer to special reports).
8. Stoppages, delays, shortages, and losses.
9. Emergency procedures.
10. Construction Change Directives received and implemented.
11. Services connected and disconnected.
12. Equipment or system tests and startups.
13. Substantial Completions authorized.

3 EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.

2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01320

SECTION 01330 - SUBMITTAL PROCEDURES

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Shop drawing and product data submittals may be transmitted to Architect in electronic (PDF) format using a website service designed specifically for transmitting submittals between construction team members.
   1. The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.
   2. The electronic submittal process is not intended for color samples, color charts, or physical material samples

C. Related Sections include the following:
   1. Division 1 Section "Payment Procedures" for submitting Applications for Payment and the Schedule of Values.
   2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
   3. Division 1 Section "Closeout Procedures" for submitting warranties.
   4. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Architect's and Contractor’s responsive action.

B. Informational Submittals: Written information that does not require Architect's and Contractor’s responsive action. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

A. General: Electronic copies of CAD Drawings of the Contract Drawings may be provided by Architect for Contractor's use in preparing submittals. See Paragraph 1.5.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   2. 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 reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Electronic Submittal Procedures:
   1. Submittal Preparation - Contractor may use any or all of the following options:
      a. Subcontractors and Suppliers provide electronic (PDF) submittals to Contractor via the Submittal website.
      b. Subcontractors and Suppliers provide paper submittals to Scanning Service which electronically scans and converts to PDF format.
   2. Subcontractor shall review and apply electronic stamp certifying that the submittal complies

with the requirements of the Contract Documents including verification of manufacturer / product, dimensions and coordination of information with other parts of the work.

3. CM shall transmit each submittal to Architect using the Submittal website service.
   a. COSTS: The cost of the Submittal website service will be paid by the Contractor.
4. Architect / Engineers review comments will be made available on the Submittal Exchange website for downloading. Subcontractor will receive email notice of completed review.
5. Distribution of reviewed submittals to sub-subcontractors and suppliers is the responsibility of the Subcontractor.
6. Submit paper copies of requested submittals at project closeout for record purposes in accordance with other specified Closeout requirements. Subcontractor to coordinate these items with the Contractor.

D. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities. **ALL SUBMITTALS BY SUBCONTRACTORS SHALL BE RECEIVED BY THE CONTRACTOR NO LATER THAN SIXTY (60) DAYS AFTER CONTRACT AWARD, or as dictated by the SUBCONTRACT AGREEMENT (whichever is more stringent).**

E. Processing Time: Allow enough time for submittal review, including time for re-submittals, 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 re-submittals.
   1. Initial Review: Allow 15 days, excluding delivery time to and from the contractor for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
   2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
   3. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days excluding delivery time to and from the contractor for review of each submittal.
   4. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days excluding delivery time to and from the contractor for review of each submittal. Submittal will be returned to Architect by Consultant before being returned to Contractor.

F. Identification: Place a permanent label or title block on each submittal for identification.
   1. Indicate name of firm or entity that prepared each submittal on label or title block.
   2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect and Contractor.
   3. Include the following information on label for processing and recording action taken:
      a. Project name.
      b. Date.
      c. Name and address of Architect and General Contractor.
      d. Name and address of Contractor.
      e. Name and address of subcontractor.
      f. Name and address of supplier.
      g. Name of manufacturer.
      h. Submittal number or other unique identifier, including revision identifier.
         1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06100.01). Re-submittals shall include an alphabetic suffix after another decimal point (e.g., 06100.01.A).
      i. Number and title of appropriate Specification Section.
      j. Drawing number and detail references as appropriate tail references, as ap.

k. Location(s) where product is to be installed, as appropriate.
l. Other necessary identification.
m. Subcontractors Responsibility to Check
1) Each requested submittal shall be checked by the originating subcontractor (or sub-subcontractor) prior to submission to the General Contractor, and shall carry the following certification on each sheet by the Subcontractor:

WE HEREBY STATE THAT WE HAVE REVIEWED, INSPECTED AND CHECKED THE INFORMATION SUBMITTED AND VOUCH FOR ITS ACCURACY AND COMPLIANCE WITH THE CONTRACT DOCUMENTS AND SURROUNDING CONDITIONS.

_____
Subcontractor

(Signature)

Per _____ Date: _____

2) Submittals submitted without this certification will be returned, not reviewed, for resubmission.

G. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.

H. Additional Copies: Unless additional copies are required for final submittal, and unless Architect or Contractor observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect and Contractor.
2. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.

I. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.
1. Transmittal Form: Provide locations on form for the following information:
a. Project name.
b. Date.
c. Destination (To:).
d. Names of subcontractor, manufacturer, and supplier.
e. Category and type of submittal.
f. Drawing number and detail references, as appropriate.
g. Transmittal number, numbered consecutively.
h. Submittal and transmittal distribution record.
2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.

J. Re-submittals: Make re-submittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.

3. Resubmit submittals until they are marked “Reviewed” or “Furnish as Corrected”.

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

L. Use for Construction: Use only final submittals with mark indicating "Reviewed" or "Furnish as Corrected" by Architect and Contractor.

1.5 CONTRACTOR'S USE OF ARCHITECT'S CAD FILES

A. General: At Contractor's written request, copies of Architect's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
1. Limited to files that already exist.
2. Contractor must sign the Architect's Limitation of Liability release form.
3. Contractor shall reimburse Architect for cost to provide CAD files.

2 PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.
1. Submit electronic submittals directly to extranet specifically established for Project.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
   a. Manufacturer's written recommendations.
   b. Manufacturer's product specifications.
   c. Manufacturer's installation instructions.
   d. Standard and premium color charts.
   e. Manufacturer's catalog cuts.
   f. Wiring diagrams showing factory-installed wiring.
   g. Testing by recognized testing agency.
   h. Application of testing agency labels and seals.
4. Submit Product Data before or concurrent with Samples.
5. Number of Copies: Where electronic submittals are not made, submit two copies of Product Data, unless otherwise indicated. Architect will return one copy as a Project Record Document.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Architect's CAD Drawings are otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
   a. Dimensions.
   b. Identification of products.
   c. Fabrication and installation drawings.
   d. Roughing-in and setting diagrams.
   e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
   f. Shopwork manufacturing instructions.
   g. Templates and patterns.
   h. Schedules.
   i. Design calculations.

j. Compliance with specified standards.
k. Notation of coordination requirements.
l. Notation of dimensions established by field measurement.
m. Relationship to adjoining construction clearly indicated.
n. Seal and signature of professional engineer if specified.
o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 40 inches.
3. Number of Copies: Where electronic submissions are not made, submit four opaque (bond) copies of each submittal. Architect will return three copies as a Project Record Document.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:
a. Generic description of Sample.
b. Product name and name of manufacturer.
c. Sample source.
d. Number and title of appropriate Specification Section.
3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product.
2. Number and name of room or space.
3. Location within room or space.
4. Number of Copies: Submit three copies of product schedule or list, unless otherwise indicated. Architect will return two copies.
a. Mark up and retain one returned copy as a Project Record Document.

F. Contractor's Construction Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation".

G. Submittals Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation."

H. Application for Payment: Comply with requirements specified in Division 1 Section "Payment Procedures."

I. Schedule of Values: Comply with requirements specified in Division 1 Section "Payment

Procedures."

J. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
   1. Name, address, and telephone number of entity performing subcontract or supplying products.
   2. Number and title of related Specification Section(s) covered by subcontract.
   3. Drawing number and detail references, as appropriate, covered by subcontract.
   4. Number of Copies: Where electronic submission is not made, submit two copies of subcontractor list, unless otherwise indicated. Architect will return one copy as a Project Record Document.

2.2 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.
   1. Number of Copies: Where electronic submissions are not made, submit two copies of each submittal, unless otherwise indicated. Architect will not return copies.
   2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
   3. Test and Inspection Reports: Comply with requirements specified in Division 1 Section "Quality Requirements."

B. Coordination Drawings: Comply with requirements specified in Division 1 Section "Project Management and Coordination."

C. Contractor's Construction Schedule: Comply with requirements specified in Division 1 Section "Construction Progress Documentation."

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

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

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

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

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

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

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

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

L. Research/Evaluation Reports: Prepare written evidence, from a model code organization

acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

M. Schedule of Tests and Inspections: Comply with requirements specified in Division 1 Section "Quality Requirements."

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

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

P. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

Q. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 1 Section "Operation and Maintenance Data."

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

S. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

T. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Statement weather conditions, products, and installation will affect warranty.

U. Insurance Certificates and Bonds: Prepare written information indicating current status of

insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

V. Construction Photographs: Take photographs weekly sufficient to document all weekly progress on the project and at Owner's and Architect's direction. Take photographs of existing conditions.

2.3 DELEGATED DESIGN

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

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

3 EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and General Contractor.

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

3.2 ARCHITECT'S AND CONTRACTOR'S ACTION

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

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

C. The Architect will review each submittal only for conformance with design concepts and compliance with the contract documents. Architect will not be responsible for reviewing quantities or verifying dimensions. The architect will mark submittal to indicate action taken, and return.

D. Action Stamp: The Architect will stamp each submittal with a self-explanatory action stamp. The stamp will be appropriately marked to indicate action taken.

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

F. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

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

END OF SECTION 01330

SECTION 01400 - QUALITY REQUIREMENTS

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

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

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

C. Related Sections include the following:

1. Division 1 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
2. Divisions 2 through 16 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

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

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

C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.

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

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

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

1.4 CONFLICTING REQUIREMENTS

A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently

equal, to Architect for a decision before proceeding.

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

1.5 SUBMITTALS

A. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
   1. Specification Section number and title.
   2. Description of test and inspection.
   3. Number of tests and inspections required.
   4. Requirements for obtaining samples.

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

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

D. Inspection Reports: Submit to Owner and Architect

1.6 QUALITY ASSURANCE

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

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

C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

D. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
   1. Training Personnel: As part of the Commissioning process, provide qualifications that authorized representatives are properly prepared to conduct training and submit course

outlines.

E. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
   1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
   2. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
      a. Allow seven days for initial review and each re-review of each mockup.
   3. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   4. Demolish and remove mockups when the work is completed, unless otherwise directed.

1.7 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
   1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
   2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
   1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
   2. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
   3. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
   4. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 1 Section "Submittal Procedures."

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

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

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

control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Contractor to schedule and coordinate Owner's testing activities.
2. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.8 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner. See Inspection Requirements in specific sections.

2 PRODUCTS (Not Used)

3 EXECUTION

3.1 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:
   1. Date test or inspection was conducted.
   2. Description of the Work tested or inspected.
   3. Date test or inspection results were transmitted to Architect.
   4. Identification of testing agency or special inspector conducting test or inspection.

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

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

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

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

END OF SECTION 01400

SECTION 01420 - REFERENCES

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

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

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

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

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

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

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

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

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

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

1.3 INDUSTRY STANDARDS

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

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

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

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

1.4 ABBREVIATIONS AND ACRONYMS

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

AA Aluminum Association, Inc. (The)
(703) 358-2960
www.aluminum.org

AAADM American Association of Automatic Door Manufacturers
(216) 241-7333
www.aaadm.com

AABC Associated Air Balance Council
(202) 737-0202
www.aabchq.com

AAMA American Architectural Manufacturers Association
(847) 303-5664
www.aamanet.org

AASHTO American Association of State Highway and Transportation Officials
(202) 624-5800
www.transportation.org

ABAA Air Barrier Association of America
(866) 956-5888
www.airbarrier.org

ACI American Concrete Institute
(248) 848-3700
www.concrete.org

ACPA American Concrete Pipe Association
(972) 506-7216
www.concrete-pipe.org

AF&PA American Forest & Paper Association
(800) 878-8878
(202) 463-2700

AGA American Gas Association
(202) 824-7000
www.aga.org

AGC Associated General Contractors of America (The)
(703) 548-3118
www.agc.org

AHRI Air-Conditioning, Heating, and Refrigeration Institute
(703) 524-8800
www.ahrinet.org

AI Asphalt Institute
(859) 288-4960
www.asphaltinstitute.org

AIA American Institute of Architects (The)
(800) 242-3837
(202) 626-7300

AISC American Institute of Steel Construction
(800) 644-2400
(312) 670-2400

AISI American Iron and Steel Institute
(202) 452-7100
www.steel.org

AITC American Institute of Timber Construction

(303) 792-9559
www.aitc-glulam.org

ALSC American Lumber Standard Committee, Incorporated
(301) 972-1700
www.alsc.org

ANSI American National Standards Institute
(202) 293-8020
www.ansi.org

APA Architectural Precast Association
(239) 454-6989
www.archprecast.org

APA APA - The Engineered Wood Association
(253) 565-6600
www.apawood.org

API American Petroleum Institute
(202) 682-8000
www.api.org

ARI Air-Conditioning & Refrigeration Institute
(Now AHRI)

ARMA Asphalt Roofing Manufacturers Association
(202) 207-0917
www.asphaltroofing.org

ASCE American Society of Civil Engineers
(800) 548-272
(703) 295-6300

ASCE/SEI American Society of Civil Engineers/Structural Engineering Institute
(See ASCE)

ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers
(800) 527-4723
(404) 636-8400

ASME American Society of Mechanical Engineers
ASME International
(800) 843-2763
(973) 882-1170
www.asme.org

ASSE American Society of Safety Engineers
(847) 699-2929
www.asse.org

ASSE American Society of Sanitary Engineering
(440) 835-3040
www.asse-plumbing.org

ASTM American Society for Testing and Materials International
ASTM International
(610) 832-9500
www.astm.org

AWCMA American Window Covering Manufacturers Association
(Now WCMA)

AWI Architectural Woodwork Institute
(571) 323-3636

www.awinet.org

AWPA American Wood Protection Association
(Formerly: American Wood Preservers' Association)
(205) 733-4077
www.awpa.com

AWS American Welding Society
(800) 443-9353
(305) 443-9353

AWWA American Water Works Association
(800) 926-7337
(303) 794-7711

BHMA Builders Hardware Manufacturers Association
(212) 297-2122
www.buildershardware.com

BIA Brick Industry Association (The)
(703) 620-0010
www.bia.org

CCC Carpet Cushion Council
(610) 527-3880
www.carpetcushion.org

CDA Copper Development Association
(212) 251-7200
www.copper.org

CGA Compressed Gas Association
(703) 788-2700
www.cganet.com

CISCA Ceilings & Interior Systems Construction Association
(630) 584-1919
www.cisca.org

CISPI Cast Iron Soil Pipe Institute
(423) 892-0137
www.cispi.org

CLFMI Chain Link Fence Manufacturers Institute
(301) 596-2583
www.chainlinkinfo.org

CRRC Cool Roof Rating Council
(866) 465-2523
(510) 485-7175

CPA Composite Panel Association
(703) 724-1128
www.pbmdf.com

CRI Carpet and Rug Institute (The)
(706) 278-3176
www.carpet-rug.com

CRSI Concrete Reinforcing Steel Institute
(847) 517-1200
www.crsi.org

CSA Canadian Standards Association
(800) 463-6727

747-4000

CSA CSA International
(Formerly: IAS - International Approval Services)
(866) 797-4272
(416) 747-4000
www.csa-international.org

CSI Cast Stone Institute
(717) 272-3744
www.caststone.org

CSI Construction Specifications Institute (The)
(800) 689-2900
(703) 684-0300
www.cedarbureau.org

CTI Cooling Technology Institute
(Formerly: Cooling Tower Institute)
(281) 583-4087
www.cti.org

DHI Door and Hardware Institute
(703) 222-2010
www.dhi.org

EIMA EIFS Industry Members Association
(800) 294-3462
(770) 968-7945

EJCDC Engineers Joint Contract Documents Committee
(703) 295-5000
www.ejdc.org

EJMA Expansion Joint Manufacturers Association, Inc.
(914) 332-0040
www.ejma.org

ETL SEMCO Intertek ETL SEMCO
(800) 967-5352
(Formerly: ITS - Intertek Testing Service NA)
www.intertek-etlsemko.com

FM Approvals FM Approvals LLC
(781) 762-4300
www.fmglobal.com

FM Global FM Global
(Formerly: FMG - FM Global)
(401) 275-3000
www.fmglobal.com

GA Gypsum Association
(202) 289-5440
www.gypsum.org

GANA Glass Association of North America
(785) 271-0208
www.glasswebsite.com

GBCI Green Building Certification Institute
www.GBCI.org

GRI (Part of GSI)

GS Green Seal
(202) 872-6400
www.greenseal.org

GSI Geosynthetic Institute
(610) 522-8440
www.geosynthetic-institute.org

HI Hydraulic Institute
(973) 267-9700
www.pumps.org

HI Hydronics Institute
(908) 464-8200
www.gamanet.org

HMMA Hollow Metal Manufacturers Association
(Part of NAAMM)

HPVA Hardwood Plywood & Veneer Association
(703) 435-2900
www.hpva.org

IAS International Approval Services
(Now CSA International)

ICEA Insulated Cable Engineers Association, Inc.
(770) 830-0369
www.icea.net

ICRI International Concrete Repair Institute, Inc.
(847) 827-0830
www.icri.org

IEC International Electrotechnical Commission
41 22 919 02 11
www.iec.ch

IEEE Institute of Electrical and Electronics Engineers, Inc. (The)
(212) 419-7900
www.ieee.org

IES Illuminating Engineering Society
(212) 248-5000
www.ies.org

IESNA Illuminating Engineering Society of North America
(Now IES)

IEST Institute of Environmental Sciences and Technology
(847) 981-0100
www.iest.org

IGCC Insulating Glass Certification Council
(315) 646-2234
www.igcc.org

IGMA Insulating Glass Manufacturers Alliance
(613) 233-1510
www.igmaonline.org

ILI Indiana Limestone Institute of America, Inc.
(812) 275-4426
www.iliai.com

ISO International Organization for Standardization

41 22 749 01 11
www.iso.ch
Available from ANSI
(202) 293-8020
www.ansi.org

ISSFA International Solid Surface Fabricators Association
(877) 464-7732
(702) 567-8150

ITS Intertek Testing Service NA
(Now ETL SEMCO)

ITU International Telecommunication Union
41 22 730 51 11
ww.itu.int/home

KCMA Kitchen Cabinet Manufacturers Association
(703) 264-1690
www.kcma.org

LPI Lightning Protection Institute
(800) 488-6864
www.lightning.org

MBMA Metal Building Manufacturers Association
(216) 241-7333
www.mbma.com

MFMA Maple Flooring Manufacturers Association, Inc.
(888) 480-9138
www.maplefloor.org

MFMA Metal Framing Manufacturers Association, Inc.
(312) 644-6610
www.metalframingmfg.org

MH Material Handling
(Now MHIA)

MHIA Material Handling Industry of America
(800) 345-1815
(704) 676-1190

MIA Marble Institute of America
(440) 250-9222
www.marble-institute.com

MPI Master Painters Institute
(888) 674-8937
(604) 298-7578

MSS Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
(703) 281-6613
www.mss-hq.com

NAAMM National Association of Architectural Metal Manufacturers
(630) 942-6591
www.naamm.org

NADCA National Air Duct Cleaners Association
(202) 737-2926
www.nadca.com

NAIMA North American Insulation Manufacturers Association

(703) 684-0084
www.naima.org

NCAA National Collegiate Athletic Association (The)
(317) 917-6222
www.ncaa.org

NCMA National Concrete Masonry Association
(703) 713-1900
www.ncma.org

NCPI National Clay Pipe Institute
(262) 248-9094
www.ncpi.org

NCTA National Cable & Telecommunications Association
(202) 775-2300
www.ncta.com

NEBB National Environmental Balancing Bureau
(301) 977-3698
www.nebb.org

NECA National Electrical Contractors Association
(301) 657-3110
www.necanet.org

NeLMA Northeastern Lumber Manufacturers' Association
(207) 829-6901
www.nelma.org

NEMA National Electrical Manufacturers Association
(703) 841-3200
www.nema.org

NETA InterNational Electrical Testing Association
(888) 300-6382
(269) 488-6382

NFPA National Fire Protection Association
(800) 344-3555
(617) 770-3000
www.nfpa.org

NGA National Glass Association
(866) 342-5642
(703) 442-4890

NHLA National Hardwood Lumber Association
(800) 933-0318
(901) 377-1818

NLGA National Lumber Grades Authority
(604) 524-2393
www.nlga.org

NOMMA National Ornamental & Miscellaneous Metals Association
(888) 516-8585
www.nomma.org

NRCA National Roofing Contractors Association
(800) 323-9545
(847) 299-9070

NRMCA National Ready Mixed Concrete Association

(888) 846-7622
(301) 587-1400

NSF NSF International National Sanitation Foundation International
(800) 673-6275
(734) 769-8010
www.nsf.org

NSSGA National Stone, Sand & Gravel Association
(800) 342-1415
(703) 525-8788

NTMA National Terrazzo & Mosaic Association, Inc. (The)
(800) 323-9736
(540) 751-0930

NTRMA National Tile Roofing Manufacturers Association
(Now TRI)

NWFA National Wood Flooring Association
(800) 422-4556
(636) 519-9663

NWWDA National Wood Window and Door Association
(Now WDMA)

PCI Precast/Prestressed Concrete Institute
(312) 786-0300
www.pci.org

PDCA Painting & Decorating Contractors of America
(800) 332-7322
(314) 514-7322

PDI Plumbing & Drainage Institute
(800) 589-8956
(978) 557-0720

PLANET Professional Landcare Network
(800) 395-2522
(703) 736-9666

PTI Post-Tensioning Institute
(602) 870-7540
www.post-tensioning.org

RCSC Research Council on Structural Connections
www.boltcouncil.org

RFCI Resilient Floor Covering Institute
(301) 340-8580
www.rfci.com

RIS Redwood Inspection Service
(925) 935-1499
www.redwoodinspection.com

SAE SAE International
(877) 606-7323
(724) 776-4841

SCTE Society of Cable Telecommunications Engineers
(800) 542-5040
(610) 363-6888

SDI Steel Deck Institute

(847) 458-4647
www.sdi.org

SDI Steel Door Institute
(440) 899-0010
www.steeldoor.org

SEFA Scientific Equipment and Furniture Association
(877) 294-5424
(516) 294-5424

SEI/ASCE Structural Engineering Institute/American Society of Civil Engineers
(See ASCE)

SGCC Safety Glazing Certification Council
(315) 646-2234
www.sgcc.org

SIA Security Industry Association
(866) 817-8888
(703) 683-2075

SJI Steel Joist Institute
(843) 626-1995
www.steeljoist.org

SMA Screen Manufacturers Association
(561) 533-0991
www.smainfo.org

SMACNA Sheet Metal and Air Conditioning Contractors' National Association
(703) 803-2980
www.smacna.org

SPIB Southern Pine Inspection Bureau
(850) 434-2611
www.spib.org

SPRI Single Ply Roofing Industry
(781) 647-7026
www.spri.org

SSINA Specialty Steel Industry of North America
(800) 982-0355
(202) 342-8630

SSPC SSPC: The Society for Protective Coatings
(877) 281-7772
(412) 281-2331

STI Steel Tank Institute
(847) 438-8265
www.steeltank.com

SWI Steel Window Institute
(216) 241-7333
www.steelwindows.com

SWRI Sealant, Waterproofing, & Restoration Institute
(816) 472-7974
www.swrionline.org

TCNA Tile Council of North America, Inc.
(864) 646-8453
www.tileusa.com

TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance (703) 907-7700 www.tiaonline.org
TMS	The Masonry Society (303) 939-9700 www.masonrysociety.org
TPI	Truss Plate Institute, Inc. (703) 683-1010 www.tpinst.org
TPI	Turfgrass Producers International (800) 405-8873 (847) 649-5555
TRI	Tile Roofing Institute (312) 670-4177 www.tileroofing.org
UL	Underwriters Laboratories Inc. (877) 854-3577 (847) 272-880
USGBC	U.S. Green Building Council (800) 795-1747 www.usgbc.org
USITT	United States Institute for Theatre Technology, Inc. (800) 938-7488 (315) 463-6463
WASTEC	Waste Equipment Technology Association (800) 424-2869 (202) 244-4700
WCLIB	West Coast Lumber Inspection Bureau (800) 283-1486 (503) 639-0651
WCMA	Window Covering Manufacturers Association (212) 297-2122 www.wcmanet.org
WCSC	Window Covering Safety Council (800) 506-4636 (212) 297-2109
WDMA	Window & Door Manufacturers Association (800) 223-2301 (847) 299-5200
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California) (916) 372-9943 www.wicnet.org (Now WI)
WMMPA	Wood Moulding & Millwork Producers Association (800) 550-7889 (530) 661-9591
WSRCA	Western States Roofing Contractors Association (800) 725-0333 (650) 570-5441

WWPA Western Wood Products Association
(503) 224-3930
www.wwpa.org

Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

IAPMO International Association of Plumbing and Mechanical Officials
(909) 472-4100
www.iapmo.org

ICC International Code Council
(888) 422-7233
www.iccsafe.org

ICC-ES ICC Evaluation Service, Inc.
(800) 423-6587
www.icc-es.org
(562) 699-0543

UBC Uniform Building Code
(See ICC)

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

CE Army Corps of Engineers
(202) 761-0011
www.usace.army.mil

CPSC Consumer Product Safety Commission
(800) 638-2772
(301) 504-7923

DOC Department of Commerce
(202) 482-2000
www.commerce.gov

DOD Department of Defense
(215) 697-6257
http://.dodssp.daps.dla.mil

DOE Department of Energy
(202) 586-9220
www.energy.gov

EPA Environmental Protection Agency
(202) 272-0167
www.epa.gov

FAA Federal Aviation Administration
(866) 835-5322
www.faa.gov

FCC Federal Communications Commission
(888) 225-5322
www.fcc.gov

FDA Food and Drug Administration
(888) 463-6332

www.fda.gov

GSA General Services Administration
(800) 488-3111
www.gsa.gov

HUD Department of Housing and Urban Development
(202) 708-1112
www.hud.gov

LBL Lawrence Berkeley National Laboratory
(510) 486-4000
www.lbl.gov

NCHRP National Cooperative Highway Research Program
(See TRB)

NIST National Institute of Standards and Technology
(301) 975-6478
www.nist.gov

OSHA Occupational Safety & Health Administration
(800) 321-6742
(202) 693-1999

PBS Public Buildings Service
(See GSA)

PHS Office of Public Health and Science
(202) 690-7694
www.hhs.gov/ophs

SD State Department
(202) 647-4000
www.state.gov

USDA Department of Agriculture
(202) 720-2791
www.usda.gov

USPS Postal Service
(202) 268-2000
www.usps.com

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

ADAAG Americans with Disabilities Act (ADA)
(800) 872-2253
Architectural Barriers Act (ABA)
(202) 272-0080
Accessibility Guidelines for Buildings and Facilities
Available from U.S. Access Board
www.access-board.gov

CFR Code of Federal Regulations
(866) 512-1800
Available from Government Printing Office
(202) 512-1800
www.gpoaccess.gov/cfr/index.html

FED-STD Federal Standard
(See FS)

FS Federal Specification
(215) 697-2664
- Available from Department of Defense Single Stock Point
  http://dodssp.daps.dla.mil
- Available from Defense Standardization Program
  www.dps.dla.mil
- Available from General Services Administration
  (202) 619-8925
  www.gsa.gov
- Available from National Institute of Building Sciences
  (202) 289-7800
  www.wbdg.org/ccb

FTMS Federal Test Method Standard
(See FS)

MIL (See MILSPEC)

MIL-STD (See MILSPEC)

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

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

2 **PRODUCTS (Not Used)**

3 **EXECUTION (Not Used)**

END OF SECTION **01420**

SECTION 01500 - TEMPORARY FACILITIES AND CONTROLS

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Sections include the following:
   1. Division 1 Section "Summary" for limitations on utility interruptions and other work restrictions.
   2. Division 1 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
   3. Division 1 Section "Execution Requirements" for progress cleaning requirements.

1.3 USE CHARGES

A. General: Cost or use charges for temporary facilities shall be covered in the Owner-Contractor Agreement Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.

B. Electric Power Service: Pay electric power service use charges for electricity used by all entities for construction operations.

C. Water Service: Water from Owner's existing water system is available for use. Water will be provided for the contractor. Provide connections and extensions of services as required for construction operations.

D. Electric Power Service: Electric power from Owner's existing system is available for use. Provide connections and extensions of services as required for construction operations.

1.4 SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

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

2 PRODUCTS

2.1 MATERIALS

A. Portable Chain-Link Fencing: Minimum 2-inch, 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch OD line posts and 2-7/8-inch OD corner and pull posts, with 1-5/8-inch OD top and bottom rails. Provide concrete bases for supporting posts.

B. Enclosure Fence screen: 6 feet high, provide heavy green canvas screen cloth attached to Chain-Link fencing as specified above.

C. No logos or advertising signage will be allowed without written permission of the Owner.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of construction personnel. Keep office clean and orderly. Furnish and equip offices as follows:
   1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
   2. Conference room of sufficient size to accommodate meetings of 10-15 individuals. Provide electrical power service and 120-V ac duplex receptacles, with not less than 1 receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack board.
   3. Drinking water and private toilet.
   4. Coffee machine and supplies.
   5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
   6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
   7. Recycling collection boxes for compliance with local regulations for paper, beverage containers and metal.
   8. Provide Secure Wireless Network.
   9. Provide projector and screen for use by Owner and consultants.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
   1. Store combustible materials apart from building.

D. Collection and disposal of waste: The contractor shall collect waste from construction areas and elsewhere daily. Dispose of material in a lawful manner. The contractor shall provide dumpsters. Materials unsuitable for the dumpsters (crates, combustibles) shall be hauled from the site by the contractor using those materials. Waste collection shall include recycling.

E. Eating areas: The contractor shall, subject to the approval of the Owner and Construction Manager, designate areas for eating, provide adequate receptacles, and maintain the area in a sanitary condition free of rodents and pests. No coffee/food wagons are permitted within the construction site without the expressed consent of the Owner.

F. Temporary Access: Except as otherwise provided, the Contractor shall provide and maintain all necessary temporary stairs, ladders, ramps, and runways to facilitate conveyance of people materials, tools and equipment for proper execution of the work.

G. Snow Removal: The Contractor shall remove snow and ice, daily, for the protection and execution of his work. This shall include access to the construction trailers, and the Owner's trailer.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control. After building is enclosed, liquid propane gas or fuel-oil heaters will not be allowed.
   1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
   2. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 13 at each return air grille in system and remove at end of construction.

C. Project Identification and Temporary Sign: No signs or posters are permitted on any structure

on the premises, except by written permission from the owner.

3 EXECUTION

3.1 INSTALLATION, GENERAL

A. Location of facilities will be as directed by the Owner. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. 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: Install temporary service or connect to existing service.
   1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
   2. Provide adequate capacity at each stage of construction.

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

C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities. Provide covered waste containers for used material. Location shall be as approved by the Owner.

D. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
   1. Power Distribution System: Install wiring overhead and rise vertically where least exposed to damage. Where permitted, wiring circuits not exceeding 125 Volts, ac 20 Ampere rating, and lighting circuits may be nonmetallic sheathed cable where overhead and exposed for surveillance.

E. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
   1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

F. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.
   1. Provide additional telephone lines for the following:
      a. Provide a dedicated telephone line for each facsimile machine and computer in each field office.
   2. At each telephone, post a list of important telephone numbers.
      a. Police and fire departments.
      b. Ambulance service.
      c. Contractor's home office.
      d. Architect's office.
      e. Engineers' offices.
      f. Owner's office.
      g. Principal subcontractors' field and home offices.
   3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
   4. Provide four additional radios with chargers and access for use by Owner's Representative.

G. Electronic Communication Service: Provide temporary electronic communication service,

including electronic mail, in common-use facilities.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:
   1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.
   2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
   3. Contractor to obtain required permits for construction trailers and temporary buildings. Trailers and temporary buildings must comply with Environment of Care and ADA.

B. Roads and Paved Areas: Maintain roads and paved areas adequate for construction operations. Locate temporary roads and paved areas as indicated on Drawings.

3.4 SITE PREPARATION

A. Traffic Controls: Comply with requirements of authorities having jurisdiction including Owner's Representative and Hospital Security.

B. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
   1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
   2. Remove snow and ice as required to minimize accumulations.

C. Project Identification and Temporary Signs: Provide Project identification and other signs. Install signs where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.
   1. Provide three (1) 4’ x 8’ Project Signs. Sign design to be coordinated with the Owner.
   2. All site advertising signage and logos must be approved in writing by the Owner
   3. Provide temporary, directional signs for construction personnel and visitors.
   4. Maintain and touchup signs so they are legible at all times.

D. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 deg F. Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material lawfully. See Division 1 Section "Construction Waste Management" for additional guidelines.

E. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
   1. Truck cranes and similar hoisting materials are considered "tools and equipment" and not temporary facilities.devices used for

F. Temporary Elevator Use: Refer to Division 1: "Summary" and Division 14 Sections for temporary use of new elevators.

G. Existing Stair Usage: Use of Owner's existing stairs will be permitted, as long as stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
   1. Comply with work restrictions specified in Division 1 Section "Summary."

B. Temporary Erosion and Sedimentation Control: Provide silt fencing at laydown and field office locations.

C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

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

E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.

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

G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

H. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
   1. Salem Community Hospital property is a no-smoking campus. Prohibit smoking, chewing tobacco and vaping in all areas.
   2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
   3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
   4. Provide temporary standpipes for fire protection.

3.6 OPERATION, TERMINATION, AND REMOVAL

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

B. Maintenance: Maintain facilities in good operating condition until removal.
   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.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
   1. Materials and facilities that constitute temporary facilities are property of Contractor.

END OF SECTION 01500

SECTION 01600 - PRODUCT REQUIREMENTS

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Sections include the following:
   1. Division 1 Section "References" for applicable industry standards for products specified.
   2. Division 1 Section "Closeout Procedures" for submitting warranties for Contract closeout.
   3. Divisions 2 through 16 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
   3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

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

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

1.4 SUBMITTALS

A. Product List: Submit a list, in tabular from, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
   1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
   2. Form: Tabulate information for each product under the following column headings:
      a. Specification Section number and title.
      b. Generic name used in the Contract Documents.
      c. Proprietary name, model number, and similar designations.
      d. Manufacturer's name and address.
      e. Supplier's name and address.

f. Installer's name and address.
g. Projected delivery date or time span of delivery period.
h. Identification of items that require early submittal approval for scheduled delivery date.

3. Initial Submittal: Within 30 days after date of commencement of the Work, submit 3 copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.
4. Completed List: Within 60 days after date of commencement of the Work, submit 3 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
5. Architect's Action: Architect will respond in writing to Contractor within 15 days of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.

B. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Substitution Request Form. Use copy of the form provided in the Project Manual.
2. Provide substitution request per section 2.2.A and prior to shop drawing submittal for that item. Shop drawings are not to be used as substitution approvals.
3. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
a. Statement indicating why specified material or product cannot be provided.
b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainability and specific features and requirements indicated.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
j. Cost information, including a proposal of change, if any, in the Contract Sum.
k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
4. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Architect

will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

a. Form of Acceptance: Change Order or ASI.
b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

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

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

B. Delivery and Handling:
1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage:
1. Store materials in a manner that will not endanger Project structure.
2. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
3. Store cementitious products and materials on elevated platforms.
4. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

2 PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that

are undamaged and, unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection from standard and custom samples..
5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. For products specified by naming three (3) or more products and manufacturers, select only from products and manufacturers named, no substitutions are permitted.
6. For products specified by naming one or more products and manufacturers followed by the phrase "no substitute"; no substitutions are permitted.
7. Products specified by naming one manufacturer with the Phrase "or equal" shall establish a standard of quality and performance and shall not be construed to limit competition. Substitutions to these products may be requested in accordance with specified procedures.
8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
    a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.

2.2 PRODUCT SUBSTITUTIONS

A. Timing: The Architect will consider, within 30 calendar days after contract execution, written requests for product substitutions.

B. Substitution requests will be considered after specified time only under the following conditions:

1. Product is no longer manufactured.
2. Product is not available due to causes beyond Contractor's control.

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

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

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

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

G. Substitution request is fully documented and properly submitted.

H. Requested substitution will not adversely affect Contractor's Construction Schedule.

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

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

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

L. Requested substitution provides specified warranty.

M. Requested subsitutuion does not jeopordize sustainble design intent of Project.

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

O. Claims for additional costs related to substitutions will not be accepted.

P. A credit, based on manufacturer's signed quotation, will be issued if product of lesser quality or lower cost is accepted.

Q. The Architect will entertain a request for product substitution only once per each item submitted for substitution.

R. Substitution Request Submittals: See 1.4B

2.3 COMPARABLE PRODUCTS

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

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

3 EXECUTION (Not Used)

END OF SECTION 01600

SUBSTITUTION REQUEST FORM **SUBSTITUTION REQUEST NUMBER** _____

TO: _____ DATE: _____

FROM: _____ PROJECT: _____

SPECIFICATION

Section Title: _____ Section: _____

Number/Page: _____ Article/Paragraph: _____

Description: _____

_____

_____

PROPOSED SUBSTITUTION Note: Limit this Request to one proposed substitution

Manufacturer: _____ Website: _____

Trade Name: _____ Model Number _____

Phone Number: _____ Contact Person: _____

Installer: _____ Address: _____

Phone Number: _____ Contact Person: _____

Product History:

☐ New Product ☐ 2 to 5 years old ☐ 5 to 10 years old ☐ more than 10 years old

Differences between proposed substitution and specified product: _____

_____

_____

☐ Point by point comparison data attached - REQUIRED BY WILMOT SANZ FOR REVIEW

Reason for Not Providing Specified Item: _____

_____

_____

Similar Installations:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

_____

Savings to Owner for accepting substitution: ($ _____)

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ Days.

Supporting Data attached: ☐ Product Data ☐ Drawings ☐ Tests ☐ Reports ☐ Samples

(required) ☐ _____

Undersigned party proposing substitution certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable is available.
- Proposed substitution will not affect or delay Construction Progress Schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions, functional clearances, and is compatible with other portions of work that are affected.
- Payment will be made for changes to building design, including architectural or engineering design, detailing, and construction costs caused by the requested substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.
- Proposed substitution has received or meets all requirements/approval of authorities having jurisdiction.

Submitted by: _____

Signature: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: _____

_____

ARCHITECT'S REVIEW AND RECOMMENDATION:

☐ Substitution Approval Recommended: Make submittals in accordance with Specification Section 01330.

☐ Substitution Approval Recommended as Noted: Make submittals in accordance with Specification Section 01330.

☐ Substitution Rejection Recommended: Use specified products. Architect shall not have responsibility for performance of substitution approved by Owner and rejected by Architect.

☐ Substitution Request received too late: Use specified products. *

Comments: _____

Signature: _____ Date: _____

OWNER'S REVIEW AND ACTION (Approval of Substitution not valid without Owner's signature)

☐ Substitution Approved - Make submittals in accordance with Specification Section 01330.

☐ Substitution Approved as Noted — Make submittals in accordance with Specification Section 01330

☐ Substitution Rejected - Use specified products.

Comments: _____

Signature: _____ Date: _____

SECTION 01700 - EXECUTION REQUIREMENTS

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Sections include the following:
   1. Division 1 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
   2. Division 1 Section “Selective Demolition” for procedural requirement for demolition and for noise pollution limitation.
   3. Division 1 Section "Closeout Procedures" for submitting Project Record Documents, and final cleaning.

2 PRODUCTS (Not Used)

3 EXECUTION

3.1 EXAMINATION

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

B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
   1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
   2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
   1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
   2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
   3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.

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

3.2 PREPARATION

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

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

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

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 CONSTRUCTION LAYOUT

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

B. General: Lay out the Work using accepted construction practices.
1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
3. Inform installers of lines and levels to which they must comply.
4. Check the location, level and plumb, of every major element as the Work progresses.
5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
6. Close surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks.

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

3.5 INSTALLATION

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

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

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

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

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

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels. Noisy operations, if allowed, must be completed before 7 am in the morning.

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

G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

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

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

3.6 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction forces.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.
1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Pre-installation Conferences: Include Owner's construction forces at pre-installation conferences covering portions of the Work that are to receive Owner's work. Attend pre-installation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully and according to the Construction Waste Management plan.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold materials more than 7 days during normal weather or 3 days if the

temperature is expected to rise above 80 deg F.

3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
4. Comply with requirements of the SMACNA IAQ Guidelines for Occupied Buildings under Construction.
   a. Clean and cap ducts at the end of the day.
   b. If air handlers are used during construction, install filters on return air ducts and replace all filtration media when visible soiled and prior to owner occupancy.

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

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

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

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

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

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

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

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

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

3.8 STARTING AND ADJUSTING

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

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

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

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

3.9 PROTECTION OF INSTALLED CONSTRUCTION

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

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

3.10 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.
   1. Replace temporary air filtration media with air filtration as specified in Division 15.

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

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

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

END OF SECTION 01700

SECTION 01732 – SELECTIVE DEMOLITION

1. GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. This Section includes the following:
   1. Demolition, including the removal of selected portions of the interior of the building undergoing alterations, capped and abandoned site utilities, and site improvements.

1.3 DEFINITIONS:

A. Existing to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by the Owner's Representative, items may be removed to a suitable, protected storage location during demolition and then reinstalled in their original locations.

B. Environmental Pollution and Damage: The presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human or animal life; affect other species of importance to humanity; or degrade the utility of the environment for aesthetic, cultural or historical purposes.

C. Recycling: The process of sorting, cleansing, treating and reconstituting materials for the purpose of using the altered form in the manufacture of a new product. Recycling does not include burning, incinerating or thermally destroying solid waste.

D. Demolition Waste: Building materials and solid waste resulting from construction, remodeling, repair, cleanup, or demolition operations that are not hazardous. This term includes, but is not limited to, asphalt concrete, Portland cement concrete, brick, lumber, gypsum wallboard, cardboard and other associated packaging, roofing material, ceramic tile, carpeting, plastic pipe, and steel. The materials may include rock, soil, tree stumps, and other vegetative matter resulting from land clearing and landscaping for construction or land development projects.

1.4 MATERIAL OWNERSHIP:

A. Prior to the Contractor starting work, the Owner will remove equipment and culturally sensitive items from the Demolition sites. These maybe items that will be reused or reinstalled in the Project or maybe items that they will resell or donate.

B. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option.
   1. Arrange a meeting no less than fifteen (15) days prior to demolition with the Owner and other designated representatives to review any salvageable items to determine if Owner wants to retain ownership, and discuss Contractor’s Waste Management and Recycling Plan.

C. Revenue: Revenues or other savings obtained from recycled, re-used, or salvaged materials shall accrue to Contractor unless otherwise noted in the Contract Documents.

1.5 SUBMITTAL:

A. General: Submit each item in this Article according to the Conditions of Contract and Division 1 Specification Sections, for information only, unless otherwise indicated.

B. Proposed dust-control measures.

C. Proposed noise-control measures.

D. Schedule of demolition activities indicating the following:

1. Detailed sequence of demolition and removal work, with starting and ending dates for each activity.
2. Interruption of utility services.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Detailed sequence of selected demolition and removal work to insure uninterrupted progress of Owner's operations.
5. Coordination of Owner's continuing occupancy of the existing building.
6. Locations of temporary partitions and means of egress.

E. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction that might be misconstrued as damage caused by demolition operations.

F. Record drawings at project closeout identifying and accurately locating capped utilities and other subsurface structural, electrical, or mechanical conditions.

1.6 QUALITY ASSURANCE:

A. Demolition firm qualifications: Engage an experienced firm that has successfully completed selective demolition Work similar to that indicated for this Project.

B. Regulatory Requirements: Comply with governing EPA notification regulations before starting demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.7 PROJECT CONDITIONS:

A. Owner will continually occupy portions of the building immediately adjacent to selective demolition area. Conduct selective demolition so that Owner's operations will not be disturbed. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

B. Conditions existing at time of inspection for bidding purposes will be maintained by Owner as far as practicable.

C. Maintain access to existing walkways, corridors, stairs and fire exits.

D. Storage or sale of removed items or materials on- site will not be permitted.

1.8 SCHEDULING:

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.9 WARRANTY:

A. Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

2. PRODUCTS

2.1 REPAIR MATERIAL:

A. Use repair materials identical to existing materials. Where identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible. Use materials whose installed performance equals or surpass that of existing materials.

3. EXECUTION

3.1 EXAMINATION:

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. Survey the condition of the building to determine whether removing any element might result in a structural deficiency or unplanned collapse of any portion of the structure or adjacency structures during selective demolition.

E. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

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

3.2 ENVIRONMENTAL CONTROLS

A. Comply with federal, state and local regulations pertaining to water, air, solid waste, recycling, chemical waste, sanitary waste, sediment and noise pollution.

B. Protection of Natural Resources: Preserve the natural resources within the project boundaries.
   1. Confine demolition activities to areas defined by public roads, easements, and work area limits indicated on the drawings.
      a) Temporary Construction: Remove indications of temporary construction facilities, such as work areas, structures, stockpiles or waste areas.
   2. Water Resources: Comply with applicable regulations concerning the direct or indirect discharge of pollutants to underground and natural surface waters.
      a) Oily Substances: Prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water in such quantities as to affect normal use, aesthetics, or produce a measurable ecological impact on the area.
         1) Store and service construction equipment at areas designated for collection of oil wastes.
   3. Dust Control, Air Pollution, and Odor Control: Prevent creation of dust, air pollution and odors.
      a) Use temporary enclosures and other appropriate methods to limit dust and dirt rising and scattering in air to lowest practical level.
      b) Store volatile liquids, including fuels and solvents, in closed containers.
      c) Properly maintain equipment to reduce gaseous pollutant emissions.
   4. Noise Pollution: The sensitive nature of the Project will require the Contractor to stop work at the Owner's demand. Perform demolition operations to minimize noise.
      a) Repetitive, high level impact noise will be permitted only between the hours of 8:00 a.m. and 6:00 p. m. Repetitive impact noise on the property shall not exceed the following dB limitations:

Sound Level in dB	Time Duration of Impact Noise
70	More than 12 minutes in any hour
80	More than 3 minutes in any hour

      b) Provide equipment, sound-deadening devices, and take noise abatement measures that are necessary to comply with the requirements of this Contract.
      c) At least once every five successive working days while work is being performed above 55 dB noise level, measure sound level for noise exposure due to the demolition. Measure sound levels on the 'A' weighing network of a General Purpose sound level meter at slow response. To minimize the effect of reflective sound waves at buildings, measurements may be taken three to six feet in front of any building face. Submit the

recorded information to the Owner noting any problems and the alternatives before mitigating actions.

3.3 POLLUTION CONTROLS:

A. Use temporary enclosure, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

B. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas. Remove debris from elevated portions of building by chute, hoist, or other devices that will convey debris to grade level.

3.4 UTILITY SERVICES:

A. Maintain existing utilities indicated in service and protect them against damage during selective demolition operations.
   1. Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by the Owner's Representative and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner's Representative and to governing authorities.
   2. Provide not less than 72 hours' notice to Owner's Representative if shutdown of services is required during changeover.

B. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services serving building to be selectively demolished.
   1. Arrange to shut off indicated utilities with utility companies or the Owner's Representative.
   2. Where utility services are required to be removed, relocated, or abandoned, provide bypass connections to maintain continuity of service to other parts of the building before proceeding with selective demolition.
   3. Cut off pipes or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit after bypassing.

C. Refer to Division 22 and 23 Sections for shutting off, disconnecting, removing, and sealing or capping utility services. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.5 PREPARATION:

A. Conduct demolition operations and remove debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities. Do not close or obstruct streets, walks or other adjacent or used facilities without permission from Owner's Representative and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations. Comply with Owner’s Infection Control Policy.

B. Conduct demolition operations to prevent injury to people and damage to facilities to remain. Ensure safe passage of people around selective demolition areas.
   1. Erect temporary protection, such as fences, railings, and partitions, where required by the Owner's Representative or authorities having jurisdiction.
   2. Protect walls, ceilings, floors, and other existing finish work that are to remain and are exposed during selective demolition operations.
   3. Cover and protect furniture, furnishings, and equipment that have not been removed.

C. Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.
   1. Construct dustproof partitions of not less than 3-5/8 inch metal studs, 5/8-inch gypsum wall-board with joints taped on occupied side, and 5/8-inch gypsum wallboard without taped joints on the demolition side.

2. Insulate partition to provide noise protection to occupied areas.
3. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.

D. Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of building to be selectively demolished. Strengthen or add new supports when required during progress of selective demolition.

3.6 SELECTIVE DEMOLITION:

A. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition work above each floor or tier before disturbing supporting members on lower levels.
2. Neatly cut openings and holes plumb, square, true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporary cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations. Maintain adequate ventilation when using cutting torches.
5. Locate selective demolition equipment throughout the structure and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
6. Dispose of demolished items and materials promptly. On-site storage or sale of removed items is prohibited.
7. Selectively demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain using power-driven masonry saw or hand tools; do not use power-drive impact tools.
8. Return elements of construction and surfaces to remain to condition existing before start of selective demolition operations.

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

3.7 PATCHING AND REPAIRING:

A. Promptly patch and repair holes and damaged surfaces caused to adjacent construction by selective demolition operations.

B. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

C. Completely fill holes and depressions in the existing masonry walls to remain with approved masonry patching material, applied according to manufacturer's printed recommendations.

D. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction to remain in a manner that eliminates evidence of patching and refinishing.

E. Patch and repair floor and wall surfaces in the new space where demolished walls or partitions extend one finished area into another. Provide a flush and even surface of uniform color and appearance.
1. Closely match texture and finish of existing adjacent surface.

2. Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
3. Where patching smooth painted surfaces, extend final paint coat over entire unbroken surface containing the patch after the surface has received primer and second coat.
4. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
5. Inspect and test patched areas to demonstrate integrity of the installation, where feasible.

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

G. After removing existing floor covering, remove adhesive with an approved method. Level floor with “Ardex” or other approved material.

3.8 CUTTING AND PATCHING:

A. 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. 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.
5. Concrete Cutting
    a) Saws and coring machines shall be of a type that fits on a framework and moves on guides so that close tolerances can be maintained.
    b) Machines, plates and attachments shall be of a size that can cut thru the entire thickness of the concrete and reinforcement from one side.
    c) Final cut openings must be within 3/4 inch of their location shown on the drawings.
    d) Sides of openings must not be out of straightness more than a total of 3/8 inch measured between the extreme deviations on either side of a straight line between the end points of the side.
    e) Openings may not be out of square or level by more than 3/8 inch total for large openings. Small openings must appear square and level upon visual inspection.
    f) Corners shall not be over-cut. The cut on the saw side shall be made just to the corner. The corner on the opposite face may be sawed or chipped out from that face.
    g) Chipping shall be done in such a manner that the roughness of the finished surface does not exceed 3/4 inch full amplitude.
    h) Openings with bottoms flush with the floor may be chipped out completely.
    i) Coring in post tensioned slabs shall be done only after steel tendons are located, marked and clearance established.

B. 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 rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Concrete Patching
    a) All chipped areas, whether the damage is new or pre-existing, shall be patched in accordance with this specification.
    b) Existing, damaged concrete shall be patched in accordance with this specification.
    c) Floor cracks and resurfacing:
        1) Chip out all loose concrete material. Sand blast or wire brush loose rust from any exposed reinforcement. Blow off dust with compressed air.
        2) Chipped out areas must not be feather-edged. Edges must be approximately square cut 1/2 inch deep.
        3) Repair hairline cracks at the bottom of the chipped out portion with a low viscosity epoxy adhesive such as Sikadur 21 Lo - Mod LV.
        4) Prepare surfaces of chipped out area and fill with epoxy modified concrete in strict accordance with the epoxy modifier manufacturer. Suggested products: Sikadur 362 and Thoroseal Acryl 60.
    d) Vertical and overhead patching:
        1) Chip out all loose concrete material. Sandblast or wire brush loose rust from any exposed reinforcement. Blow off dust with compressed air.
        2) Chipped out areas must not be feather-edged. Edges must be approximately square cut 1/2 inch deep.
        3) Patching shall be done with a commercial patching compound in strict accordance with manufacturer's instructions. Suggested products: Thoroseal Thorite (with Acryl 60 and water mixed one-to-one as the liquid) or one part mixed Sikadur Lo-Mod Gel with one part Sika Colma Quartzite Aggregate.
    e) All patching shall be smooth trowelled on the final layer to match the surface adjacent to the patch.

3.9 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site. Promptly remove items for disposal or recycling from Project Site.

B. Do not burn, bury or otherwise dispose of materials on site.

C. Disposal: Legally transport and dispose of materials off site to a recycling facility or to a transfer station and/or disposal facility that can legally accept the materials for the purpose of disposal.
    1. Transport waste off-site in a manner that will prevent spillage on adjacent surfaces, streets and areas or dust being emitted into the atmosphere.
    2. Clean adjacent areas of dust, dirt and C&D materials caused by demolition operations. At the end of each work day, return adjacent areas to condition existing before start of demolition.

3.10 CLEANING:

A. In areas where cutting and patching activities are performed, sweep the building broom clean on completion of selective demolition operations.

B. 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.

C. Change filters on air-handling equipment on completion of selective demolition operations.

D. Rough grade and level site where existing building demolished and removed.

E. Return adjacent areas to condition existing before start of selective demolition.

END OF SECTION 01732

SECTION 01740 – WARRANTIES

1. GENERAL

1.1 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 1, Section "Submittal Procedures" specifies procedures for submitting warranties.
   2. Division 1, Section "Closeout Procedures" specifies contract closeout procedures.
   3. Divisions 2 through 16, Sections for specific requirements for warranties on products and installations specified to be warranted.
   4. 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.

1.2 DEFINITIONS

A. Standard product warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

B. Special warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.3 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.

1.4 SUBMITTALS

A. Submit written warranties to the Owner 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 Owner.
   1. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Owner within 15 days of completion of that designated portion of the Work.

B. When the Contract Documents require the Contractor, or the Contractor and a subcontractor, supplier or manufacturer to execute a special warranty, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner for approval prior to final execution.
   1. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Form of Submittal: At Final Completion compile 3 copies of each required warranty properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

2. PRODUCTS

Not Applicable

3. EXECUTION

Not Applicable

END OF SECTION 01740

SECTION 01770 - CLOSEOUT PROCEDURES

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Inspection procedures.
   2. Warranties.
   3. Final cleaning.

B. Related Sections include the following:
   1. Division 1 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
   2. Division 1 Section "Execution Requirements" for progress cleaning of Project site.
   3. Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
   4. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   5. Division 1 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
   6. Divisions 2 through 16 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

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

14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

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

1.4 FINAL COMPLETION

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

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

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
   1. Contractor to organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
   2. Contractor to organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
   3. Include the following information at the top of each page:
      a. Project name.
      b. Date.
      c. Name of Architect.
      d. Name of Contractor.
      e. Page number.

1.6 WARRANTIES

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

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of

designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

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

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

2 PRODUCTS

2.1 MATERIALS

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

3 EXECUTION

3.1 FINAL CLEANING

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

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
   1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
      a. Clean Project site, yard, and grounds, in areas disturbed by construction activities. of rubbish, waste material, litter, and other foreign substances.
      b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
      c. Remove tools, construction equipment, machinery, and surplus material from Project site.
      d. Remove snow and ice to provide safe access to building.
      e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
      f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
      g. Sweep concrete floors broom clean in unoccupied spaces.
      h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
      i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

j. Remove labels that are not permanent.

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

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

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

m. Replace parts subject to unusual operating conditions.

n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

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

p. Clean ducts, blowers, and coils if units were operated without filters during construction.

q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

r. Leave Project clean and ready for occupancy.

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

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

END OF SECTION 01770

SECTION 01781 - PROJECT RECORD DOCUMENTS

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.
   4. Record Shop Drawings
B. Related Sections include the following:
   1. Division 1 Section "Closeout Procedures" for general closeout procedures.
   2. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   3. Divisions 2 through 16 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit one set of marked-up Record Prints.
B. Record Specifications: Submit two copies of Project's Specifications, including addenda and contract modifications.
C. Record Product Data: Submit one copy of each Product Data submittal.
   1. Where Record Product Data is required as part of operation and maintenance manuals and is not covered by the Commissioning plan, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.
D. Approved Substitution Requests
E. Test Reports
F. Inspection Certificates
G. Manufacturer's Certificates
H. Record Shop Drawings: Submit one copy of changes made during construction.

2 PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
   1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
      a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
      b. Accurately record information in an understandable drawing technique.
      c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
      d. Provide 1 set of full size coordination drawings that were produced during the construction BIM effort.

2. Content: Types of items requiring marking include, but are not limited to, the following:
   a. Dimensional changes to Drawings.
   b. Revisions to details shown on Drawings.
   c. Depths of foundations below lowest floor.
   d. Locations and depths of underground utilities.
   e. Revisions to routing of piping and conduits.
   f. Revisions to electrical circuitry.
   g. Actual equipment locations.
   h. Duct size and routing.
   i. Locations of concealed internal utilities.
   j. Changes made by Change Order
   k. Changes made following Architect's written orders.
   l. Details not on the original Contract Drawings.
   m. Field records for variable and concealed conditions.
   n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record CAD Drawings: Immediately before inspection for Certificate of Substantial Completion, review marked-up Record Prints with Architect.
1. Architect will furnish Contractor one set of CAD Drawings of the Contract Drawings for use in recording information.
   a. Architect makes no representations as to the accuracy or completeness of CAD Drawings as they relate to the Contract Drawings.
2. Provide Cad drawings format at conclusion of the project. Contractor and Subcontractors to provide any BIM coordination files generated for this project.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in

manufacturer's written instructions for installation.

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

2.4 MISCELLANEOUS RECORD SUBMITTALS

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

3 EXECUTION

3.1 RECORDING AND MAINTENANCE

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

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

END OF SECTION 01781

SECTION 01782 - OPERATION AND MAINTENANCE DATA

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
   1. Operation and maintenance documentation directory.
   2. Emergency manuals.
   3. Operation manuals for systems, subsystems, and equipment.
   4. Maintenance manuals for the care and maintenance of products, materials, finishes, systems and equipment.

B. Related Sections include the following:
   1. Division 1 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
   2. Division 1 Section "Closeout Procedures" for submitting operation and maintenance manuals.
   3. Division 1 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
   4. Divisions 2 through 16 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

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

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

1.4 SUBMITTALS

A. Initial Submittal: Submit 2 draft copies of each manual, to the Architect in both electronic file format and print copy, at least 30 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Provide two hard copies and electronic copy. Electronic copy to be a PDF with electronic index. Architect will return one copy of draft and mark whether general scope and content of manual are acceptable.

B. Correct each copy to comply with architects comments. Submit one copy in both electronic file format and print copy of each corrected manual within 15 days of receipt of architect's comments.

C. Final Submittal: Submit 3 copies of each manual in both electronic file format and print copy at least 30 days before final inspection, and start of Owner Training.
   1. Correct or modify each manual to comply with Architect's comments. Submit 1 copy of each corrected manual within 15 days of receipt of Architect's comments.

1.5 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

2 PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:
   1. List of documents.
   2. List of systems.

3. List of equipment.
4. Table of contents.

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

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

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

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

2.2 MANUALS, GENERAL

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

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name, address, and telephone number of Contractor.
6. Name and address of Architect.
7. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
   a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
   b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
   a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
   b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:
   1. Type of emergency.
   2. Emergency instructions.
   3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
   1. Fire.
   2. Flood.
   3. Water leak.
   4. Power failure.
   5. Water outage.
   6. System, subsystem, or equipment failure.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:
   1. Instructions on stopping.
   2. Shutdown instructions for each type of emergency.
   3. Operating instructions for conditions outside normal operating limits.
   4. Required sequences for electric or electronic systems.
   5. Special operating instructions and procedures.
   6. Re-start procedures after emergency shut down or power failure.

2.4 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
   1. System, subsystem, and equipment descriptions.
   2. Performance and design criteria if Contractor is delegated design responsibility.
   3. Operating standards.
   4. Operating procedures.
   5. Operating logs.
   6. Wiring diagrams.
   7. Control diagrams.
   8. Piped system diagrams.
   9. Precautions against improper use.
   10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:
   1. Product name and model number.
   2. Manufacturer's name.
   3. Equipment identification with serial number of each component.

4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

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

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

2.5 PRODUCT MAINTENANCE MANUAL

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

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

C. Product Information: Include the following, as applicable:
1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

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

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

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

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

B. Source Information: List each system, subsystem, and piece of equipment included in manual,

identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
   1. Standard printed maintenance instructions and bulletins.
   2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
   3. Identification and nomenclature of parts and components.
   4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
   1. Test and inspection instructions.
   2. Troubleshooting guide.
   3. Precautions against improper maintenance.
   4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   5. Aligning, adjusting, and checking instructions.
   6. Demonstration and training DVD, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
   1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
   2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Specifications, submittal, final TAB data.

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

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   1. Include procedures to follow and required notifications for warranty claims.

3 EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

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

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
   1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
   2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only

sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

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

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

1. Do not use original Project Record Documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared Record Drawings in Division 1 Section "Project Record Documents."

G. Comply with Division 1 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01782

SECTION 03300 – CAST-IN-PLACE CONCRETE

1. GENERAL:

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes for the concrete members shown on the structural drawings.

1.3 DEFINITIONS:

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans and ground granulated blast-furnace slag.

1.4 SUBMITTALS:

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mix water to be withheld for later addition at Project site.
2. Indicate location where each mix will be used.
3. Submit all backup data necessary to show mixture conforms to project requirement as described in ACI 318.

C. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork. Design and engineering of formwork are Contractor's responsibility.

1. Formwork and drawings shall be signed and sealed by the person responsible for the design.
2. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
3. Formwork shop drawings will be reviewed for general conformance with structural geometry only.

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

1. Cementitious materials and aggregates.
2. Form materials and form-release agents.
3. Steel reinforcement and reinforcement accessories.
4. Admixtures.
5. Waterstops.
6. Curing materials.
7. Floor and slab treatments.
8. Bonding agents.
9. Adhesives.

10. Repair materials.

F. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

G. Field quality-control reports.

1.5 QUALITY ASSURANCE:

A. Installer Qualifications: An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in Ohio and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for formwork and shoring and reshoring installations that are similar to those indicated for this Project in material, design, and extent.

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

1. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.

D. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

F. ACI Publications: Comply with the following, unless more stringent provisions are indicated:

1. ACI 301, "Specification for Structural Concrete."
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
3. 3. ACI 318-05, “Building Code Requirements for Structural Concrete”

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1. Before submitting design mixes, review concrete mix design and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
   a) Contractor's superintendent.
   b) Independent testing agency responsible for concrete design mixes.
   c) Ready-mix concrete producer.
   d) Concrete subcontractor.
   e) Structural engineer of Record.

1.6 DELIVERY, STORAGE AND HANDLING:

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

2. PRODUCTS:

2.1 FORM-FACING MATERIALS:

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

1. Plywood, metal, or other approved panel materials.

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

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

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

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

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

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface.
2. Furnish ties that, when removed, will leave holes not larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive waterproofing.

2.2 STEEL REINFORCEMENT:

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

B. Plain-Steel Wire: ASTM A 82, as drawn.

C. Welded Wire Fabric: Welded steel; ASTM A185 with minimum yield strength of 70,000 psi.

2.3 REINFORCEMENT ACCESSORIES:

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

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

B. Mechanical Butt Splice Devices: Size devices to develop 125 percent of yield strength of bar in tension or compression

2.4 CONCRETE MATERIALS:

A. Portland Cement: ASTM C 150, Type I and/or Type III.

1. Fly Ash: ASTM C 618, Class C or F.
2. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Blended Hydraulic Cement: ASTM C 595M, Type IS, portland blast-furnace slag cement.

C. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:

1. Class: Severe weathering region, but not less than 3S.
2. Nominal Maximum Aggregate Size: 3/4 inch.

D. Water: Potable and complying with ASTM C 94.

2.5 ADMIXTURES:

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.

B. Air-Entraining Admixture: ASTM C 260.

C. Water-Reducing Admixture: ASTM C 494, Type A.

D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.

E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.

F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

2.6 FIBER REINFORCEMENT:

A. Carbon-Steel Fiber: ASTM A 820/A 820M, deformed, minimum of 1.5 inches long, and aspect ratio of 45 to 50.

B. Synthetic Micro-Fiber: Monofilament polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1 to 2 ¼ inches long.

C. A combination of steel and microfiber materials specified above.

2.7 CURING MATERIALS:

A. Curing materials shall be selected based on compatibility with floor finished from the following:

1. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
2. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
3. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
4. Water: Potable.
5. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, certified by curing compound manufacturer to not interfere with bonding of floor covering.
6. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A, certified by curing compound manufacturer to not interfere with bonding of floor covering.

2.8 RELATED MATERIALS:

A. Joint-Filler Strips: Unless noted in architectural specifications, ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

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

C. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:

1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
2. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.9 REPAIR MATERIALS:

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.

2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.

B. Repair Topping: Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5700 psi at 28 days when tested according to ASTM C 109.

2.10 CONCRETE MIXES:

A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:
1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.

B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.

C. Proportion normal-weight concrete mix for all concrete structural elements as follows:
1. Compressive Strength (28 Days): See Drawings
2. Maximum Water-Cementitious Materials Ratio: See Drawings
3. Slump Limit: As required to provide a workable mix for placement conditions that does not result in aggregate separation.
4. Air Content:
a) Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus 1 or minus 1.5 percent, unless otherwise indicated:
b) Finished floors and interior toppings: not to exceed 3%.
c) Exposed concrete: 6% plus or minus 1 ½%.
d) Do not air entrain concrete to trowel-finished interior floors and suspended slabs. Do not allow entrapped air content to exceed 3 percent.

D. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Ground Granulated Blast-Furnace Slag: 35 percent.
2. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 35 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.

E. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

F. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

3. Use water-reducing admixture in pumped concrete and concrete with a water-cementitious materials ratio below 0.50.

2.11 FABRICATING REINFORCEMENT:

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

2.12 CONCRETE MIXING:

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

B. When air temperature is between 85 and 95 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 95 deg F, reduce mixing and delivery time to 60 minutes.

3. EXECUTION:

3.1 FORMWORK:

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

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

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class C, 1/2 inch for permanently exposed surfaces.
2. Class D, 1 inch for concealed surfaces.

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

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

1. Do not use rust-stained steel form-facing material.

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

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

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

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

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

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

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

3.2 EMBEDDED ITEMS:

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor bolts, accurately located, to elevations required.
2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS:

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

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

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

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

3.4 SHORES AND RESHORES:

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete. Remove shoring or reshoring in a controlled, planned manner that does not cause tensile stresses to exceed the concrete’s modulus of rupture (as determined by ACI 318) at the time of removal.

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

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

3.5 STEEL REINFORCEMENT:

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.

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

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

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

3.6 JOINTS:

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

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

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

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

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

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

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated on Drawings.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.7 WATERSTOPS:

A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, bonding or mechanically fastening and firmly pressing into place. Install in longest lengths practicable.

3.8 CONCRETE PLACEMENT;

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

B. Do not add water to concrete during delivery, at Project site, or during placement, unless water has been intentionally withheld at the batch plant and indicated on the batch ticket, or as otherwise approved by the Engineer of Record.

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

C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation. Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.

1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.

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

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

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

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

F. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 95 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES:

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch in height.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, veneer plaster, or painting.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS:

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

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes.

1. Apply scratch finish to surfaces indicated and to surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finishes.

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

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

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

1. Apply a trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.
2. Finish surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155/E 1155M for a randomly trafficked floor surface:
   a) Specified overall values of flatness, F(F) 20; and levelness, F(L) 15; with minimum local values of flatness, F(F) 24; and levelness, F(L) 15; for suspended slabs and slabs on grade.

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

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

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

3.11 MISCELLANEOUS CONCRETE ITEMS:

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

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

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

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

3.12 CONCRETE PROTECTION AND CURING:

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.

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

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

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

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

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a) Water.
   b) Continuous water-fog spray.
   c) Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   a) Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b) Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

c) Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period. Do not use curing and sealing compounds on slabs to receive moisture sensitive floor coverings.

3.13 PENETRATING LIQUID FLOOR TREATMENT:

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions. Provide penetrating liquid floor treatment to all interior exposed concrete floors that are not scheduled to receive floor treatment and to the exterior raised concrete platforms and ramps.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.

2. Do not apply to concrete that is less than seven days old.

3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

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

3.14 JOINT FILLING:

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

1. Defer joint filling until concrete has aged at least six months. Do not fill joints until construction traffic has permanently ceased.

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

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

3.15 CONCRETE SURFACE REPAIRS:

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

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

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

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has

dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

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

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 1/16 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

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

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

3.16 FIELD QUALITY CONTROL:

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, inspect formwork, inspect reinforcing steel and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this section.

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

1. Testing Frequency: Obtain concrete test specimens in quantities necessary for specified compressive testing for each day's pour of each concrete mix exceeding 5 cu. yd., and for each additional 150 cu. yd. or fraction thereof.
2. Mold and cure standard cylinder specimens in accordance with ASTM C31.
3. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
5. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
6. Unit Weight: ASTM C 567, fresh-unit weight of structural lightweight concrete; test for each composite sample, but not less than one test for each day's pour of each concrete mix.
7. Field cured cylinders are not required for concrete placed in column footings, wall footings or foundation walls.
8. Compressive-Strength Tests: ASTM C 39. Test cylinder specimens as follows:
   a) For all elevated concrete construction, including but not limited to: slabs, beams, and columns: 2 at 7 days lab cured, 2 at 7 days field cured, 2 at 28 days lab cured, s at 28 days field cured.
   b) For footings: 2 at 7 days lab cured, 2 at 28 days lab cured.
   c) A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.
9. Inspect formwork prior to concrete placement for conformance to the specified tolerances and to verify that forms are free of foreign material.
10. Inspect reinforcing steel prior to concrete placement and verify acceptability of reinforcing size and length, spacing, depth of cover, stability of supports, bends, laps and splices.

C. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

D. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

E. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests. If required, a 56 day test.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.

END OF SECTION 03300

SECTION 03450 - ARCHITECTURAL PRECAST CONCRETE

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Architectural precast concrete units and related anchors.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:
   1. Dead Loads: design precast units and anchors to support loads.
   2. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 120 deg F.
   3. Panels at garage area to be designed for impact loads.

1.4 SUBMITTALS

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

B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.

C. Material Certificates: for cementitious materials, reinforcing, admixtures, aggregates, etc.

D. Shop Drawings: Detail fabrication and installation of architectural precast concrete units. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit. Indicate joints, reveals, and extent and location of each surface finish. Indicate details at building corners.
   1. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware and connections.
   2. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction. Precast manufacturer to design and detail all anchors between precast items and adjacent materials and supporting members. Shop drawings to show details, configuration and locations for all clips, anchors and connections from precast to precast and between precast and adjacent or supporting materials.
   3. Include plans and elevations showing unit location and sequence of erection for special conditions.
   4. Indicate location of each architectural precast concrete unit by same identification mark placed on panel.
   5. Indicate relationship of architectural precast concrete units to adjacent materials including brick veneer, steel relieving angles supporting precast, curtainwalls, metal copings, masonry through wall flashings, air moisture barrier, steel stud backup and sheathing.

E. Samples: For each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches. Samples to be a minimum of four weeks old.

F. Welding certificates (if welding is required). Welders must be certified for each type of weld required.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A precast concrete erector who has retained a "PCI-Certified Field Auditor" to conduct a field audit of a project in same category as this Project before erection of precast concrete and who can produce an Erectors' Post-Audit Declaration.

B. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer. The fabricator shall be certified either by PCI Plant Certification program or APA (Architectural Precast Association). Any engineering analysis required shall be performed by a professional engineer licensed in the Ohio and submitted for approval.

C. Design Standards: Comply with ACI 318 and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.

D. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."

E. Welding: Qualify procedures and personnel according to AWS D1.1/D.1.1M, "Structural Welding Code - Steel"; and AWS D1.4, "Structural Welding Code - Reinforcing Steel." Welders shall be certified for each type of weld required.

2 PRODUCTS

2.1 REINFORCING MATERIALS

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

B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

2.2 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.

B. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

C. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117. Reference ASTM C1602: “Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete”

D. Precast color to match color, texture and finish of existing limestone band above existing louvers adjacent to new addition.

2.3 STEEL CONNECTION MATERIALS

A. Zinc-Coated Finish: all embeds, anchors and connections for precast to receive hot-dipped galvanizing coating or be fabricated of Stainless Steel. Apply zinc coating by hot-dip process according to ASTM A 123/A 123M or ASTM A 153/A 153M.

2.4 ACCESSORIES

A. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install architectural precast concrete units.

2.5 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.

B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.

C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.

D. Normal-Weight Concrete Mixtures: Proportion full-depth mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
   1. Compressive Strength (28 Days): 5000 psi minimum.
   2. Maximum Water-Cementitious Materials Ratio: 0.40.

E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.

F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.

G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions. All admixtures to be submitted as part of the design mixture submittal for review and approval.

H. All units must be wet-cast architectural precast. Dry tamped cast stone not acceptable.

2.6 MOLD FABRICATION

A. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
   1. Edge and Corner Treatment: Uniformly radiused.

2.7 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.

C. Joints: joint spacing to match joints in existing limestone adjacent to new addition.

D. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement. Provide minimum 1 ½” concrete cover over reinforcement.

E. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses.

F. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.

G. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 117.

H. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.

I. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

J. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

2.8 FABRICATION TOLERANCES

A. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with the following product tolerances:
   1. Overall Height and Width of Units, Measured at the Face Exposed to View: As follows:
      a. 10 feet or under, plus or minus 1/8 inch.

2.9 FINISHES

A. Finish end surfaces of architectural precast concrete units to match face-surface finish.

2.10 SOURCE QUALITY CONTROL

A. Strength of precast concrete units will be considered deficient if units fail to comply with ACI 318 requirements for concrete strength.

3 EXECUTION

3.1 INSTALLATION

A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.

B. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
   1. Protect architectural precast concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.

3.2 ERECTION TOLERANCES

A. Erect architectural precast concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.
   1. Plan Location from Building Grid Datum: Plus or minus 1/2 inch.

3.3 REPAIRS

A. Repair architectural precast concrete units if permitted by Architect. The Architect reserves the right to reject repaired units that do not comply with requirements.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.

C. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.4 CLEANING

A. Clean surfaces of precast concrete units exposed to view.

B. Clean mortar and other deleterious material from concrete surfaces and adjacent materials immediately.

C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
   1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
   2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 03450

SECTION 04810 - UNIT MASONRY ASSEMBLIES

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes unit masonry assemblies consisting of the following:
   1. Concrete masonry units (CMUs).
   2. Face brick.
   3. Mortar and grout.
   4. Reinforcing steel.
   5. Masonry joint reinforcement.
   6. Ties and anchors.
   7. Flexible membrane though-wall flashing.
   8. Cavity Drainage Materials
   9. Miscellaneous masonry accessories

B. Related Sections include the following:
   1. Division 1 Section “Alternates” for Alternate 002 to Delete Masonry.
   2. Division 7 Section "Fluid-Applied Membrane Air Barriers" for Air/Moisture Barrier.
   3. Division 7 Section “Building Insulation” for insulation installed in cavities behind masonry veneers
   4. Division 7 Section "Joint Sealants" for sealing top of wall, control and expansion joints in unit masonry.

1.3 DEFINITIONS

A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths of 2000 (f'm) at 28 days.

B. Determine net-area compressive strength (f'm) of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated and all auxiliary materials.

B. Samples for Verification: For each type and color of the following:
   1. Face brick.
   2. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project**.**

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
   1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
   2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

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

1.6 QUALITY ASSURANCE

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, especially sand from a single source, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. Check wrapping for condensation. If units become wet, do not install until they are dry.

B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

C. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

1.8 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect sills, ledges, and projections from mortar droppings.
   2. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
   1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

2 PRODUCTS

2.1 CONCRETE MASONRY UNITS (CMUs)

A. Shapes: Provide shapes indicated and as follows:
   1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
   2. Provide bullnose units for outside corners, unless otherwise indicated.

B. Concrete Masonry Units: ASTM C 90.
   1. Unit Compressive Strength: Provide units with minimum average net-area compressive

strength of 2800 psi.
2. Weight Classification: Normal weight.
3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

2.2 BRICK

A. General: Provide shapes indicated and as follows:
1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.

B. Face Brick: Brick shall match existing building brick near new addition.

2.3 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

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

C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.

D. Do not use masonry cement or mortar cement.

E. Colored Cement Product: Packaged blend made from portland cement and lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.
1. Glen-Gery Color Mortar Blend, color to match existing building, and clean washed sand conforming to requirements of ASTM C144
2. Pigments shall not exceed 10 percent of portland cement by weight.
3. Sand shall conform to requirements of ASTM C144 except that gradation shall comply with the limits specified in Section 3.3 of BIA M1-88.

F. Aggregate for Mortar: ASTM C 144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.

G. Aggregate for Grout: ASTM C 404.

H. Water: Potable.

I. Sand shall contain no more than 100 parts per million of chloride ions. Sand shall be free of organic contaminants.

J. Pre-bagged mixes shall contain no gypsum has been added in excess of that necessary during the clinking process.

K. Admixtures shall not be used without written approval from the Architect/Engineer. No calcium chloride or admixtures containing calcium shall be used in the mortar. No antifreeze compounds or other substances shall be added to mortar.

2.4 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951.
1. Exterior Walls: Hot-dip galvanized, carbon: steel:
2. Wire Size for Side Rods: 9 ga.

3. Wire Size for Cross Rods: 9 ga.
4. Wire Size for Veneer Ties: 9 ga.
5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

D. Masonry Joint Reinforcement for Multiwythe Masonry:
1. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate ties that extend into facing wythe. Ties have two hooks that engage eyes or slots in reinforcement and resist movement perpendicular to wall. Ties extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.

2.5 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with eight subparagraphs below, unless otherwise indicated.
1. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.
1. Where wythes are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches.
2. Wire: Fabricate from stainless steel wire.

D. Adjustable Masonry-Veneer Anchors
1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
2. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section. Attach all masonry veneer anchors with stainless steel screws.
a. Anchor Section: Sheet metal plate, 1-1/4 inches wide by 6 inches long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch wide by 5-1/2 inches long, stamped into center to provide a slot between strap and plate for inserting wire tie.
b. Fabricate sheet metal anchor sections and other sheet metal parts from stainless steel. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from stainless steel
c. Products:
1) Construction Tie Products: CTP-16. Ties to be sized to match insulation thickness.
2) Provide insulation retainer plates where insulation is included in cavity behind masonry veneers.

2.6 FLEXIBLE MEMBRANE FLASHING MATERIALS

A. Self-Adhered Flexible Membrane Through-wall Flashing:
1. Required where flexible membrane flashing extends to or past face of masonry wall.
2. Located at lintels, under precast sills, below Textured Concrete Masonry Units

3. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy as follows:
   a. Monolithic Sheet: Elastomeric thermoplastic flashing, 0.040 inch thick.
   b. Self-Adhesive Sheet with Drip Edge: Elastomeric thermoplastic flashing, 0.025 inch thick, with a 0.015-inch thick coating of rubberized-asphalt adhesive. Rubberized-asphalt coating is held back 3" from edge of flashing. The exposed drip edge is the 3" of thermoplastic flashing without the rubberized asphalt. When flashing is installed, the drip edge extends 1" to 2' past the face of the wall.
      1) Color: Tan/buff.
   c. Self-Adhesive Sheet without Drip Edge: Elastomeric thermoplastic flashing, 0.025 inch thick, with a 0.015-inch thick coating of rubberized-asphalt adhesive.
      1) Required where flexible flashing is installed over metal flashing
      2) Color: Match Brick.
   d. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
   e. Manufacturers / Products:
      1) Hyload, Inc.; Hyload Cloaked Flashing System. (No substitutions)

2.7 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

C. Weep/Vent Products: Use one of the following, unless otherwise indicated:
   1. Wicking Material: Absorbent rope, made from cotton, 1/4 to 3/8 inch in diameter, in length required to produce 2-inch exposure on exterior and 18 inches in cavity between wythes. Use only where specifically indicated.
   2. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard. Use for all conditions except under precast.
      a. Products:
         1) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
         2) Heckmann Building Products Inc.; No. 85 Cell Vent.
         3) Hohmann & Barnard, Inc.; Quadro-Vent.

D. Cavity Drainage Material:
   1. Manufacturers: Subject to compliance with requirements, provide cavity wall drainage system by Mortar Net, USA, Ltd, or approved equal.
   2. Materials:
      a. All dimensions are nominal. Measurements are inclusive of the continuous bottom strip and the dovetail shape.
      b. Size: 1-inch thick by 10 –inch height by 5 feet long.
      c. Continuous bottom strip on all sizes of material is 3-inches high, regardless of material thickness or overall material height.
   3. Product is recycled polyester. Product is a 90% open weave mesh in a dovetail configuration connected by a continuous bottom strip.

E. Termination Bar for Flexible Flashing: 1" wide strip with predrilled holes at 1'-0". Type 304 stainless steel

2.8 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Do not use products containing hydrochloric or muriatic acid. Test product on small sample area before proceeding with cleaning. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
   1. AvailableManufacturers:
      a. Diedrich Technologies, Inc.
      b. EaCo Chem, Inc.
      c. ProSoCo, Inc.

2.9 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
   1. Do not use calcium chloride in mortar or grout.

B. Mortar for Unit Masonry: Comply with ASTM C 270 BIA Technical Notes 8A, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
   1. For masonry below grade or in contact with earth, use Type M.
   2. For reinforced masonry, use Type S.
   3. For mortar parge coats, use Type N.
   4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

C. Grout for Unit Masonry: Comply with ASTM C 476.
   1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
   2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

3 EXECUTION

3.1 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

C. Wetting of Brick: (If required) Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

D. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
   1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.

3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

3.2 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.

C. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.
   1. Install compressible filler and sealant in joint between top of partition and underside of structure above.
   2. Provide anchorage between CMU wall and concrete slab as indicated on the Structural Drawings.
   3. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 7 Section "Fire-Resistive Joint Systems."

3.3 MORTAR BEDDING AND JOINTING

A. Lay hollow concrete masonry units as follows:
   1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
   2. With webs fully bedded in mortar in grouted masonry, including starting course on footings.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

D. Use industry standard practices to limit mortar droppings within wall cavity. See BIA Technical Note 21C.

E. Masonry units should not be shifted or tappped after mortar has achieved initial set. Where adjustment is necessary, remove and replace.

3.4 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
   1. Space reinforcement not more than 16 inches o.c.
   2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
   3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
      a. Reinforcement above is in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.5 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
   1. Provide an open space not less than 1/2 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid

materials. Provide full height drainage mat where open space is less than 2”.

2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 16 inches o.c. horizontally.

3.6 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:
   1. Fasten screw-attached anchors through sheathing to wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
   2. Embed tie sections in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.
   3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
   4. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than 1 anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.

3.7 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

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

B. Install flashing as follows, unless otherwise indicated:
   1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
   2. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches above cavity drainage material; with upper edge tucked under air barrier, lapping at least 4 inches, or anchored with termination bar and continuous sealant, (as indicated).

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

D. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
   1. Use specified weep/vent products to form weep holes.
   2. Space weep holes 24 inches o.c., unless otherwise indicated.

E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article.

3.8 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them

with liquid strippable masking agent or polyethylene film and waterproof masking tape.

4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

END OF SECTION **04810**

SECTION 05120 – STRUCTURAL STEEL

1. GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes structural steel.

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

1. Division 1 Section "Quality Control" for independent testing agency procedures and administrative requirements.
2. Division 5 Section "Steel Deck" for field installation of shear connectors.

1.3 SUBMITTALS

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

B. Product Data for each type of product specified.

C. Shop Drawings detailing fabrication of structural steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.

D. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Mill test reports signed by manufacturers certifying that their products, including the following, comply with requirements.

1. Structural steel, including chemical and physical properties.
2. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
3. Shop primers.
4. Nonshrink grout.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.

1. Fabricator must participate in the AISC Quality Certification Program and be designated an AISC-Certified Plant as follows:
   a) Category: Category I, conventional steel structures.

C. Comply with applicable provisions of the following specifications and documents:

1. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
2. AISC's "Specification for Allowable Stress Design of Single-Angle Members."

3. AISC's "Seismic Provisions for Structural Steel Buildings."
4. ASTM A 6 "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
5. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel."
   1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.
   1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
   2. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.6 SEQUENCING

A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

2. PRODUCTS

2.1 MATERIALS

A. Rolled wide flange shapes: ASTM A992

B. Rigid frame continuity plates and all column base plates: ASTM A572, grade 50.

C. Cold-Formed Structural Steel Tubing: ASTM A 500, Grade B.

D. Hot-Formed Structural Steel Tubing: ASTM A 501.

E. Steel Pipe: ASTM A 53, Type E or S, Grade B.
   1. Finish: Black, except where indicated to be galvanized.

F. Anchor Rods, Bolts, Nuts, and Washers: As follows:
   1. Unheaded Rods: ASTM A 36.
   2. Headed Bolts: ASTM A 325, Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.
   3. Washers: ASTM A 36.

G. Nonhigh-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A; carbon-steel, hex-head bolts; carbon-steel nuts; and flat, unhardened steel washers.
   1. Finish: Plain, uncoated; unless noted otherwise on Drawings.

H. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.
   1. Finish: Plain, uncoated; unless noted otherwise on Drawings.

2. Direct-Tension Indicators: ASTM F 959, Type 325.
   a) Finish: Plain, uncoated.

I. Welding Electrodes: Comply with AWS requirements.

2.2 PRIMER

A. Primer: Nonasphaltic primer complying with SSPC's "Painting System Guide No. 7.00."

B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds and repair painting galvanized steel, with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, of consistency suitable for application, and a 30-minute working time.

2.4 FABRICATION

A. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in Shop Drawings.
   1. Identify high-strength structural steel according to ASTM A 6 and maintain markings until steel has been erected.
   2. Mark and match-mark materials for field assembly.
   3. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
   4. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded.

C. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.

D. Holes: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on Shop Drawings.
   1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.
   2. Weld threaded nuts to framing and other specialty items as indicated to receive other work.

2.5 SHOP CONNECTIONS

A. Shop install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
   1. Bolts: ASTM A 325 high-strength bolts, unless otherwise indicated on Drawings.
   2. Connection Type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.

B. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
   1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.

2.6 SHOP PRIMING

A. Do not shop prime steel surfaces, except the following:
   1. Surfaces that are exposed to weather.
   2. Steel members located in unconditioned spaces.

B. Painting: Apply a 1-coat, nonasphaltic primer complying with SSPC's "Painting System Guide No. 7.00" to provide a dry film thickness of not less than 1.5 mils.

2.7 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel indicated for galvanizing according to ASTM A 123.

2.8 SOURCE QUALITY CONTROL

A. Owner will engage an independent testing and inspecting agency to perform shop inspections and tests and to prepare test reports.
   1. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.
   2. Provide testing agency with access to places where structural steel Work is being fabricated or produced so required inspection and testing can be accomplished.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

D. Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

E. In addition to visual inspection, shop-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below.
   1. Ultrasonic Inspection: ASTM E 164. Each complete penetration butt or groove weld and 50 percent of partial penetration welds.

3. EXECUTION

3.1 EXAMINATION

A. Before erection proceeds, and with the steel erector present, verify elevations of concrete bearing surfaces and locations of anchorages for compliance with requirements.

B. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.

B. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
   1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
   2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
   3. Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
      a) Comply with manufacturer's instructions for proprietary grout materials.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure.
   2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.

E. Splice members only where indicated on Drawings.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
   1. Bolts: ASTM A 325 high-strength bolts, unless otherwise indicated on Drawings.
   2. Connection Type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.

B. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
   1. Comply with AISC specifications referenced in this Section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
   2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.

3.5 FIELD QUALITY CONTROL

A. Owner will engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.
   1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

D. Field-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

E. In addition to visual inspection, field-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.
   1. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Ten percent of all fillet welds. Cracks or zones of incomplete fusion or penetration will not be accepted.
   2. Ultrasonic Inspection: ASTM E 164. Each complete penetration butt or groove weld and 50 percent of partial penetration welds.

3.6 CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.

1. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils.

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

END OF SECTION **05120**

SECTION 05310 – STEEL DECK

1. GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Steel roof deck.

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

1. Division 3 Section "Cast-in-Place Concrete" for concrete fill and reinforcing steel.

1.3 SUBMITTALS

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

B. Product data for each type of deck, accessory, and product specified.

C. Shop drawings showing layout and types of deck panels, anchorage details, reinforcing channels, pans, deck openings, special jointing, accessories, and attachments to other construction.

1. For steel deck indicated to comply with certain design loadings, include load tables.

D. Product certificates signed by manufacturers of steel deck certifying that their products comply with specified requirements.

E. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

F. Product test reports from qualified independent testing agencies evidencing compliance with requirements of the following based on comprehensive testing:

1. Mechanical fasteners.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel" and AWS D1.3 "Structural Welding Code--Sheet Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

C. Fire-Test-Response Characteristics: Where indicated, provide steel deck panels identical to those tested as part of an assembly for fire resistance per ASTM E 119 by a testing and inspection agency performing testing and follow-up services, that is acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: As indicated by design designations listed in UL "Fire Resistance Directory."
2. Labeling: Identify steel deck with appropriate markings of applicable testing and inspecting agency.

D. FM Listing: Provide steel roof deck evaluated by Factory Mutual and listed in Factory Mutual "Approval Guide" for Class 1 fire rating and Class 1-60 windstorm ratings.

1.5 DELIVERY, STORAGE, AND HANDLING

1. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
2. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a water-proof covering and ventilate to avoid condensation.

2. PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Bowman Metal Deck Armco, Inc.
2. Consolidated Systems, Inc.
3. Epic Metals Corp.
4. Robertson A United Dominion Co.
5. Roof Deck, Inc.
6. United Steel Deck, Inc.
7. Vulcraft Div. of Nucor Corp.
8. Walker Div. of Butler Manufacturing Co.
9. Wheeling Corrugating Co., Div. of Wheeling-Pittsburgh Steel Corp.

2.2 ROOF DECK

A. Steel Roof Deck: Fabricate panels without top-flange stiffening grooves conforming to SDI Publication No. 28 "Specifications and Commentary for Steel Roof Deck" and the following:

1. Galvanized-Steel Sheet: ASTM A 446, Grade A, G 90 zinc coated according to ASTM A 525.
2. Deck Profile: Type WR, wide rib.
3. Profile Depth: 1-1/2 inches where indicated on Drawings.
4. Side Joints: Overlapped or interlocking seam at Contractor's option.

2.3 ACCESSORIES

A. General: Provide accessory materials for steel deck that comply with requirements indicated and recommendations of the steel deck manufacturer.

B. Mechanical Fasteners: Manufacturer's standard, corrosion-resistant, low-velocity, powder-actuated or pneumatically driven carbon steel fasteners; or self-drilling, self-threading screws.

C. Side Lap Fasteners: Manufacturer's standard, corrosion-resistant, hexagonal washer head; self-drilling, carbon steel screws, No. 10 minimum diameter.

D. Miscellaneous Roof Deck Accessories: Steel sheet, 0.0359 inch thick minimum ridge and valley plates, finish strips, and reinforcing channels, of same material as roof deck.

E. Pour Stops and Girder Fillers: Steel sheet, of same material as deck panels, and of thickness and profile as required.

F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material and thickness as deck panels, unless otherwise indicated.

G. Recessed Sump Pans: Manufacturer's standard size, single piece steel sheet 0.071-inch thick minimum, of same material as deck panels, with 1-1/2-inch minimum deep level recessed pans and 3-inch wide flanges. Cut holes for drains in the field.

H. Flat Receiver Pan: Manufacturer's standard size, single-piece steel sheet, 0.071-inch thick minimum units, of same material as deck panels. Cut holes for drains in the field.

I. Shear Connectors: ASTM A 108, Grade 1010 through 1020 headed stud type, cold-finished carbon steel, AWS D1.1, Type B.

J. Steel Sheet Accessories: ASTM A 446, G 60 coating class, galvanized according to ASTM A 525.

K. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

3. EXECUTION:

3.1 EXAMINATION

A. Examine supporting framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of steel deck.

3.2 PREPARATION

A. Do not place deck panels on concrete supporting structure until concrete has cured and is dry.

B. Locate decking bundles to prevent overloading of supporting members.

3.3 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary of SDI Publication No. 28, manufacturer's recommendations, and requirements of this Section.

B. Install temporary shoring before placing deck panels when required to meet deflection limitations.

C. Place deck panels on supporting framing and adjust to final position with ends accurately aligned and bearing on supporting framing before being permanently fastened. Do not stretch or contract side lap interlocks.

D. Place deck panels flat and square and fasten to supporting framing without warp or deflection.

E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to the decking.

F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.

G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.

3.4 ROOF DECK INSTALLATION

A. Fasten roof deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter, but not less than 1-1/2 inches long, and as follows:

1. Weld Diameter: 5/8 inch, nominal.
2. Weld Spacing: Weld edge ribs of panels at each support. Space welds an average of 12 inches apart, with a minimum of two welds per unit at each support.

B. Side Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding 18 inches, using one of the following methods:

1. Mechanically fasten with self-drilling No. 10 diameter or larger carbon steel screws.
2. Fasten with 1-1/2-inch long minimum welds.

C. End Bearing: Install deck ends over supporting framing with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum or butted at Contractor’s option.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof decking, and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld at each corner.

E. Miscellaneous Roof Deck Accessories: Install ridge and valley plates, finish strips, cover plates, end closures, and reinforcing channels according to deck manufacturer's recommendations. Weld to substrate to provide a complete deck installation.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: A qualified independent testing agency employed and paid by Owner will perform field quality-control testing.

B. Field welds will be subject to inspection.

C. Shear connector welds will be inspected and tested according to the requirements of AWS D1.1 for stud welding and as follows:

1. Shear connector welds will be visually inspected.
2. Bend tests will be performed when visual inspections reveal either less than a continuous 360 degree flash or welding repairs to any shear connector.
3. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to the requirements of AWS D1.1.

D. Testing agency will report test results promptly and in writing to Contractor and Architect.

E. Remove and replace work that does not comply with specified requirements.

F. Additional testing will be performed to determine compliance of corrected work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces with galvanized repair paint according to ASTM A 780 and the manufacturer's instructions.

B. Provide final protection and maintain conditions to ensure steel decking is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05310

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Exterior non-load-bearing wall framing.

1.3 PERFORMANCE REQUIREMENTS

A. AISI "Specifications" : Calculate structural characteristics of cold-formed metal framing according to AISI's "Specification for the Design of Cold-Formed Steel Structural Members" and the following:

1.4 SUBMITTALS

A. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

B. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:
   1. Expansion anchors.
   2. Power-actuated anchors.
   3. Mechanical fasteners.

1.5 QUALITY ASSURANCE

A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code-Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

C. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steell Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following members of the SFIA, CSSA, or SSMA:
   1. ClarkDietrich Building Systems.

2. MarinoWare; a division of Ware Industries.
3. Super Stud Building Products, Inc. NY, NJ

2.2 MATERIALS

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
   1. Grade: As required by structural performance.
   2. Coating: G60.

B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: As required by structural performance.
   2. Coating: G90.

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0538 inch.
   2. Flange Width: 1-3/8 inches.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: Matching steel studs.
   2. Flange Width: 1-1/4 inches.

C. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure.

2.4 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.
   2. Bracing, bridging, and solid blocking.
   3. Web stiffeners.
   4. Anchor clips.
   5. Gusset plates.
   6. Stud kickers, knee braces, and girts.
   7. Joist hangers and end closures.
   8. Hole reinforcing plates.
   9. Backer plates.

2.5 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

C. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

E. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.

2.7 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.
   3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
      a. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
   4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
   2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

3 EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Where cold-formed framing attaches to steel with sprayed fire-resistive materials: Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or off-set anchor plates to structural members indicated to receive sprayed fire-resistive materials. Do not attach tracks directly to steel framing members to receive spray fireproofing.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

3.3 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions", ASTM C 1007 and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
   1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
      a. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

H. Install insulation, specified in Division 7 Section "Building Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
   1. Stud Spacing: minimum 16 inches, as required by shop drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing metal framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Install single-leg deflection tracks and anchor to building structure.
   2. Do not install screws from top of studs into deflection track.

E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.5 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05400

SECTION 07210 - BUILDING INSULATION

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 ACTION SUBMITTALS

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

B. Insulation Schedule: provide schedule indicating type, thickness, manufacturer and product number of each insulation to be provided at each location where insulation will be installed.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

C. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Surface-Burning Characteristics: ASTM E 84.
2. Fire-Resistance Ratings: ASTM E 119.
3. Combustion Characteristics: ASTM E 136.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

2 PRODUCTS

A. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Locations: Located between metal studs.
1. Where glass-fiber blanket insulation is indicated by the following thicknesses, provide blankets in batt or roll form with thermal resistances indicated:
   a. 3-1/2 inches thick with a thermal resistance of 13 deg F x h x sq. ft./Btu at 75 deg F.

B. Unfaced Mineral Wool Board Insulation. ASTM C 612, maximum flame-spread and smoke-developed indexes of 25 and 5, respectively; passing ASTM E 136 for combustion characteristics.

1. Location: Behind blanked off louvers. Mechanically anchored to metal panels with stick pins adhered to metal panels. Install between metal studs in roof parapet partitions.
2. Nominal density of 4.0 lb/cu. ft, thermal resistivity of 4.2 deg F x h x sq.ft/Btu x in. at 75 deg F. ASTM C 612 Types 1A, 1B, and II
3. Products: Thermafiber VersaBoard 40 or approved equal

4. Minimum Recycled Content 75%

C. Water Resistant Mineral Wool Fiber Board Insulation: ASTM C 612, maximum flame-spread and smoke-developed indexes of 15 and 0, respectively; passing ASTM E 136 for combustion characteristics; and of the following nominal density and thermal resistivity:
   1. Location: cavities behind brick veneers.
   2. Nominal density of 4.5 lb/cu. ft., Types IA and IB, thermal resistivity of 4.2 deg F x h x sq. ft./Btu x in. at 75 deg F.
   3. Unfaced
   4. Products:
      a. Thermafiber: RainBarrier 45
      b. Roxul: Cavity Rock
      c. Approved Equal

3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for existing conditions, compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.

3.2 PREPARATION

A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

3.3 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

F. Do not piece together small pieces of insulation.

3.4 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
   1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
   2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
   3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation.

3.5 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION **07210**

SECTION 07272 - FLUID-APPLIED MEMBRANE AIR BARRIERS

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Fluid-applied membrane air/moisture barrier, vapor permeable. (Referenced as "air barrier" in this specification). Air Barrier installed over CMU backup wall. Reference Alternate 002: if Masonry wall is deleted, air barrier will also be deleted.

1.3 DEFINITIONS

A. ABAA: Air Barrier Association of America.

B. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to the exterior side of the exterior wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor- permeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

1.5 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.

1.6 QUALITY ASSURANCE

1.7 WARRANTY:

A. Provide a ten year warranty for the system, materials and the application.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store liquid materials in their original undamaged packages in a clean, dry, protected location at temperatures of 40 degrees and rising. Avoid excessive heat.

B. Protect stored materials from direct sunlight.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

2 PRODUCTS

2.1 FLUID-APPLIED MEMBRANE AIR BARRIER

A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: Elastomeric, membrane.

1. Products: Subject to compliance with requirements, provide one of the following. All materials in air barrier assembly to be provided by one manufacturer:
   a. Synthetic Polymer Membrane:
      1) Basis of Design: Henry Company; Air-Bloc 33. Contract Drawing details based on Henry system
      2) Acceptable alternate manufacturer: Grace: Perm-A-Barrier VP
2. Physical and Performance Properties:
   a. Membrane Air Permeance: Not to exceed 0.004 cfm/ sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
   b. Membrane Vapor Permeance: Not less than 10 perms; ASTM E 96.
   c. Assembly Air Permeance at 75 PA (0.3 in. water) Differential Pressure: Less than 0.004 L/s*m2 or less than 0.0008 cfm/ft2; ASTM E 2357.

2.2 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by air barrier manufacturer for intended use and compatible with air barrier membrane. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Adhesive-Coated Transition Strip:

1. Henry Company: Blueskin Breather: Vapor-permeable, 17-mil- (0.43-mm-) thick, self-adhering strip consisting of an adhesive coating over a permeable laminate with a permeance of 37 perms (2145 ng/Pa x s x sq. m).

2. Grace: Perm-A-Barrier VPS

C. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

D. Joint Sealants: for sealant in direct contact with air barrier and for joints between air barrier and other materials: provide sealant by same manufacturer as air barrier.

1. Product: Henry HE925 BES.

2. Comply with requirements of Division 7 Section "Joint Sealants." Reference Joint Sealant specification for backer rod and for installation requirements.

3 EXECUTION

3.1 SURFACE PREPARATION

A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

E. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.2 TRANSITION STRIP INSTALLATION

A. Install strips, transition strips, and auxiliary materials according to air barrier manufacturer's written

instructions to form a seal with adjacent construction and maintain a continuous air barrier.

B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.
   1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

C. Apply joint sealants forming part of air barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

D. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

E. Seal top of masonry through-wall flashings to air barrier with, silicone sealant as specified.

F. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

G. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.3 AIR BARRIER MEMBRANE INSTALLATION

A. Apply air barrier membrane to form a seal with strips and transition strips and to achieve a continuous air barrier according to air barrier manufacturer's written instructions.

B. Apply air barrier membrane within manufacturer's recommended application temperature ranges.

C. Apply a continuous unbroken air barrier to substrates according to the following minimum thickness. Apply membrane in full contact around protrusions such as masonry ties.
   1. Vapor-Permeable Membrane Air Barrier: 45-mil minimum dry film thickness.

D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

3.4 CLEANING AND PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
   1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed for more than 60 days.
   2. Protect air barrier from contact with creosote, uncured coal-tar products, TPO, EPDM, flexible PVC membranes, and sealants not approved by air barrier manufacturer.

END OF SECTION 07272

SECTION 07543 - THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Adhered TPO membrane roofing system.
   2. Substrate boards
   3. Roof insulation.
   4. Cover Boards
   5. Vapor Retarders under roof insulation

B. Related Sections:
   1. Division 7 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counterflashings.

1.3 DEFINITIONS

A. TPO: Thermoplastic polyolefin.

B. Roofing Terminology: See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

B. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.
   1. Corner Uplift Pressure: 45 lbf/sq. ft.

C. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.
   1. Fire/Windstorm Classification: Class 1A-90
   2. Hail Resistance: MH.

1.5 SUBMITTALS

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

B. Shop Drawings: For roofing system. Include job specific plans, elevations, sections, details, and attachments to other work.
   1. Base flashings and membrane terminations.
   2. Tapered insulation, including slopes

C. Qualification Data: For qualified Installer and manufacturer.

D. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies

with requirements specified in "Performance Requirements" Article.

1. Submit evidence of compliance with performance requirements.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.

F. Research/Evaluation Reports: For components of membrane roofing system, from the ICC-ES.

G. Maintenance Data: For roofing system to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed FM Approvals approved for membrane roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

C. Source Limitations: Obtain components including roof insulation for membrane roofing system from same manufacturer as membrane roofing approved by membrane roofing manufacturer.

D. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

E. Fire-Resistance Ratings: Provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

F. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
4. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
   1. Special warranty includes membrane roofing, base flashings, roof insulation, substrate board, and other components of membrane roofing system.
   2. Warranty Period: 20 years from date of Substantial Completion.

2 PRODUCTS

2.1 TPO MEMBRANE ROOFING

A. Fabric-Reinforced Thermoplastic Polyolefin Sheet with Fleeceback: ASTM D 6878, internally fabric or scrim reinforced, uniform, flexible TPO sheet.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Firestone Building Products Company: Fleeceback: Firestone UltraPly TPO
      b. Carlisle: Fleeceback
      c. Approved Equal.
   2. Thickness: 60 mils , nominal.
   3. Exposed Face Color: White.

2.2 AUXILIARY MEMBRANE ROOFING MATERIALS

A. Sheet Flashing: Manufacturer's standard unreinforced thermoplastic polyolefin sheet flashing, 60 mils thick, minimum, of same color as sheet membrane.

B. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.3 SUBSTRATE BOARDS

A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, Type X, 5/8 inch thick.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Georgia-Pacific Corporation; Dens Deck
      b. USG: Securock Glass-Mat Roof Board.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.4 COVER BOARDS

A. Roof Board and Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch thick, factory primed. Boards installed over insulation to receive roof membrane. Board installed at roof-side of parapet to receive roof membrane flashing.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Georgia-Pacific Corporation; Dens Deck Prime.
      b. USG: Securock Gypsum-Fiber Roof Board

2.5 ROOF INSULATION

A. General: Polyisocyanurate preformed roof insulation boards manufactured or approved by TPO

membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Approvals- using an approved roof insulation.

B. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

C. Total tapered insulation to have minimum thickness of 3". Maximum thickness for any individual board layer shall not exceed 2". Multiple layers will be required.

2.6 VAPOR RETARDERS

A. Vapor barrier over Metal Deck: Basis of Design: Carlisle Vap Air Seal MD

2.7 INSULATION ACCESSORIES

A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.

3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
   1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
   2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 SUBSTRATE BOARD

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows a minimum of 12 inches in both directions. Tightly butt substrate boards together.
   1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
   2. Substrate board required where Polyisocyanurate insulation installed over metal deck

3.4 VAPOR RETARDER

A. Install as recommended by Manufacturer.

3.5 INSULATION INSTALLATION

A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install insulation under area of roofing to achieve required thickness. Where overall insulation

thickness is greater than 2 inches, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction. No insulation board should be greater than 2”

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows a minimum of 12”, abutting edges and ends between boards. Gaps exceeding 1/4 inch shall be corrected with replacement boards.

3.6 COVER BOARD INSTALLATION

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together and fasten to roof deck.
   1. Cover board not required at insulating concrete.
   2. Fasten cover boards according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
   3. Install cover board over all Polyisocyanurate insulation to receive TPO Roofing.

3.7 ADHERED MEMBRANE ROOFING INSTALLATION

A. Adhere membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions.

B. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.

C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeter of roofing.

E. Apply membrane roofing with side laps shingled with slope of roof deck where possible.

F. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
   1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane and flashings.

3.8 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

B. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars

C. Where membrane installed over Lightweight Concrete Roof Insulation, provide perimeter venting as required.

3.9 FIELD QUALITY CONTROL

A. Protect completed roof assembly from damage from other trades.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation at beginning of installation, and regular intervals during installation and again on completion.

C. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

D. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 07543

SECTION 07620 - SHEET METAL FLASHING AND TRIM

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Formed Products:
      a. Prefinished metal copings
      b. Metal flashing, counterflashing, receivers and reglets.

B. Related Sections:
   1. Division 4 Section "Masonry" for Self Adhered Membrane Flashings at brick veneer.

1.3 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
   1. Identification of material, thickness, weight, and finish for each item and location in Project.
   2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
   3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
   4. Details of termination points and assemblies, including fixed points.
   5. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
   6. Details of special conditions.
   7. Details of connections to adjoining work.
   8. Detail formed flashing and trim at a scale of not less than 3 inches per 12 inches .

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

2 PRODUCTS

2.1 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Aluminum Sheet: ASTM B 209 , alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.
   1. Surface: Smooth, flat.
   2. Exposed Coil-Coated Finishes:
      a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   3. Color: Match existing building.
   4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
   1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
      a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
      b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
   2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel. Provide neoprene gaskets between aluminum sheet metal flashing/coping and stainless steel fasteners.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight. Provide butyl sealant for concealed splices in metal copings/flashings where “liquid” sealant is required.

2.3 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
   1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
   2. Obtain field measurements for accurate fit before shop fabrication.
   3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Underlayment: all metal flashings, copings, gravel stops, scuppers etc. should be provided with underlayment. The metal should never be installed in direct contact with wood blocking or metal deck. In the case of the membrane roofs the membrane will typically be extended over and completely cover the wood parapet blocking

1. TPO Roof Membrane where possible.

2. At locations where it is not possible to continue roof membrane: Self-adhered composite membrane underlayment: “Blueskin” PE 200HT as manufactured by the Henry Company.

C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.

E. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

G. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

H. Do not use graphite pencils to mark metal surfaces.

2.4 SHEET METAL FABRICATIONS

A. Copings: Fabricate in minimum 96-inch- long, but not exceeding 10-foot- long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.
1. Joint Style: Butt, with 12-inch- wide, concealed backup plate.
2. Fabricate from the following materials:
a. Aluminum: 0.050 inch thick. Copings painted: colors as indicated.

B. Base Flashing, Metal Through Wall Flashing, Corrosion Resistant Continuous Metal Flashing, metal flashings to support Flexible Membrane Masonry Flashing: Fabricate from the following materials:
1. Stainless Steel: 0.019 inch thick.

C. Flashing Receivers and Counterflashing: Fabricate from the following materials:
1. Stainless Steel: 0.019 inch thick.

3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to

performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
   1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
   2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
   3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
   4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
   5. Install sealant tape where indicated.
   6. Torch cutting of sheet metal flashing and trim is not permitted.
   7. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
   1. Coat back side of uncoated aluminum sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of membrane roofing or Impervious Membrane as a separator.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate wood blocking not less than 3/4 inch for wood screws.

E. Seal joints as shown and as required for watertight construction.
   1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F .
   2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.
   1. Do not solder aluminum sheet.

3.3 ROOF FLASHING INSTALLATION

A. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.
   1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-

inch centers.

2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.

3.4 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.5 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07620

SECTION 07811 – SPRAYED FIRE RESISTIVE MATERIALS

1. GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this Section.

1.2 SUMMARY:

A. This Section includes the following:
   1. Exposed sprayed-on fireproofing.

1.3 SUBMITTALS:

A. Product Data for each sprayed-on fireproofing product indicated.

B. Test Data:
   1. Independent test reports confirming that materials meet or exceed performance criteria specified.
   2. Reports from an approved independent testing agency of material proposed for use, indicating conformance to ASTM E84 and E119.

C. Product Certificates:
   1. Certificate from fireproofing manufacturer that each sprayed-on fireproofing product indicated for the Project complies with specified requirements including those for fire-test-response characteristics and compatibility with adhesives, primers, and other surface coatings on substrates indicated to receive fireproofing.
   2. Certificate from fireproofing manufacturer that each sprayed-on fireproofing product indicated has been approved for the required application by all authorities having jurisdiction.

1.4 QUALITY ASSURANCE:

A. Work provided by Contractor having minimum 2 years experience on project comparable to this project.

B. Contractor licensed by manufacturer of material approved for use. Materials and application equipment application/methods approved by manufacturer.

C. Materials tested and listed by Underwriters Laboratories to meet required ratings and performance for assemblies shown on conform to applicable requirements of authorities having jurisdiction.

1.5 DELIVERY, STORAGE AND HANDLING:

A. Deliver materials to project in manufacturers unopened containers, fully identified as to trade name, grade and other identifying data and bearing the UL label where required.

B. Store materials above ground indoor, and in a dry location protected from weather.

C. Damaged packages found unsuitable for use shall be removed from project.

1.6 PROJECT CONDITIONS:

A. Environmental Conditions: Ambient and substrate temperature of 40 degrees F. or above shall be required for 24 hours before and 24 hours after application as well as during application.

B. Ventilation: Ventilate sprayed-on fireproofing by natural means or, where this is inadequate, forced-air circulation during and after application until fireproofing dries thoroughly.

1.7 REFERENCE STANDARDS:

A. ASTM E84: Test for Surface Burning Characteristics of Building Materials.

B. ASTM E119: Fire Tested of Building Construction and Materials.

C. ASTM E605: Thickness and Density of Sprayed Fire-Resistive Material Applied.

D. ASTM E736: Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members.

E. ASTM E759: Effect of Deflection of Sprayed Fire-Resistive Materials Applied to Structural Members.

F. ASTM E760: Impact on Bonding of Sprayed Fire-Resistive Materials Applied to Structural Members.

G. ASTM E761: Compressive Strength of Sprayed Fire-Resistive Materials Applied to Structural Members.

H. ASTM E859: Air Erosion of Sprayed Fire-Resistive Materials Applied to Structural Members.

I. ASTM E937: Corrosion of Steel by Sprayed Fire-Resistive Materials Applied to Structural Member.

1.8 SEQUENCING:

A. Sequence and coordinate application of sprayed-on fireproofing with other related work specified in other Sections to comply with the following requirements:

B. Do not begin applying fireproofing until clips, hangers, sleeves, and other items penetrating fireproofing are in place.

C. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until fireproofing is installed.

D. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, tested, and corrections have been made to any defective fireproofing.

1.9 WARRANTY:

A. General: The warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

B. Warranty: Submit a written warranty, executed by Contractor and cosigned by the Installer, agreeing to repair or replace sprayed-on fireproofing that has fallen off or been removed during construction. Failures include but are not limited to the following:
   1. Cracking, flaking, eroding in excess of specified requirements, peeling, and delaminating of sprayed-on fireproofing from substrates due to defective materials and workmanship.
   2. Not covered under the warranty are failures attributable to damage by occupants and Owner's maintenance personnel.

C. Warranty Period: Two years from date of Substantial Completion.

2. PRODUCTS

2.1 MANUFACTURERS/PRODUCTS

A. GCP Applied Technologies; Monokote Z-106 HY.

B. Isolatek International, Cafco 400.

2.2 MATERIALS

A. Cementitious Type: Factory mixed cementitious materials with approved aggregate.

B. Material shall be type which can be applied to painted or unpainted steel.

C. Water: Clean, fresh and free from organic and mineral impurities.

2.3 FIRE HAZARD CLASSIFICATION:

A. In conformance with ASTM E84.

B. Flame spread: 10 or less.

C. Smoke developed: 0.

2.4 PERFORMANCE CRITERIA

A. Material applied to provide compliance with manufacturer's specified performance specification and test criteria.
   1. Dry density: The field density measured and reported in accordance with ASTM E605.
   2. Deflection: Material shall not crack or delaminate when tested in accordance with ASTM E759. Deflection 1/120 of the span.
   3. Impact resistance: Fireproofing materials tested in accordance with ASTM E760 shall not crack or delaminate.
   4. Cohesion/adhesion strength: Fireproofing, when tested in accordance with ASTM E736, will have minimum bond strength of 200 psf.
   5. Air Erosion: Maximum allowable weight loss of the fireproofing material is .025 gm/sq. ft. when tested in accordance with ASTM E859.
   6. Compression: Compression strength shall be 500 psf. or greater when tested in accordance with ASTM E761. Maximum 10 percent deformation at 500 psf.
   7. Corrosion resistance: Steel shall be tested in accordance with ASTM E937 without evidence of corrosion of the steel.

B. Fire Resistance Rating
   1. Fire resistance rating shall be in accordance with requirements as specified herein. Tests conducted in accordance with approved criteria.
   2. Hourly rating requirements: See drawings fire protection drawings and partition types for required hourly ratings.
   3. Materials applied shall be non-combustible in accordance with ASTM E136.
   4. Applied thickness in conformance with UL Laboratories and manufacturer's specific approved test criteria for hourly rating design requirements for fireproofing material type.
   5. Material density in conformance with manufacturer's specific approved test criteria for hourly rating design requirements for fireproofing material type.

3. EXECUTION

3.1 INSPECTION

A. Examine all surfaces and conditions to which application of material will occur.

B. Cooperate in the coordination and scheduling with work of other section.

C. Clips, hangers, supports, sleeves, connections and other attachments to fireproofing bases under other sections shall be installed prior to application of fireproofing material.

D. Ducts, piping, conduit and other suspended equipment that may interfere with uniform application of material shall be positioned after fireproofing application, unless otherwise indicated in such cases continuity of fireproofing shall be maintained.

E. Prior to material application, Contractor shall conduct an inspection to verify that all substrate surfaces are acceptable to receive fireproofing material. Clean all grease from substrate before application of spray fireproofing.

3.2 SURFACE PREPARATION:

A. Before application, clean all surfaces of any material that would cause adhesion problems.

3.3 PROTECTION OF ADJACENT SURFACES:

A. All finished surfaces on adjoining surfaces shall be protected by masking or other suitable protection.

3.4 INSTALLATION

A. Application shall not commence until certification from application or attesting surfaces have been inspected by applicator and are acceptable to applicator to receive fireproofing materials.

B. Equipment, mixing and application shall be in accordance with manufacturer's specification and application instruction.

C. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.

D. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

E. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
   1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
   2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.

F. Extend material full thickness over entire substrate in monolithic blanket of uniform texture.

G. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.

H. Add a blue dye to the topcoat to determine when the installation is complete.

3.5 PATCHING:

A. Provide all patching and repairing and sprayed fireproofing material in areas where original application was damaged or removed by work of other trades. Restore to full thickness and fire rating.

3.6 CLEANING AND REPAIR:

A. After completion of work, Contractor shall remove sweep and clean all adjoining surfaces of over-spray and fallout deposits of sprayed fireproofing materials.

B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing will be without damage or deterioration at time of Substantial Completion.

C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.

D. Repair or replace work that has not been successfully protected.

END OF SECTION 07811

SECTION 07920 - JOINT SEALANTS

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PERFORMANCE REQUIREMENTS

A. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.3 SUBMITTALS

A. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

B. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

D. Qualification Data: For Installer.

E. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
   1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
   2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

F. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
   2. When joint substrates are wet.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.5 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Three years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Three years from date of Substantial Completion.

C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint

sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.

2 PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

D. Consult the manufacturer’s technical representative for recommendations on the type of sealant most suitable for the project conditions and each substrate. Conduct preconstruction and field testing of the sealant to confirm sufficient adhesion to the materials used on this project.

E. Single-Component Neutral-Curing Silicone Sealant: Use for vertical and horizontal joints, around doors and windows, and other exterior locations.

1. Products:
   a. Dow Corning Corporation; 790.
   b. GE Silicones; SilPruf LM SCS2700.
   c. GE Silicones; SilPruf SCS2000.
   d. Pecora Corporation; 864.
   e. Pecora Corporation; 890.
   f. Polymeric Systems Inc.; PSI-641.
   g. Sonneborn, Division of ChemRex Inc.; Omniseal.
   h. Tremco; Spectrem 3.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 100/50.
4. Use Related to Exposure: NT (nontraffic).

2.3 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.4 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

3 EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
   a. Metal.
   b. Glass.
   c. Porcelain enamel.
   d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. Install sealants using proven techniques that comply with the following and at the same time

backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration , unless otherwise indicated.
4. Provide flush joint configuration where indicated
5. Provide recessed joint configuration of recess depth and at locations indicated on the drawings
    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

H. Installation of Preformed Tapes: Install according to manufacturer's written instructions.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION **07920**

SECTION 09111 - NON-LOAD-BEARING STEEL FRAMING

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes non-load-bearing steel framing members for the following applications:
   1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).

B. Related Sections include the following:
   1. Division 7 Section "Building Insulation" for insulation.
   2. Division 9 Section "Gypsum Board" for interior gypsum board.

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

2 PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
   1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.

2.2 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. Steel Studs and Runners: ASTM C 645.
   1. Minimum Base-Metal Thickness: 0.0312 inch.
   2. Depth: As indicated on Drawings 3-5/8 inches and 6 inches.
   3. Provide deep leg bottom tracks: 2” vertical leg for bottom tracks.

B. Dimpled Steel Studs and Runners: ASTM C 645.
   1. Design Thickness: 0.0312 in.
   2. Minimum Thickness: 0.0296 in
   3. Steel Strength: 33 ksi
   4. Basis of Design: ClarkDietrich ProStud 30
   5. Depth: As indicated on Drawings
   6. Provide deep leg bottom tracks: 2” vertical leg for bottom tracks.

2.3 Top Runner Track
   1. Single Runner System: ASTM C 645 top runner with 2-inch deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing. .
   2. Provide diagonal stud bracing up to and attach to ceiling construction at 6 foot intervals to stabilize the top track..

B. Cold-Rolled Channel Bridging: 0.0538-inch bare-steel thickness, with minimum 1/2-inch wide flanges.
   1. Depth: 1-1/2 inches.

C. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base Metal Thickness: 0.0179 inch.
2. Depth: 7/8 inch.

D. Resilient Furring Channels: 1/2-inch deep, steel sheet members designed to reduce sound transmission.

E. Cold-Rolled Furring Channels: 0.0538-inch bare-steel thickness, with minimum 1/2-inch wide flanges.

F. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

3 EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Installation of studs at exterior wall shall follow installation of exterior insulation and vapor barrier. Demising partition framing shall not extend into area to receive exterior insulation.

B. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.
1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.3 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install felt paper isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.
1. Space studs as follows:
a. Single-Layer Application: 16 inches o.c., unless otherwise indicated.
b. Multilayer Application: 16 inches o.c., unless otherwise indicated.
c. Tile backing panels: 16 inches o.c., unless otherwise indicated.

C. Install tracks (runners) at floors and overhead supports. Extend framing to height of 14’ above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling. Provide bracing up to structure as noted above.
1. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

D. Direct Furring:
1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

E. Z-Furring Members:

1. At outer corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At inner corners, space second member no more than 12 inches from corner and cut insulation to fit.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION **09111**

SECTION 09250 - GYPSUM BOARD

1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Interior gypsum board.
   2. Joint treatment.

B. Related Requirements:
   1. Division 07 Section ‘Building Insulation' for insulation installed in assemblies that incorporate gypsum board.
   2. Division 9 Section "Non-Load-Bearing Steel Framing" for metal studs and ceiling suspension systems

1.3 ACTION SUBMITTALS

A. Product Data.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging. Remove plastic packaging according to manufacturer's recommendations.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install paper faced interior gypsum panels until building installation areas are enclosed and conditioned. If approved by Architect, moisture and mold resistant gypsum panels may be used prior to building readiness as long as MR panels meet Type X rating.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
   3. Wet and moldy products are to be removed immediately from the job site including any adjacent materials directly in contact with the product even if no damage is visible to the adjacent product. Remediate the source of water damage and notify the architect.

2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Airtight Assemblies: For gypsum board assemblies along all exterior walls, provide materials and construction to deliver an airtight enclosure that envelops the existing exterior wall assembly, insulation, supporting structure and any penetrations.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

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

1. American Gypsum.
2. CertainTeed Corp. / BPB America Inc.
3. Georgia-Pacific Gypsum LLC.
4. Lafarge North America Inc.
5. National Gypsum Company.
6. Temple.
7. USG Corporation.

B. Fiberglass Faced Interior Panels
   1. Core: Moisture Resistant, 5/8 inch Type X
   2. Long Edges: Tapered.
   3. Products:
      a. National Gypsum: Gold Bond eXP Interior Extreme
      b. Georgia Pacific: DensArmor Plus

C. Interior Trim: ASTM C 1047.
   1. Material: Paper-faced galvanized steel sheet.
   2. Products: Basis of Design: USG Sheetrock, substitutions as approved by Architect
   3. Shapes:
      a. 90 deg Outside Cornerbead, Micro Bead.
      b. Offset Outside Corner, B1 OS.

D. Interior Trim: ASTM C 1047.
   1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
   2. Shapes:
      a. Bullnose bead.
      b. LC-Bead: J-shaped; exposed long flange receives joint compound.
      c. Expansion (control) joint.
      d. Reveal trim

2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Compound and Joint Tape:
   1. Fiberglass Faced Interior Panels:
      a. Tape: fiberglass mesh, 1.9" minimum width.
      b. Compound: setting type
         1) Basis of Design: National Gypsum, Proform Quick Set Setting Compound.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
   1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
   1. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
   1. As specified in Division 7 Section "Joint Sealants".
   2. Acoustical joint 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. Thermal Insulation: As specified in Division 7 Section "Building Insulation."

3 EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

C. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

D. Form control and expansion joints with space between edges of adjoining gypsum panels.

E. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc., except in chases braced internally.
   1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
   2. Fit gypsum panels around ducts, pipes, and conduits.
   3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

F. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 3/8-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant. Provide 1/4" gap between floor and bottom of panels.

G. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:
   1. Wallboard Type: Vertical surfaces unless otherwise indicated.

3.4 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
   1. Provide control joints in walls and ceilings at maximum of 30’.
   2. Control joints in walls should typically be located at corners of door frames.

C. Interior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners unless otherwise indicated.
   2. Bullnose Bead: Use where indicated.
   3. LC-Bead: Use at exposed panel edges.
   4. L-Bead: Use where indicated.
   5. U-Bead: Use at exposed panel edges.

3.5 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations,

fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape and compound over gypsum board joints, except for trim products specifically indicated as not intended to receive tape. For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
   1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use taping compound.
   2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use taping compound.
   3. Fill Coat: For second coat, sandable topping.
   4. Finish Coat: For third coat, sandable topping.
   5. Skim Coat: For final coat of Level 5 finish, sandable topping compound

D. Joint compounds at different substrates: At locations where the tape and joint compound are applied between two different substrates, follow the below.
   1. Gypsum board and moisture resistant board: Setting Compound.
   2. Moisture resistant board and cement board: Setting Compound.

E. Gypsum and Cement Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
      a. Primer and its application to surfaces are specified in other Division 9 Sections.

3.6 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION **09250**

SRMC CENTRAL POWER BUILDING

SBM PROJECT NO.17055

MECHANICAL SPECIFICATIONS

230500	Common Work Results for HVAC
230501	Basic HVAC Materials and Methods
230519	Piping and Equipment Specialties
230523	General Duty Valves and Strainers
230529	Hangers, Supports and Anchors
230548	Vibration and Seismic Controls for HVAC Piping and Equipment
230593	Testing, Adjusting and Balancing
230701	Duct Insulation
230702	Pipe Insulation
230900	Electric Control Systems
230910	Building Automation Systems
232113	Hydronic Piping
232300	Refrigerant Piping
233113	Metal Ductwork and Accessories
238119	Environmental Conditioning Units (ECU-1&2 Base Bid)
238120	Environmental Conditioning Units (ECU-1&2 Alternate 1)
238121	Environmental Conditioning Units (ECU-3)

ELECTRICAL SPECIFICATIONS

260100	Basic Electrical Requirements
260500	Basic Electrical Materials and Methods
260519	Conductors and Cables
260526	Grounding
260529	Supporting Devices
260533	Raceways and Boxes
260553	Electrical Identification
262726	Wiring Devices
262813	Fuses
262816	Disconnect Switches

SECTION 230500 – COMMON WORK RESULTS FOR HVAC

1. GENERAL

1.1 GENERAL REFERENCE

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

B. Refer to Division 01 section "Alternates" for possible alternates affecting the extent of this Section of work.

C. This Contractor is also referred to the Architectural, Structural, Electrical and all other drawings and specifications pertinent to this project. All of the above mentioned drawings and specifications are considered a part of the Contract Documents.

D. This section specifies the basic requirements for mechanical installations and includes requirements common to more than one section of Division 23. It expands and supplements the requirements specified in sections of Division 01.

1.2 DEFINITIONS

A. The term "Contractor" as applied to work specified, shown or reasonably implied in the contract documents for Division 23 shall be defined as the subcontractor who is responsible for the work specified or indicated. All subcontracted work must be incorporated by and coordinated by the prime contractor.

B. Throughout this specification section the term “Design Professional” is referenced. The specification calls for certain actions to be undertaken or referred to the Design Professional. Accordingly, the term “Design Professional” shall be defined as the firm with which the “Owner” has contracted to produce the contract drawings and specifications. It shall be understood that the Design Professional for this project is the Architect whose name is shown on the drawing title block.

1.3 MECHANICAL COORDINATION

A. This Contractor shall familiarize himself with the work to be done under other Divisions of this specification and their related drawings and shall so coordinate and schedule his work as not to cause delays or interference with the work of others. Such coordination and scheduling shall accomplish the installation of equipment and piping with a minimum of cutting through masonry and other adjustments.

B. Ceiling grid systems shall not be supported from ductwork, heating or plumbing lines or any other utility lines, and vice versa. Each utility and the ceiling grid system shall be a separate installation and each shall be independently supported from the building structure-concrete, steel or masonry. Where interferences occur, in order to support ductwork, piping, ceiling grid systems, etc., trapeze type hangers or supports shall be employed which shall be located so as not to interfere with access to such mechanical equipment as valves, regulators, VAV or reheat terminals, fire dampers, etc.

C. This Contractor shall be responsible for proper size and location of anchors, chases, recesses, openings, etc., required for the proper installation of his work. Verify all dimensions by field measurements. Coordinate the installation of required supporting devices and sleeves in structural components as they are constructed. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work.

D. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing. Extend all grease fittings to an accessible location. Install equipment to facilitate maintenance and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with a minimum of interference with other installations.

E. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

F. Specific divisions of responsibility when coordinating with trades other than mechanical shall be as indicated on drawings, in Division 01, and as follows:

1. Each Contractor under this division shall provide and place all sleeves in floors, walls, etc., and coordinate such location.

1.4 EXAMINATION OF SITE

A. Before submitting a bid, each Contractor is requested to visit the job site to familiarize himself with construction conditions. No consideration or remuneration will be given for his failure to do so.

1.5 DIVISION 23 DESIGN DOCUMENTS

A. Should it appear that there is a discrepancy between or within the drawings and/or specifications concerning the nature, quality or extent of materials or work to be furnished and/or installed, and such discrepancy is not clarified by Addendum during the bidding period, this Contractor shall base his bid on performing the work in the manner having the higher cost. The Design Professional shall have the option of selecting either of the manners shown and/or specified. In the event the lower cost manner is selected, a credit shall be due the Owner in the amount of the difference between the lower cost and higher cost manner. Any discrepancies shall be called to the attention of the Design Professional before proceeding with work affected thereby.

B. Should it appear that there is a duplication on the drawings or in the specifications, wherein the same work or items are shown or specified as being provided under separate subcontracts or supply orders, and such duplication is not clarified by addendum during the bidding period, it shall be assumed that the responsible prime contractor will select and coordinate which subcontract will supply the item and the item will be supplied as indicated. Occasionally, certain references may be indicated on the Drawings to items which are suggested to be furnished and/or installed by various subcontractors. This is done to assist the applicable Prime Contractor in organizing his subcontractor's bids. However, no attempt has been made, nor is it implied, that this specification or plans are attempting to specifically divide all responsibilities for subcontractors. It is the Prime Contractor's responsibility that all items covered on mechanical plans and Division 23 specifications are included in his bid and are coordinated with his subcontractors. No consideration will be given for Prime Contractor's failure to include all applicable mechanical work in his bid.

C. The design drawings, as submitted, are diagrammatic and are not intended to show exact location of equipment, piping and ductwork unless dimensions are given. Drawings are not to be scaled.

1. Equipment shall be installed along the general arrangement indicated on the drawings, and in accordance with the manufacturer’s instructions.

a) Provide at least the minimum manufacturer’s recommended and code required clearance around the equipment for normal maintenance.

b) Locate and arrange equipment in relationship to other system components to assure that the equipment will be operating under the best possible conditions to meet the scheduled performance requirements.

2. Piping and ductwork are to be installed along the general plans shown on the drawings keeping in mind the constraints of the available space and the need to coordinate with the work of other trades. Additional offset and fittings shall be provided as necessary to meet space constraints and to facilitate the work of other trades.

a) Recognizing the potential need for additional offsets and fittings in piping and ductwork, the Engineer has included a safety factor in all friction calculations. The Contractor is advised to plan and coordinate his work carefully to minimize the need for additional offsets and fittings. The Contractor shall be responsible to notify the Engineer of any and all modifications to systems which may affect the ability of equipment to serve its intended use prior to the purchase and installation of such equipment.

D. All equipment, piping and material specified hereinafter as shown on the drawings shall be furnished and installed by this Contractor, unless specifically indicated to the contrary.

E. If this Contractor proposes to install equipment requiring space conditions other than those as specified and/or shown on the design drawings, or to rearrange the equipment, he shall assume full responsibility for the rearrangement of the space and shall obtain the full approval of the Design Professional before proceeding with the work.

1.6 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements of this division, and in Division 01.

B. This Contractor shall record all changes from original design drawings which were made during the installation of the work. These changes shall be recorded in red ink on a designated set of prints. Changes shall be accurately dimensioned and/or drawn to scale.

C. This Contractor shall keep an updated set of specifications and prints, including changes on the job site, at all times and shall submit one (1) set of updated and legible prints to the Design Professional when the work is complete.

1.7 SHOP DRAWINGS

A. Refer to the conditions of the Contract (General and Supplementary) and Division 01 Section: Shop drawings, product data, and samples for submittal definitions, requirements, and procedures.

B. This Contractor shall review, stamp and sign with his approval and submit, with reasonable promptness and in orderly sequence so as to cause no delay in the work or in the work of any other Contractor, all submittal information required by the contract documents. Shop drawings not stamped with Contractor approval will be returned for reprocessing.

1. In approving the submittals, the Contractor guarantees that the submittals accurately and completely represent the equipment and materials to be installed.

2. Shop drawings shall be submitted for ALL material items as outlined in these specifications. Any deviations from contract requirements must be clearly indicated on shop drawings, and justification for their consideration must be included.

3. Acceptance of submittal items will not preclude rejection of those items upon later discovery that their suitability for the application or ability to meet the requirements of these specifications was misrepresented in the submittals.

4. Submittals for equipment shall include detailed dimensional drawings which completely and accurately represent the specific piece of equipment to be supplied. When more than one piece of similar equipment is to be supplied, provide accurate dimensional drawings for each unique size and/or configuration of the equipment.

C. In checking shop drawings, the Design Professional will make every effort to detect and correct errors, omissions and inaccuracies in such drawings, but his failure to detect errors, omissions and inaccuracies shall not relieve the Contractor of responsibility for the proper and complete installation in accordance with the intent of the Contract Documents.

D. Submit shop drawings to the Design Professional. The prints shall contain a blank 6" x 3" area for Engineer's stamp. Shop drawings which do not contain a blank space for Engineer's approval stamp will be returned for reprocessing. The Architect and Engineer shall each retain one (1) print and return the remainder to the Contractor who shall print and distribute copies as required to properly conduct the work; including requirements of the operating manual.

1.8 EQUIPMENT

A. Before entering into a contract, the successful bidder may be required to submit satisfactory evidence to show that the manufacturer of all parts of the equipment offered have been regularly engaged in the manufacture of such equipment for three (3) years and have not less than three (3) installations of a similar type which have been in successful operation under conditions similar to those specified for not less than two (2) years.

B. When two or more items of same equipment are required (plumbing fixtures, pumps, valves, etc.) they shall be of the same manufacturer.

C. In placing his bid, the Contractors under this Division shall take note that manufacturer’s products change frequently, and only the scheduled products have been checked by the Engineer for compliance with the Contract Documents and physical characteristics. Other manufacturers are listed because they are believed to be capable of complying, and in order to achieve fair and competitive bidding. However, it is the responsibility of the manufacturer in his relationship with the Contractor to bid to the Contractor only products complying with the Contract Documents, and the responsibility of the Contractor to base his bid only on manufacturers which do comply. No consideration will be given to the Contractor for his failure to do this. Should Contractors during the bidding process discover that listed manufacturers cannot comply with the Documents, they are encouraged to contact the Engineer as soon as practical, and provided sufficient time in the bidding process exists, and the Engineer agrees with the request, the Engineer will attempt to adjust the documents in the addendum process. If no addendum is issued adjusting the requirements so that all listed manufacturers can bid, the Contractor will be required to supply one of the listed manufacturers which comply with the Contract Document requirements.

1.9 SUBSTITUTIONS

A. Refer to the Instructions to Bidders and the related Division 01 sections for requirements in selecting products and requesting substitutions.

1.10 CODES AND PERMITS

A. All equipment, materials, and installation shall comply with the National Fire Protection Association's "National Fire Codes" and "National Electrical Code". Equipment shall bear the "UL" label as required by these codes.

B. Install work in full accordance with rules and regulations of State, County and City authorities having jurisdiction over premises. This shall include safety requirements of Ohio State Department of Industrial Relations. Do not construe this as relieving Contractor from compliance with any

requirements of specifications which are in excess of Code requirements and not in conflict therewith. Sanitary waste and vent piping indicated may, in some instances, exceed code requirements. If drawings indicate individual wastes for each fixture, the drawings shall hold precedent over the Code as long as pipe sizing equals or exceeds prescribed waste and vent Code minimums.

C. Unless otherwise indicated, secure and pay for all permits and certificates of inspection incidental to this work required by foregoing authorities. Be responsible for payments to all public utilities for work performed by them in connection with provision of service connections required under this DIVISION of specifications. Deliver all certificates to Design Professional in duplicate.

1.11 INTERFERENCES

A. Before installing any work, this Contractor shall see that it does not interfere with clearance required for finish on beams, columns, pilasters, walls or other structural or architectural members, as shown on Architectural Drawings. If any work is so installed and it later develops that Architectural design cannot be followed, Contractor shall, at his own expense, make such changes in his work as the Design Professional may direct to permit completion of Architectural work in accordance with plans and specifications.

B. Install additional offsets on piping or ductwork where required to obtain maximum headroom or to avoid conflict with other work without additional cost to the Owner. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.

C. Report any interferences between work under this division and that of any other Contractors to the Design Professional as soon as they are discovered. The Design Professional will determine which equipment shall be relocated, regardless of which was first installed, and his decision shall be final.

1.12 SHOP AREAS AND MATERIAL STORAGE

A. No mechanical related trade is permitted to use as shop working area, any concrete slab that is to receive metallic waterproofing, asphalt tile, plastic tile, etc., except by express permission of the Design Professional.

B. The Contractor shall make provisions for the delivery and safe storage of his materials and equipment in coordination with the work of others. Materials and equipment shall be delivered at such stages of the work as will expedite the work as a whole and shall be marked and stored in such a way as to be easily checked and inspected. The arrival and placing of large equipment items shall be scheduled early enough to permit entry and setting when there is no restriction or problem due to size and weight.

1.13 CLEAN-UP

A. Refer to the Division 01 for general requirements for project cleaning.

B. Insofar as the Mechanical work is concerned, at all times keep premises and building in neat and orderly condition follow explicitly any instructions of Design Professional in regard to storing of materials, protective measures, cleaning-up of debris, etc.

C. Upon completion of work this Contractor shall thoroughly clean all apparatus furnished by him, pack all valves and thoroughly clean piping, ductwork, fixtures, and equipment removing all dirt, grease and oil.

D. Air systems shall not be operated without filters. Upon completion of work replace all filters.

1.14 OPERATING AND MAINTENANCE

A. This Contractor shall furnish competent personal instruction to the Owner's operating personnel for a period of hours as indicated in individual Division 23 specification sections in the proper operation of the mechanical equipment. He shall also supply the Owner with three (3) hardbound copies of an operation manual containing the following:

1. Step-by-step procedures for start-up and shutdown for each system and piece of equipment.
2. Performance data, curves, ratings.
3. Wiring diagrams.
4. Manufacturer's descriptive literature.
5. Manufacturer’s model and serial numbers for each piece of equipment.
6. Automatic controls with diagrams and written sequence of operation.
7. Manufacturer's maintenance and service manuals.
8. Spare parts and replacement parts list for each piece of equipment.
9. Name of service agency and installer complete with an emergency service phone number for nights, weekends and holidays.
10. Final approved shop drawings.
11. Final approved balance reports.

1.15 WARRANTIES

A. Refer to the Division 01 Section: Specific Warranties for procedures and submittal requirements for warranties. Refer to individual equipment specifications for additional warranty requirements.

B. This Contractor shall warranty all materials, workmanship and the successful operation of all equipment and apparatus installed by him for a period of one year from the date of the final acceptance of the entire work and shall guarantee to repair or replace at his own expense any part of the apparatus which may show defect during that time provided such defect is, in the opinion of the Design Professional, due to imperfect material or workmanship and not to carelessness or improper use. Compile and assemble the warranties specified in Division 23 into a separated set of vinyl covered three-ring binders, tabulated and indexed for easy reference.

1.16 TEMPORARY SERVICES

A. Permanent equipment may not be used for temporary (construction period) services only as directed by the Design Professional. Any permanent equipment used, shall be maintained by this Contractor. Owner's warrantee period shall not begin until final acceptance of the completed system.

1.17 PROTECTION OF WORK AND PROPERTY

A. The Contractor shall be responsible for safeguarding work, property and facilities against damage, both his own as well as others, with which he may come into contact in the performance of his work.

B. Stored materials shall be protected against damage from weather. Pipe and duct openings shall be closed with caps or plugs during installation. All fixtures and equipment shall be covered and protected against injury. Any materials or equipment damaged at any stage in the construction shall be replaced or repaired, and at the final completion of all work shall be in a clean, unblemished condition.

1.18 CUTTING AND PATCHING

A. Refer to the Division 01 Section: CUTTING AND PATCHING for general requirements for cutting and patching.

B. Do not endanger or damage installed Work through procedures and processes of cutting and patching. Arrange for repairs required to restore other work, because of damage caused as a result of mechanical installations. No additional compensation will be authorized for cutting and patching Work that is necessitated by ill-timed, defective, or non-conforming installations.

C. Each contractor under this division shall perform cutting, fitting, and patching of building components and mechanical equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work;

2. Remove and replace defective Work;

3. Remove and replace Work not conforming to requirements of the Contract Documents;

4. Remove samples of installed Work as specified for testing;

5. Install equipment and materials in existing structures;

6. Upon written instructions from the Design Professional, uncover and restore Work to provide for Design Professional observation of concealed Work.

D. See other sections of this specification for demolition requirements.

E. Pipe holes in floors and walls shall be core drilled if not sleeved during construction.

1.19 INTERRUPTION OF SERVICE

A. When work progress makes temporary shutdown of services unavoidable, shutdown shall be coordinated with and approved by Owner so as to cause minimum disruption to established operating routine. Arrange to work as necessary to re-establish service within shortest possible down time. In those instances where the length of time required for the service interruption is not acceptable to the Owner, unless otherwise indicated, furnish and install temporary connections as required to reduce the length of time of service interruption to an acceptable level.

2. ___PRODUCTS (Not Applicable to this Section)

3. ___EXECUTION

3.1 TESTS AND ADJUSTMENTS

A. Upon completion of the erection of all equipment and all work specified herein and/or shown on approved drawings, or at such times as directed by the Design Professional, this Contractor shall start all apparatus, make necessary tests as directed and as specified herein and make complete adjustments of all items of equipment before acceptance by the Design Professional to whose representative this Contractor shall demonstrate (by performance) all of the various apparatus and equipment.

B. This Contractor is referred to Section 230593 "Testing, Adjusting, and Balancing for HVAC" for additional information and requirements. Cooperate fully with the AABC Balancing Contractor to achieve a successful balance. Any and all adjustments to equipment including fan sheave replacement shall be the responsibility of this Contractor. Required adjustments shall be made during the course of the balancing procedure; the final balance report must reflect the best possible performance of the systems.

C. When the Contractor is ready to run capacity tests, he shall notify the Design Professional. When this notice is given, the Design Professional will assume that the Contractor has made preliminary tests and is satisfied that the plant will develop specified and guaranteed capacities. It will be the Contractor's responsibility to furnish any and all instruments required to obtain test data which shall include thermometers, electric meters, pressure gages, etc.

D. Work under this division of the specifications shall not be considered complete until the Contractor has obtained required inspection, performance tests, made necessary adjustments and has submitted satisfactory evidence of compliance. The Design Professional or his representative will make spot checks to determine the accuracy and completeness of final adjustments. Should spot checks indicate more than a reasonable deviation from design requirements, the Contractor shall repeat tests and adjustments to the satisfaction of the Design Professional.

E. After or during one complete heating and cooling season, the HVAC Contractor shall make any minor adjustments that may be necessary to ensure uniform temperatures throughout the spaces.

F. During the testing and balancing period, this Contractor shall maintain on the job a competent individual thoroughly familiar with all phases of air conditioning, including refrigeration, temperature control, air and water distribution, for as long a period as may be required to thoroughly adjust all of the systems and to demonstrate to the Design Professional that they are functioning properly.

3.2 PUNCHLISTS

A. From time to time throughout the course of the work, or upon completion of the work the Design Professional may perform site observations resulting in written documentation of deviations in the work from the Contract Documents. In such cases the Contractor shall respond in writing to each and every item on this written documentation stating the specific action taken to remedy the deviation. A response shall be provided by the Contractor for each separate observation. This work shall not be considered complete until such satisfactory written response is received by the Design Professional.

END OF SECTION 230500

SECTION 230501 – BASIC HVAC MATERIALS AND METHODS

1. GENERAL

1.1 RELATED DOCUMENTS

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

B. Requirements specified in Division 23 Section “Common Work Results for HVAC" apply to this section.

1.2 DESCRIPTION OF WORK

A. Extent of mechanical related work required by this section is indicated on drawings and/or specified in other Division 23 sections.

B. Furnish and install all miscellaneous steel required for supports, hangers, anchors, guides, etc., required for installation of equipment and materials furnished and installed under this Division. Steel used in a moist environment shall be hot dipped galvanized unless otherwise noted.

C. This Contractor shall perform all Division 23 related and indicated selective demolition including nondestructive removal of materials and equipment for re-use or salvage as indicated. Unless otherwise indicated, dismantle mechanical materials and equipment made obsolete by these installations. All equipment removed shall be offered to the Owner for his retention. If the Owner elects to retain equipment, it shall be turned over to the Owner at the site. If not, the equipment shall be removed from the premises by this Contractor.

D. Furnish and install sound stopping around penetrations or mechanical materials and equipment.

E. Furnish and install fire and smoke penetration seals around penetrations of mechanical materials and equipment through fire or smoke barriers, floors and foundation walls.

1.3 QUALITY ASSURANCE

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

B. Concrete Work Codes and Standards: Comply with governing regulations and, where not otherwise indicated, comply with industry standard, in its application to work in each instance.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including the recommended installation method, all in accordance with Division 01 and Section 230500 requirements.

B. Mechanical System Penetration Seals: Submit the following:

1. Shop drawings showing each condition requiring penetration seals in dictating proposed UL systems materials, anchorage, methods of installation, and actual adjacent construction.

2. A copy of UL illustration of each proposed system indicating manufacturer approved modifications.

3. Manufacturer's specifications, recommendations, installation instructions and maintenance instructions.

2. PRODUCTS

2.1 MATERIALS OF DIVISION 23 CONCRETE WORK

A. Reinforcing Materials:

B. Reinforcing Bars: Except as otherwise indicated, provide ASTM A 615, deformed, Grade 40 for size numbers 3 through 18; ASTM A 675, plain, Grade 60, for size number 2; sizes as indicated or required.

C. Reinforcement Supports: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Provide wire bar type supports complying with CRSI recommendations, unless otherwise indicated.

D. Concrete Materials:

1. Portland Cement: ASTM C 150, Type I, except as otherwise indicated.

2. Aggregates: ASTM C 33, except as otherwise indicated.

a. Local aggregates not complying with ASTM C 33 but which have shown by special test or actual service to produce concrete of adequate strength and durability may be used.

b. For rough grouting, provide aggregate which is well graded and 100 percent passing through 3/8" sieve.

3. Water: Clean and free of substances harmful to concrete.

2.2 DESIGN AND PROPORTIONING OF CONCRETE MIXES

A. General: Design mechanical work concrete as follows, for each 28-day compressive strength class:

1. 3000 psi Class: 500 lbs of cement per cu. yd. (5.25 sacks), and 0.46 water/cement ratio.

B. Mix for Patching: Where mechanical work requires patching of exposed concrete work which has been cut to accommodate mechanical work, provide concrete patching mix which is identical with mix of work being patched (same cement, aggregates, admixtures and proportioning).

3. EXECUTION

3.1 INSTALLATION OF CONCRETE WORK

A. Formwork:

1. General: Design, construct and maintain formwork to support vertical and lateral loads including pressure of cast-in-place concrete. Construct formwork so that formed concrete will be required size and shape and in required location. Construct with joints which will not leak cement paste. Form sides and bottoms of concrete work, except where clearly indicated to be cast directly in excavation or against other construction, or on grade or prepared subgrade. Design and construct forms for easy removal without damage to concrete and other work.

a. Install chamfer strips at external corners of exposed concrete work.

b. Construct forms to retain equipment anchor bolts in accurate locations during placement of reinforcing steel and concrete. Use templates furnished by equipment

manufacturers to locate anchor bolts or, where not furnished, locate by accurate measure from certified setting diagrams.

B. Placing Reinforcement:

1. General: Comply with requirements and recommendations of specified standards, including "Placing Reinforcing Bars" by CRSI. Place bars where indicated and support to prevent displacement during concrete placement, using appropriate reinforcement supports, properly spaced and wire tied to reinforcing bars.

   a. Place reinforcement to obtain at least minimum recommended coverages for concrete protection. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

2. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which would reduce bond with concrete.

C. Placing Concrete:

1. Wet wooden forms which have been coated with compound, immediately before concrete, and remove excess water from forms.

2. Strength-Class Application: Comply with the following general application requirements.

   a. Miscellaneous Supported Work: Provide 3000 PSI class for curbs, pads, and similar supported work.

3. Deposit concrete continuously or in layers of thickness which will result in no concrete being placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within section. If section cannot be placed continuously, provide construction joints. Deposit concrete as nearly as practicable in its final location, so as to avoid segregation due to rehandling or flowing.

4. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures complying with recommended practices of ACI 309; eliminate voids in work.

5. Finishing Horizontal Surfaces: Float and trowel horizontal (top) surfaces to level, smooth, uniform textured, dense finish, where surface is to remain exposed or receive coating, membrane or other thin-set finish. Otherwise, leave struck-off surface undisturbed; except scratch surfaces which are to receive concrete or mortar topping or setting bed, by raking with a stiff broom.

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

7. Surface Repairs:

   a. Exposed Surfaces: On formed surfaces which are to be exposed, including those to be coated or covered with membrane or other thin-set applied finish, repair and patch form-tie holes and damaged and honeycombed areas, filling voids with grout and completely removing fins and other projections.

D. Concrete Curing and Protection;

1. General: Protect freshly placed concrete from drying and excessively cold and hot temperatures, and maintain in moist condition at relatively constant temperature for period of time necessary for hydration of cement, proper hardening, and achievement of strength requirements as specified.

E. Miscellaneous Concrete Work:

1. Concrete Bases: In the absence of more specific information, either on drawings, or manufacturer's literature, the bases shall be level, shall have a minimum height above finished floor of 4" and extend 4" beyond the skids, feet or bed plate of the item of equipment.

2. Concrete pads, beams, pedestals, or saddles placed in existing structures shall be mounted securely to the original substrate with anchor bolts.

F. General Concrete Clean-Up: Upon completion of concrete work, clean excess concrete from adjacent areas and surfaces. Remove excess concrete by proper methods of washing or scraping, using care not to scratch or otherwise damage finished surfaces.

3.2 SELECTIVE DEMOLITION

A. General: demolish, remove, demount, and disconnect abandoned mechanical materials and equipment indicated to be removed and not indicated to be salvaged or saved.

B. Protect adjacent materials indicated to remain.

C. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.

D. Locate, identify, and protect mechanical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

E. Materials and Equipment to be Salvaged: Remove, demount, and disconnect existing mechanical materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for relocation or storage.

F. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.

G. Mechanical Materials and Equipment: Demolish, remove, demount, and disconnect the following items:

1. Inactive and obsolete piping, supports, fittings and specialties, equipment, ductwork, controls, fixtures, and insulation.

2. Perform cutting and patching required for demolition in accordance with requirements of other sections of this specification.

H. The use of explosives in this work is prohibited.

3.3 MECHANICAL SYSTEM SOUND STOPPING

A. Where pipes or ducts or other components of Division 23 work pass through non-fire rated walls or floors, but walls which extend from horizontal structure to structure, provide sound stopping between such mechanical work and the building structure intended to reduce the transmission of sound from one side of the wall to the other.

B. Sound stopping of pipes in sleeves shall consist of sealing the outside of the sleeve with caulking and the inside with an insulating material.

1. See Section 230529 for pipe sleeve requirements.

C. Sound stopping of pipes or ducts without sleeves shall consist of packing the cavity around the penetration with an insulating material and sealing the opening with approved sealant or plaster.

D. Insulating materials shall be non-asbestos and non-friable, and shall have a flame spread rating of no more than 25 and a smoke developed rating of no more than 50.

3.4 MECHANICAL SYSTEM PENETRATION SEALS

A. Where pipes or ducts or other components of Division 23 work pass through fire or smoke rated walls or floors, provide non-asbestos seal assemblies classified by UL to provide fire barriers equal to the time rating of the construction being penetrated, with materials that comply with applicable codes and that have been tested in accordance with UL 1479 or ASTM E-814. Note HILTI is the only approved manufacturer for firestopping materials.

B. Install penetration seal materials in accordance with printed instructions of the UL Building Materials Directory and in accordance with manufacturer's instructions. Seal all holes or voids made by penetrations. Where floor openings without penetrating items are more than four inches in width and subject to traffic or loading, install fire stopping materials capable of supporting same loading as floor.

END OF SECTION 23 05 01

SECTION 230519 – PIPING AND EQUIPMENT SPECIALTIES

1. ___GENERAL

1.1 RELATED DOCUMENTS

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

B. Division 23 Common Work Results for HVAC and Basic HVAC Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK

A. Extent of piping and equipment specialties work required by this section is indicated on drawings and schedules and by requirements of this section.

B. Types of piping specialties specified in this section include the following:

Pipe Escutcheons. Pipe Sleeves.

Piping and Equipment Identification.

C. Piping and equipment specialties furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division-23 sections.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of piping and equipment specialties of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards:

1. EMJA Compliance: Construct expansion compensation products in accordance with standards of the Expansion Joint Manufacturer's Association (EMJA).

2. ANSI and ISA Compliance: Comply with applicable portions of ANSI and the Instrument Society of America (ISA) standards pertaining to the construction and installation of meters and gages.

3. ANSI Standards: Comply with ANSI A13.1 for mechanical identification lettering size, length of color field, colors and viewing angles of identification devices unless otherwise specified.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions, and dimensioned drawings for each type of manufactured mechanical specialty.

1. Submit an expansion compensation schedule showing manufacturer's figure number, size, location and features for each required expansion compensation product.

2. Submit a meter and gage schedule showing manufacturer's figure number, scale range, locations and accessories for each meter and gage.

B. Shop Drawings: Submit for fabricated specialties, indicating details of fabrication, materials, and method of support.

C. Maintenance Data: Submit maintenance data and spare parts lists for each type of manufactured piping and equipment specialty. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Divisions 01 and 23.

2. ___PRODUCTS

2.1 PIPE ESCUTCHEONS

A. General: Provide pipe escutcheons on all pipes passing thru floors and all pipes passing thru walls or ceilings in exposed areas with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.

B. Pipe Escutcheons for Moist Areas (Equipment Rooms): For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.

C. Pipe Escutcheons for Dry Areas: Provide chrome plated sheet steel escutcheons, solid or split hinged.

D. Manufacturer: Subject to compliance with requirements, provide pipe escutcheons of one of the following:

Chicago Specialty Mfg. Co.

Producers Specialty & Mfg. Corp.

Sanitary-Dash Mfg. Co.

2.2 FABRICATED PIPING SPECIALTIES

A. Pipe Sleeve: Provide pipe sleeves sized to allow for fire and sound stopping between the inside sleeve wall and the pipe or insulation surface of one of the following:

1. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.

2.3 PIPING AND EQUIPMENT IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-23sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.4 PLASTIC PIPE MARKERS

A. Snap-On Type: Provide manufacturer's standard preprinted, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.

B. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1.

C. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 deg F (52 deg C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.

D. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 deg around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Laminated or bonded application of pipe marker to pipe (or insulation).
4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".

E. Large Pipes: For external diameters of 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:

1. Laminated or bonded application of pipe marker to pipe (or insulation).
2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2" wide; full circle at both ends of pipe marker, tape lapped 3".
3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

F. Lettering: Comply with piping system nomenclature as described in ANSI A13.1 and abbreviate only as necessary for each application length.

1. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

G. Background Colors and Legend: Furnish piping identification in colors conforming to the following schedule. Note: Not all piping types listed are utilized on this project.

LEGEND WORDING	MARKER COLORS
Drain (A/C Condensate)	GW
Refrigerated Liquid	Y
Refrigerated Suction	Y
Refrigerant Hot Gas	Y

Y = Yellow with Black Letters

GW = Green with White Letters

2.5 PLASTIC TAPE

A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

B. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6", 2-1/2" wide tape for larger pipes.

C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.6 VALVE TAGS

A. Brass Valve Tags: Provide 19-gage polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve number 1/2" high, and with 5/32" hole for fastener.

1. Provide 1-1/2" diameter tags, except as otherwise indicated.

B. Plastic Laminate Valve Tags: Provide manufacturer's standard 3/32" thick, engraved, color coded plastic laminate valve tags, with piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.

1. Provide 1-1/2" square tags with color coded lettering and backgrounds as required for the piping serviced. Provide a separate background color for each major piping group (e.g., chilled water, heating water, etc.).

C. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

D. Valve Access Panel Markers: Provide manufacturer's standard 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8" center hole to allow attachment.

2.7 PLASTIC EQUIPMENT MARKERS

A. General: Provide manufacturer's standard laminated plastic, equipment markers.

B. Nomenclature: Include the following:

1. Name and owner's equipment identification number.

2. Equipment service.

C. Size: Provide approximate 2-1/2" x 4" markers for control devices, dampers, and valves; and 4-1/2" x 6" for equipment.

2.8 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide mechanical identification materials of one of the following:

Allen Systems, Inc.

Brady (W.H.) Co.; Signmark Div.

Industrial Safety Supply Co., Inc.

Lab Safety Supply

Seton Name Plate Corp.

3. ___EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

A. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration thru floors, walls, partitions, and ceilings where penetration is exposed to view; and on exterior of building. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole, and is flush with adjoining surface.

3.2 INSTALLATION OF FABRICATED PIPING SPECIALTIES

A. Drip Pans: Locate drip pans under piping passing over or within 3' horizontally of electrical equipment, and elsewhere as indicated. Hang from structure with rods and building attachments, weld rods to sides of drip pan. Brace to prevent sagging or swaying. Connect 1" drain line to drain connection, and run to nearest plumbing drain or elsewhere as indicated.

B. Pipe Sleeves: Install pipe sleeves of types indicated where piping passes through walls, floors, ceilings, and roofs. Do not install sleeves through structural members of work, except as detailed on drawings, or as reviewed by Architect/Engineer. Install sleeves accurately centered on pipe runs. Size sleeves so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but no less than 2 pipe sizes larger than piping run. Where insulation includes vapor-barrier jacket, provide sleeve with sufficient clearance for installation. Install length of sleeve equal to thickness of construction penetrated, and finish flush to surface; except floor sleeves. Extend floor sleeves 2" above level floor finish, 3/4" above floor finish sloped to drain, and flush with floor in other areas. Provide temporary support of sleeves during placement of concrete and other work around sleeves, and provide temporary closure to prevent concrete and other materials from entering sleeves.

1. Install sheet-metal sleeves at non-rated or non-masonry interior penetrations other than suspended ceilings.

2. Install iron-pipe sleeves at exterior penetrations; both above and below grade.

3. Install steel-pipe sleeves except as otherwise indicated.

3.3 INSTALLATION OF PIPING AND EQUIPMENT IDENTIFICATION

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.4 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:

1. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.

B. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

1. Near each valve and control device.

2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.

3. Near locations where pipes pass through walls or floors/ ceilings, or enter non-accessible enclosures.

4. At access doors, manholes and similar access points which permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.

6. Spaced intermediately at maximum spacing of 50 ft. along each piping run, except reduce spacing to 25 ft. in congested areas of piping and equipment.

7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.5 VALVE IDENTIFICATION

A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.

B. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.

1. Where more than one major machine room is shown for project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than single machine room.

3.6 MECHANICAL EQUIPMENT IDENTIFICATION

A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:

1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.

2. Primary scheduled equipment.

3. Temperature and other control panels.

4. Temperature control devices located with panels and on outside of panels except for room thermostats.

B. Optional Sign Types: Where lettering larger than 1" height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, at Installer's option.

C. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.

D. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.7 ADJUSTING AND CLEANING OF MECHANICAL IDENTIFICATION

A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

END OF SECTION 230519

SECTION 230523 - GENERAL DUTY VALVES AND STRAINERS

1. GENERAL

1.1 RELATED DOCUMENTS

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

B. Division 23 Common Work Results for HVAC and Basic HVAC Materials and Methods sections apply to work specified in this section.

C. See other Division 23 sections for valves in addition to general duty valves required for specific applications.

1.2 DESCRIPTION OF WORK

A. Extent of valves required by this section is indicated on drawings and/or specified in other Division 23 sections.

B. Valves furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 23 sections.

1.3 QUALITY ASSURANCE

A. Valve Types: Provide valves of same type by same manufacturer.

B. Valve Identification: Provide valves with manufacturer's name (or trademark) and pressure rating clearly marked on valve body.

C. Codes and Standards:

1. MSS Compliance: Mark valves in accordance with MSS-25 "Standard Marking System for Valves, Fittings, Flanges and Unions".

2. ANSI Compliance: For face-to-face and end-to-end dimensions of flanged- or welded-end valve bodies, comply with ANSI B16.10 "Face-to-Face and End-to-End Dimensions of Ferrous Valves".

3. FCI Compliance: Test and rate "Y" type strainers in accordance with FCI 73-1 "Pressure Rating Standard for "Y" Type Strainers". Test and rate other type strainers in accordance with FCI 78-1 "Pressure Rating Standard for Pipeline Strainers Other than "Y" Type".

1.4 SUBMITTALS

A. Include pressure drop curve or chart for each type and size of valve and strainer. Submit schedule showing manufacturer's figure number, size, location and features for each required valve and strainer. Indicate sizes being supplied.

2. ___PRODUCTS

2.1 VALVES

A. General: Provide factory-fabricated valves recommended by manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by Installer to comply with installation requirements. Provide end connections which properly mate with pipe, tube, and equipment connections.

B. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.

C. Operators: Unless otherwise specified provide handwheels, fastened to valve stem, for valves other than quarter-turn. Unless otherwise indicated provide lever handle for quarter-turn valves, 6" and smaller, other than plug valves. Provide gear operators for quarter-turn valves 8" and larger. Provide chain-operated sheaves and chains for overhead valves as indicated.

A. Ball Valves 2" and smaller shall be 150 psi saturated steam rated; 600 psi non-shock cold water, oil or gas rated; two-piece body; chrome plated ball; blowout proof stem; reinforced TFE seats; full port design in all sizes; bronze or brass body; all 316 stainless steel trim on valves used for steam service; screwed/soldered pattern. Valves shall be Nibco 585-70, Apollo 77-100/200, Watts B-6080, Milwaukee BA-125/155.

B. Ball Valves 2" and smaller shall be 150 psi saturated steam rated; 600 psi non-shock cold water, oil or gas rated; two-piece body; chrome plated ball; blowout proof stem; reinforced TFE seats; full port design in all sizes; bronze or brass body; all 316 stainless steel trim on valves used for steam service; screwed/soldered pattern. Valves shall be Nibco 585-70, Apollo 77-100/200, Watts B-6080.

C. Air Vents and Drains for main water lines and coils shall be bronze, screwed/soldered pattern ball valves with a 3/4" male hose thread adaptor. The hose thread adaptor shall have a metal cap with a rubber washer. Valves shall be Apollo 70-100.

3. EXECUTION

3.1 INSTALLATION OF VALVES

A. Valves shall be provided in suitable locations at each item of equipment, branch circuit, riser, or section of piping as indicated or required for proper and safe operation of the system and to facilitate maintenance and/or removal of all equipment and apparatus. On horizontal pipe runs, install all valve stems vertically up where possible and in no case shall the stems be turned more than 90 degrees from the vertically up position.

B. Install valves in compliance with manufacturer's installation instructions.

C. Potable water and/or hydronic systems (2" and smaller) shall utilize valves as indicated with soldered connections where used for zone isolation, or threaded connections when used in conjunction with a union for equipment isolation.

END OF SECTION 230523

SECTION 230529 - HANGERS, SUPPORTS AND ANCHORS

1. __GENERAL

1.1 RELATED DOCUMENTS

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

B. Division 23 Basic Mechanical Requirements and Basic Mechanical Materials and Methods sections apply to work specified in this section.

C. See also Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment".

1.2 DESCRIPTION OF WORK

A. Extent of supports and anchors required by this section is indicated on drawings and/or specified in other Division 23 sections.

B. Types of supports and anchors specified in this section include the following:

Horizontal - Piping Hangers and Supports.
Vertical - Piping Clamps.
Hanger - Rod Attachments.
Building Attachments.
Saddles and Shields.
Miscellaneous Materials.
Roof Equipment Supports.

C. Supports and anchors furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 23 sections.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of type and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards:

1. Code Compliance: Unless requirements are exceeded herein, comply with applicable codes pertaining to product materials and installation of supports and anchors.
2. Factory fabricate hangers, supports, and components according to MSS SP-58.

1.4 SUBMITTALS

A. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of support, indicating dimensions, weights, required clearances, and methods of assembly of components.

B. Manufacturer Seismic Qualification Certification: Submit certification that all equipment will withstand seismic forces as required for Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements."

2. PRODUCTS

2.1 HORIZONTAL - PIPING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with MSS SP-58, of one of the MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type of one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems. Provide felt lined hangers or clamps for uninsulated refrigerant piping to eliminate transmission of sound and vibration. Perforated strap hangers shall not be used in any work.

2.2 VERTICAL-PIPING CLAMPS

A. General: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps complying with MSS SSP-58, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.

2.3 HANGER-ROD ATTACHMENT

A. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with MSS SP-58, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.

2.4 BUILDING ATTACHMENTS

A. General: Except as otherwise indicated, provide factory-fabricated building attachments complying with MSS SP-58, expansion shells, inserts or beam clamps selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. All beam clamps shall be installed with a retaining strap to grasp two opposing sides of structure to prevent possible movement of the clamp due to vibration. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems. "C" clamps shall not be permitted.

2.5 MANUFACTURERS OF HANGERS AND SUPPORTS

A. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:

B-Line Systems, Inc.
Globe Hanger
ITT Grinnell Corp.
Mason Industries, Inc.
Michigan Hanger
Modern Hanger
PHD Manufacturing, Inc.

2.6 SADDLES AND SHIELDS

A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation. See PART 3 for application.

B. Saddles: Install MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation. Utilize hardwood block saddle (minimum 6" long), with sufficient width to prevent hanger bearing on insulation for chilled water piping saddles. Multiple hardwood block sections shall be installed on piping over 4” at angles recommended by support manufacturer.

C. Shields: Install MSS Type 40, protective shields. Shields shall span an arc of 180 degrees, and have a length of 12 inches, thickness of 0.048 inches for piping under 4 inches diameter; length of 12 inches, thickness of 0.060 inches for piping 4 inches diameter; and length of 18 inches, thickness of 0.060 inches for piping 5 and 6 inches in diameter.

D. Thermal Hanger Shield Inserts:

1. Constructed of 360 deg insert of high density, 100 psi, water-proofed calcium silicate, encased in 360 deg sheet metal shield. Provide assembly of same thickness as adjoining insulation, with sufficient width to prevent hanger bearing on insulation.

E. Insulation Clamps:

1. Insulated piping is to maintain continuous insulation at all supports and hangers. Where insulated piping is supported from unistrut or other similar systems, crush resistant insulation clamps similar to ZSI Cush-A-Therm, K-Flex® 360 Insulated Pipe Support, and Klo-Shure insulation couplings will be acceptable.

2.7 MISCELLANEOUS MATERIALS

A. Metal Framing: Provide products complying with NEMA STD ML 1.

B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.

C. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards. Material coatings for interior use shall be electro-plated zinc (ASTM B633), or mill galvanized (ASTM A525 G90). For exterior use, materials shall be hot-dip galvanized after fabrication (ASTM A386).

D. Bolts and Nuts: ASME B18.10 or ASTM A183, steel, hex-head, track bolts and nuts. Use galvanized or stainless steel for use in moist environments.

2.8 ROOF EQUIPMENT SUPPORTS

A. Refer to the drawings, schedules and applicable specification sections for roof equipment supports indicated to be furnished by the unit manufacturer.

B. Fabricated Roof Equipment Supports:

1. General: Construct roof equipment supports using minimum 18-ga galvanized steel with fully mitered and welded corners, 3" cant, internal bulkhead reinforcing, integral base plates, pressure treated wood nailer, and 18-ga galvanized steel counterflashing.
2. Configuration: Construct of sizes as indicated, compensate for slope in roof so top of support is dead level.
3. Pipe Boots: Provide boots for piping, power conduit and control conduit as required by pipe curb manufacturer. Boot to be expandable, designed to accommodate the pipe or conduit size utilized, and capable of maintaining a weather-tight seal even with minor vibration in piping:
4. Manufacturer: Subject to compliance with requirements, provide roof equipment supports of one of the following:

Custom Curb
Pate Co.
Roof Products and Systems (RPS)
Thycurb Div.; Thybar Corp.

3. EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PREPARATION

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.

3.3 INSTALLATION OF BUILDING ATTACHMENTS

A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated below. Install additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. For new concrete, install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

B. Two or one-end threaded rod sizing for various support loads shall be as follows:

ROD DIAMETER	MAXIMUM LOAD (LBS.)
3/8"	610
1/2"	1130
5/8"	1810
3/4"	2710

7/8"	3770
1”	4960
1-1/8"	6230
1-1/4"	8000
1-1/2"	11630
1-3/4"	15700
2”	20700
2-1/4”	27200
2-1/2”	33500

Note limitations on structure supporting rods.

C. For reference purposes, the following table provides filled weights of steel piping for various sizes:

PIPE SIZE	FILLED PIPE WEIGHT (LB/FT)
1/2”	1.0
3/4”	1.4
1”	2.1
1-1/4”	3.0
1-1/2”	3.6
2”	5.1
2-1/2”	7.9
3”	10.8
4”	16.3
6”	31.5
8”	50.2
10”	74.6
12”	98.6
14”	114.4
16”	141.8
18”	171.9
20”	204.4
22”	240.4
24”	278.7
26”	319.8
28”	363.6
30”	410.1
32”	459.3
34”	511.3
36”	565.9

D. Unless hanger spacing is

1. specifically indicated on drawings
2. indicated in other Division 23 specification sections for special applications
3. required to be more frequently by State or local codes

all piping shall be supported at distances not exceeding the spacing in the following table. This table is intended for general distribution piping. Within equipment rooms, hangers must be arranged to provide full support of piping. No piping is to be supported by, or impose a load upon the equipment to which it is connected.

HANGER SPACING TABLE		
PIPING MATERIAL	MAX. HORIZONTAL SPACING (FEET)[4]	MAX. VERTICAL SPACING (FEET)[4]
ABS Pipe	4	4
Aluminum Tubing	10	15
Brass Pipe	10	10
Brass Tubing, 1-1/4" Dia. & Smaller	6	10
Brass Tubing, 1-1/2" Dia. & Larger	10	10
Cast-Iron Pipe[1]	5	15
Copper or Copper-Alloy Pipe	12	10
Copper or Copper-Alloy Tubing, 1-1/4" Dia. & Smaller	6	10
Copper or Copper-Alloy Tubing, 1-1/2" Dia. & Larger	10	10
CPVC Pipe or Tubing, 1" Dia. & Smaller	3	4[2]
CPVC Pipe or Tubing, 1-1/4" Dia. & Larger	4	4
Galvanized Steel Pipe	12	15
Lead Pipe	Continuous	4
PB Pipe or Tubing	2.67 (32")	4
PVC Pipe	4	4
Steel Pipe	12	15
Steel Tubing	8	10
Gas Piping[3]		
Rigid Pipe, 3/4" Dia. and Under	10	-----
Rigid Pipe, 1" Dia. & Over	12	-----
Tubing, 1-1/2" Dia. & Under	6	-----
Tubing, 1-1/2" Dia. & Over	10	-----

Footnotes:

1. The maximum horizontal spacing of cast-iron pipe hangers shall be increased to 10 feet where 10-foot lengths of pipe are installed.
2. Install mid-story guide.
3. Gas piping horizontal maximum hanger spacing shall be the lesser of that indicated for the specific material utilized or that indicated for gas piping. Maximum vertical spacing shall be that indicated for the material utilized.
4. 1 foot = 304.8 mm.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washer and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

C. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

D. Provisions for Movement:

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

E. Pipe Slopes: Install hangers and supports to provide indicated or specified pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.

F. Horizontal Piping: Comply with the following installation requirements.

1. Individual hangers for uninsulated piping not specified to be supported with roller hangers may be supported with either adjustable band hangers or adjustable steel clevis hangers.
2. Individual hangers for insulated piping not specified to be supported with roller hangers shall be adjustable steel clevis hangers.
3. Support the following horizontal piping using adjustable roller hanger supports MSS Type 43 for twelve (12) inches and below and MSS Type 41 for fourteen (14) inches and above:

    a. Piping over 2 inches in size transporting medium above 150 deg. F.
    b. All piping 4 inches in size and above, regardless of medium.

4. Heavy duty trapezes may be utilized for multiple horizontal pipes where applicable. Design of same shall be by trapeze manufacturer considering weight, available structure, pipe medium, material, etc. Supports for individual piping group on trapezes shall be as specified for individual piping.

G. Insulated Piping: Comply with the following installation requirements.

1. Clamps: At contractor's option to shields, where flexible elastomeric insulation is indicated on piping size two (2) inches and under, attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
2. Saddles: Where piping is insulated and piping is eight (8) inches in diameter or larger, or piping of any size on roller hanger supports, install protection saddles. Fill interior voids with segments of insulation matching adjoining insulation.
3. Shields: Where insulation is indicated on piping, install galvanized protective shields for all pipe sizes . Shields shall be installed on all piping systems in conjunction with saddles, except on hot systems which have steel saddles. Install thermal hanger shield inserts with same thickness as pipe insulation.

3.5 ROOF EQUIPMENT SUPPORTS

A. Install roof equipment supports in compliance with manufacturer's instructions and recommendations. Coordinate with installation of roof deck and other substrates to receive accessory units, vapor barriers, roof insulation, roofing and flashing as required to ensure that each element of the work performs properly and that combined elements are waterproof and weathertight. Anchor units securely to supporting structural substrates, adequate to withstand lateral and thermal stresses as well as inward and outward loading pressures. Meet all requirements necessary to maintain the roofing manufacturer's warranty.

3.6 ADJUSTING AND CLEANING

A. Hanger Adjustments: Adjust hangers so as to distribute loads equally on attachments and to achieve slope of pipe.

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 230529

SECTION 230548 – VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

1. GENERAL

1.1 RELATED DOCUMENTS

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

B. Division 23 Common Work Results for HVAC and Basic HVAC Materials and Methods sections apply to work specified in this section.

C. See also Section 230529 “Hangers and Supports for HVAC Piping and Equipment” for seismic restraint devices for all ductwork, piping, and equipment.

1.2 DESCRIPTION OF WORK

A. Extent of vibration control work required by this section is indicated on drawings and schedules, and/or specified in other Division 23 sections.

B. Types of vibration control products specified in this section include the following:

Fiberglass Pads and Shapes.

C. Vibration control products furnished as integral part of factory-fabricated equipment, are specified as part of equipment assembly in other Division-23 sections.

D. Refer to other Division 23 sections for equipment foundations, hangers, sealants, gaskets, and other work related to vibration control work.

E. Refer to other Division 23 sections for requirements of electrical connections to equipment isolated on vibration control products.

F. Refer to other Division 23 sections for requirements of duct connections to air handling equipment isolated on vibration control products.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration control products, of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 3 years.

1. Except as otherwise indicated, obtain vibration control products from single manufacturer.

2. Engage manufacturer to provide technical supervision of installation of vibration control products.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of vibration control product. Submit schedule showing size, type, deflection, and location for each product furnished.

B. Maintenance Data: Submit maintenance data for each type of vibration control product. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Divisions 01 and 23.

2. PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide vibration control products of one of the following:

1. Vibration Isolators:

Consolidated Kinetics Corp.

Flexhose

Korfund Dynamics Corp.

Mason Industries, Inc.

Peabody Noise Control, Inc.

Vibration Eliminator Co., Inc.

B. Manufacturer: Subject to compliance with requirements, provide roof-curb isolators of one of the following:

Mason Industries, Inc.

Pate Co.

Thycurbs Div.; Thybar Corp.

Vibro-Acoustics

2.2 VIBRATION CONTROL MATERIALS AND SUPPORT UNITS

A. Fiberglass Pads and Shapes: Glass fiber of not more than 0.18 mil diameter, produced by multiple-flame attenuation process, molded with manufacturer's standard fillers and binders through 10 compression cycles at 3 times rated load bearing capacity, to achieve natural frequency of not more than 12 Hertz, in thicknesses and shapes required for use in vibration isolation units.

3. EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which vibration control units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PERFORMANCE OF ISOLATORS

A. General: Comply with minimum static deflections listed in vibration control schedule or as recommended by ASHRAE, for selection and application of vibration isolation materials and units as indicated.

B. Manufacturer's Recommendations: Except as otherwise indicated, comply with manufacturer's recommendations for selection and application of vibration isolation materials and units.

3.3 APPLICATIONS

A. General: Except as otherwise indicated, select vibration control products in accordance with vibration control schedule and ASHRAE Handbook, 1980 Systems Volume, Chapter 35 "Sound and Vibration Control", Table 27. Where more than one type of product is offered, selection is Installer's option.

3.4 INSTALLATION

A. General: Except as otherwise indicated, comply with manufacturer's instruction for installation and load application to vibration control materials and units. Adjust to ensure that units have equal deflection, do not bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices intended for temporary support during installation.

B. Install units between substrate and equipment as required for secure operation and to prevent displacement by normal forces, and as indicated.

C. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where substrate is not level.

3.5 ADJUSTING AND CLEANING

A. Upon completion of vibration control work, prepare report showing measured equipment deflections for each major item of equipment as indicated.

B. Make final adjustments to vibration control devices while equipment is operating wherever safely possible.

C. Clean each vibration control unit, and verify that each is working freely, and that there is no dirt or debris in immediate vicinity of unit that could possibly short-circuit unit isolation.

D. Ferrous components of vibration control devices exposed to weather to be painted with two coats of zinc-chromate paint.

3.6 VIBRATION ISOLATION SCHEDULE:

A. General: Furnish vibration isolation in accordance with the following schedule and table:

1. ECU-1 through ECU-3 – mount on housekeeping pads through neoprene pads.

2. Air Cooled Condensers or Condensing Units – secure to support steel through neoprene pads.

END OF SECTION 230548

SECTION 230593 - TESTING, ADJUSTING AND BALANCING

1. GENERAL

1.1 RELATED DOCUMENTS

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

B. Division 23 Common Work Results for HVAC and Basic HVAC Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK

A. Extent of testing, adjusting, and balancing work required by this section is indicated on drawings and schedules, and by requirements of this section; and is defined to include, but is not necessarily limited to mechanical systems, and associated equipment and apparatus of mechanical work. The work consists of setting speed, volume, flow by adjusting valves, dampers, sheaves, etc., as applicable provided for in the systems, confirming proper system function and operation, recording data, conducting tests, preparing and submitting reports, and recommending modifications to work as required by the Contract Documents.

B. This work also includes specified duct leak testing.

C. Component types of testing, adjusting, and balancing specified in this section includes in general the following as applied to mechanical equipment:

Ductwork systems

Piping systems

D. Refer to Division-23 sections for installation and start-up of equipment to be tested, adjusted, and balanced; not work of this section.

E. Refer to Division-23 sections for pressure testing of piping systems; not work of this section.

F. The air balance shall be performed as:

1. A part of the HVAC contract.

1.3 REFERENCES

A. ASHRAE-Standard 111--1988 Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air Conditioning, and Refrigeration Systems.

B. ASHRAE--HVAC Applications Handbook: Chapter 34--Testing, Adjusting and Balancing.

C. AABC--National Standards for Total System Balance.

D. SMACNA--HVAC Systems--Testing, Adjusting and Balancing.

E. Sheet Metal Industry--Testing, Adjusting, Balancing Bureau (TABB) Certified Technician Standards, Procedures and Specifications.

1.4 QUALITY ASSURANCE

A. Tester's Qualifications: Contractors shall be contractor members in good standing and certified by AABC or NEBB in those testing and balancing disciplines similar to those required for this project, with a minimum of three years of documented balancing experience as a firm and proven capability in work of the type and size as presented by this project.

B. Codes and Standards:

1. AABC Compliance: Comply with AABC's "AABC National Standards", or NEBB “Procedural Standards for Testing, Balancing and Adjusting” as applicable to mechanical air and hydronic distribution systems, and equipment and apparatus, except where these specifications exceed requirements.

2. Industry Standards: Comply with the latest ASHRAE and Sheet Metal Industry systems volume testing, adjusting, and balancing recommendations pertaining to measurements, instruments, and testing, adjusting, and balancing, except as otherwise indicated.

3. SMACNA Compliance: Comply with the latest edition of the SMACNA testing, adjusting, and balancing manual.

1.5 SUBMITTALS

A. Submit to the Architect/Engineer for review, prior to commencement of work, a list of equipment and procedures to be used in balancing the systems.

B. Submit the same number of copies of the report as required for shop drawings on standard AABC or SMACNA forms. The results of the balancing work shall be submitted in report form to the Architect/Engineer no later than 14 days following substantial completion of the HVAC systems. Where test results differ from specified design conditions, indicating a deficiency, include explanation comments in report. The balancing foreman shall sign and date each form in the report under his responsibility and the balancing supervisor's proof of certification shall accompany the report.

C. Failure to submit in accordance with the above will be cause for the automatic rejection of the report.

1.6 CEILING ACCESS

A. The Balancing Contractor shall be fully responsible for removal and reinstallation of lay-in ceiling tile and replacement of any tile damaged by balancing technicians in the performance of this work.

B. Coordinate required work in areas above inaccessible ceilings in sufficient time to allow balancing before ceilings are installed. Notify Architect/Engineer prior to ceiling installation if this becomes impossible.

1.7 GENERAL PROCEDURES

A. All Systems shall be balanced using a procedure, which results in minimum restrictions being imposed. At completion of balancing (as applicable):

1. At least one damper for an outlet/inlet shall be fully open on every branch duct.

2. At lest one branch duct balancing damper shall be fully open on every trunk duct.

3. At least one trunk (zone) balancing damper shall be fully open to each air system.

4. Fan RPM shall be set so the static pressure at the terminal, which is most difficult to serve is adequate, but not excessive.

5. At least one hydronic terminal unit-balancing valve in each piping branch shall be fully open.

6. At least one branch line balancing valve in each Hydronic System shall be fully open.

1.8 HVAC CONTRACTOR RESPONSIBILITIES

A. Prepare each system for testing and balancing.

B. Cooperate with testing organization, provide access to equipment and systems. Operate systems at designated times, and under conditions required for proper testing, adjusting and balancing.

C. Coordinate interfacing work between Temperature Control Contractor and testing organization.

D. Notify testing organization at a minimum seven days prior to time system will be ready for testing, adjusting and balancing.

E. Replace sheaves based on initial balance information provided by testing organization on driven air equipment requiring same in order to comply with these specifications regarding balance tolerances.

F. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

1.9 WARRANTY

A. General Warranty: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Guarantee: Provide a guarantee on AABC or NEBB forms stating that AABC or NEBB will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified Agent has tested and balanced systems according to the Contract Documents.

2. Systems are balanced to optimum performance capabilities within design and installation limits.

2. PRODUCTS

2.1 APPROVED CONTRACTORS

A. Professional Balance Company (PBC), 37903 Euclid Avenue, Willoughby, Ohio, 44094

B. Kahoe Air Balance, 35601 Curtis Blvd., Eastlake, Ohio 44095

C. Fulton & Associates Balance Co., 29251 Anderson Road, Wickliffe, Ohio 44092, Attn: Mr. Dominic Mazzolini, 440-943-9450

2.2 EQUIPMENT

A. Provide all necessary tools, scaffolding and ladders.

B. Provide all necessary instruments. Instruments shall be used and applied which are best suited to the system function being tested. Instruments shall be in first class state of repair and have been calibrated within a period of six months prior to starting the job. Calibration history of each instrument shall be available for examination. Instruments shall be recalibrated upon completion of the job, if required by the Architect/Engineer to prove reliability.

3. EXECUTION

3.1 PRELIMINARY PROCEDURES FOR AIR AND HYDRONIC SYSTEM BALANCING

A. Before operating the system, perform these steps:

1. Obtain design drawings and specifications including all addenda, and construction changes and become thoroughly acquainted with the design intent.

2. Contact the Engineer’s authorized representative to review system operation and balancing approach. Document the date of this review, the person contacted and any specific noteworthy items relative to this review in the Balance Report.

3. Obtain copies of approved shop drawings of all applicable mechanical equipment such as pumps, fans, air handling equipment, outlets (supply, return, and exhaust) and temperature control diagrams.

4. Walk the systems to determine variations of installation from design.

5. Check filters for cleanliness.

6. Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.

7. Prepare report test sheets. Obtain manufacturer's data and recommended procedures for testing and balancing.

8. Prepare a summation of required outlet volumes to permit a cross-check with required fan volumes.

9. Determine best locations in main and branch ductwork for most accurate duct traverses.

10. Place outlet dampers in the full open position.

11. Use design drawings of system or "as-built" system layouts to facilitate reporting.

12. Check fan belt tension.

13. Check fan rotation.

14. Open valves to full open position. Close coil bypass valves (if applicable).

15. Notify the installing contractor if strainers are suspected to be clogged. Do not proceed until installing contractor cleans strainers.

16. Check pump rotation.

17. Clean and set automatic fill valves for required system pressure. Record setpoints in report.

18. Check expansion tanks for proper operation.

19. Notify installing contractor if improper air venting is occurring in piping system. Do not proceed until installing contractor corrects venting problems.

20. Set temperature controls so all coils are calling for full flow.

21. Check and set operation of automatic bypass valves.

22. Check and set operating setpoints of equipment in the system to design requirements.

3.2 GENERAL BALANCE PROCEDURES

A. The balancing company shall advise the installing contractor of any additional work or rework required to obtain design performance during the course of the balancing work. Such additional work shall be performed prior to the completion of balancing and submission of the balancing report.

B. The Architect or his representative may make spot checks to determine the accuracy and completeness of final adjustments. Should spot checks indicate more than a reasonable deviation from design requirements, the Balancing Contractor shall repeat tests and adjustments to the satisfaction of the Architect/Engineer.

C. If any imbalancing occurs which is not the direct result of misoperation by the user during the warranty period, the Balancing Contractor must re-balance as required to obtain proper operating conditions. After or during one complete heating and cooling season, the Balancing Contractor shall make any minor adjustments that may be necessary to insure uniform temperatures throughout the spaces.

D. Where existing systems are modified requiring revisions in flows, test and record existing flows to remainder of system if not indicated on drawings prior to commencing balancing work and rebalance as required to these values after revisions are complete.

3.3 INSTALLATION TOLERANCES

A. Adjust Air Handling Systems to the following tolerances, unless otherwise specifically indicated for special tolerances. Rooms indicated so that the sum of the air to be removed from the room exceeds the amount to be supplied (negative pressure rooms) shall be balanced to obtain a negative pressure, and conversely, positive pressure rooms shall be balanced to obtain a positive pressure, regardless of tolerances:

1. Supply systems shall be balanced so that:

   a. The total quantity to each space is within -5% to +10% of design values.

   b. If two or more outlets in space, each outlet is within -5% to +10% of design value.

   c. Supply fans are within –5% to +5% of scheduled value.

3.4 ADJUSTING

A. Recorded data shall represent actually measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices, allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing moving part guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 AIR SYSTEM PROCEDURE

A. Measure and balance air quantities at air inlets and outlets. Diffusers, registers, and grilles shall be balanced using a flow measuring hood or an anemometer as recommended by manufacturer. Area used in calculating airflow shall be net core area. Test readings shall be taken for each supply outlet, return or exhaust inlet. For each of these units obtain and furnish information on manufacturer, testing equipment used, procedure followed, location, size, average velocity, gross and net core areas, observed cfm and specified cfm. Separate tabulations shall be furnished for each manufacturer, each system and each type of register, grille and diffuser. Adjust registers, grilles and diffusers to obtain the best air flow pattern and minimize drafts in all areas.

B. Adjust Air Handling and Distribution Systems to provide design air quantities.

C. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Effect volume control at outlets by use of dampers installed in the ductwork as far away from outlets as possible. Do not use volume dampers that are integral with the outlets unless no other balancing damper is available. Adjust all duct dampers, proportioning air flow to minimize adjustments required at individual grilles, registers, and diffusers.

F. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50% loading of filters. If unloaded filters will cause air quantities in excess of specified tolerances, contact the Engineer to review flow rates before adjusting or selecting replacement sheaves.

G. Measure temperature conditions across outside air, return air, and exhaust air dampers to check leakage. Where modulating dampers are provided, take measurements and balance at extreme conditions.

H. Set variable volume terminals at maximum indicated airflow rate, set and read volumes at minimum airflow rate and full heating.

I. For each piece of air handling, list the data of the fan, motor and drive and obtain by measurement and furnish in the Balance Report the fan speed, motor voltage, operating amps, cfm and static pressure as determined from the manufacturer's fan curves and determine the fan cfm by means of a velocity traverse which shall be taken a minimum of three fan diameters from fan outlet. Before running any tests, the HVAC Contractor shall have installed all the components of the system and shall insure the cleanliness of the filters. In the event that the drive assembly requires a change in belts or pulleys, the Balance Contractor shall advise the installing contractor of the size of the replacement equipment, and rebalance the air handling equipment after installation of new drive assemblies. Drive and drive changeout shall be the responsibility of the HVAC Contractor

J. Check for leaks in air handling unit casings, around doors, and coil connections. Report leaks to HVAC Contractor and list uncorrected leaks in report

K. Variable Volume Systems: Balance main air handling equipment to design flow with all terminal units open. If the sum of the connected loads is less than the scheduled fan airflow, balance to the sum of the connected loads. If the sum of the connected loads exceeds the scheduled fan airflow, the fan has been sized with system diversity. Balance fan to scheduled airflow with all terminal units at maximum flow open position. After air handling equipment is balanced, set/reset room thermostats as necessary to check heating and cooling function, and maximum/minimum flow rates for factory set terminal units and adjust units if not correct. Set static pressure controllers as low as practicable and still maintain required pressure at the remote terminal units. Record static pressure points in balance report and coordinate setpoint with Temperature Control Contractor.

3.6 POST BALANCING WORK

A. The Balancing Contractor shall patch test holes in insulation, ductwork, and housings, which have been cut or drilled for test purposes, in manner recommended by original Installer, with materials to match, or plastic plugs.

B. Mark equipment settings, including such items as control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings at completion of TAB work. Provide markings with paint or other suitable permanent identification materials.

C. Retest, adjust, and balance systems subsequent to significant system modification, and resubmit test results.

D. Adjust air pattern from adjustable diffusers where excessive velocities are creating a nuisance for occupants.

END OF SECTION 230593

SECTION 230701 – DUCT INSULATION

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. Division 23 Common Work Results for HVAC and Basic HVAC Materials and Methods sections apply to work specified in this section.

C. Refer to drawing “Duct Material” schedules which indicate ducts to be insulated.

1.2 SUMMARY

A. This Section includes semirigid and flexible duct, plenum, and breeching insulation; insulating cements; field-applied jackets; accessories and attachments, and sealing compounds as applicable to this project.

B. Related Sections include the following:

1. Division 23 Section “Basic HVAC Materials and Methods” for firestopping materials and requirements for penetrations through fire and smoke barriers.
2. Division 23 Section “Basic HVAC Materials ad Methods” for sound stopping materials and requirements.
3. Division 23 Section "HVAC Piping Insulation" for insulation for piping systems.

1.3 CODES AND STANDARDS

A. The following published specifications, standards, or tests apply to flexible, fire rated ductwrap systems in this section:

1. NFPA 101, 92A, 92B
2. International Organization for Standardization (ISO)
3. International Building Code (IBC)
4. International Mechanical Code (IMC)
5. National Building Code of Canada
6. ASTM E-119 Standard Test Methods for Fire Tests of Building Construction and Materials
7. ISO 6944 - 1985 Edition, Fire Resistance Tests for Ventilation Air Ducts
8. ASTM E-84, UL/ULC 723 Standard Test Method for Surface Burning Characteristics of Building Materials
9. ASTM E-814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops
10. ASTM E-518 Standard Test Method for Thermal Resistance
11. ASTM C-411 Standard Test Method for Hot Surface Performance of High-Temperature Thermal Insulation

1.4 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

B. Shop Drawings: Show typical fabrication and installation details for the following as applicable:

1. Removable insulation sections at access panels.

2. Application of field-applied jackets.
3. Applications at linkages for control devices.

C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 3 years successful installation experience on projects with mechanical insulations similar to that required for this project.

C. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.6 DEFINITIONS

A. Concealed: Ductwork and plenums concealed from normal view above ceilings and in chases.

B. Exposed: Ductwork and plenums exposed to view in finished areas, including mechanical and electrical equipment rooms. Attics and crawl spaces where central station air handling units are located are considered to be mechanical equipment rooms.

1.7 DELIVERY, STORAGE AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and minimum use temperature.

B. Protect insulation against dirt, water, chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site. Insulation made wet or damaged even after installation shall be removed and replaced.

1.8 COORDINATION

A. Coordinate clearance requirements with duct Installer for insulation application.

1.9 SCHEDULING

A. Schedule insulation application after testing duct systems. Insulation application may begin on segments of ducts that have satisfactory test results.

2. PRODUCTS

2.1 MANUFACTURERS

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

1. Mineral-Fiber Insulation:
   CertainTeed Manson.
   Knauf FiberGlass GmbH.
   Owens-Corning Fiberglas Corp.
   Johns Manville

2.2 INSULATION MATERIALS

A. Mineral-Fiber Board Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612; Form A, Class 1, max. k=0.26 at 75 F mean, up to 250 F, 3.0 PCF density minimum; Type 1B, max. k=0.47 at 300 F mean, up to 850 F, 2.8 PCF density minimum; all without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.

2.3 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type I, unless otherwise indicated.

2.4 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz/sq. yd. (270 g/sq. m).

1. Tape Width: 4 inches (100 mm).

B. Bands: 3/4 inch (19 mm) wide, in one of the following materials compatible with jacket:

1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch (0.5 mm) thick.
2. Aluminum: 0.007 inch (0.18 mm) thick.

C. Wire: 0.080-inch (2.0-mm), nickel-copper alloy; 0.062-inch (1.6-mm), soft-annealed, stainless steel; or 0.062-inch (1.6-mm), soft-annealed, galvanized steel.

D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.

1. Welded Pin Holding Capacity: 100 lb (45 kg) for direct pull perpendicular to the attached surface.

E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb (45 kg) for direct pull perpendicular to the adhered surface.

F. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

2.5 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

3. EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.

B. Refer to schedules for materials, forms, jackets, and thicknesses required for each duct system. Unless otherwise indicated, furnish and install insulations of the same type for the same service throughout this work.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply multiple layers of insulation with longitudinal and end seams staggered.

E. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

F. Clean and dry ductwork prior to insulating.

G. Keep insulation materials clean and dry during application and finishing.

H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

I. Apply insulation with the least number of joints practical.

J. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

K. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.

L. Insulation Terminations: Seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder. No exposed fiberglass will be permitted.

M. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.

N. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.

O. Install vapor-retarder mastic on ducts and plenums.

1. Ducts with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.

P. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

1. Seal penetrations with vapor-retarder mastic.
2. Apply insulation for exterior applications tightly joined to interior insulation ends.
3. Seal insulation to roof flashing with vapor-retarder mastic.

Q. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions. Refer also to sound stopping requirements.

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Board Applications for Ducts and Plenums: Secure board insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Space anchor pins as follows:

    a. On duct sides with dimensions 18 inches (450 mm) and smaller, along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    b. On duct sides with dimensions larger than 18 inches (450 mm). Space 16 inches (400 mm) o.c. each way, and 3 inches *(75* mm) maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
    c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.

4. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch (13-mm) staples, 1 inch (25 mm) o.c., and cover with pressure-sensitive tape having same facing as insulation.

6. Apply insulation on duct elbows and transitions with a full insulation segment for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch-(150-mm-) wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches *(150* mm) o.c.
8. Apply vapor-retarder mastic for ducts other than flues to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.

1. Apply jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of jacket manufacturer's recommended adhesive.
3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

3.6 DUCT SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Materials and thicknesses for systems listed below are specified in schedules at the end of this Section.

C. Insulate the scheduled plenums and duct systems.

D. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment as applicable:

1. Metal ducts with duct liner.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
4. Ductwork flexible connectors.
5. Vibration-control devices.
6. Testing agency labels and stamps.
7. Nameplates and data plates.
8. Access panels and doors in air-distribution systems.

E. General: Where more than one material is indicated for a particular service, choice of listed material is installers option, unless otherwise indicated in duct material schedule on drawings.

3.7 INDOOR DUCT AND PLENUM APPLICATION SCHEDULE

A. General: Where more than one material is indicated for a particular service, choice of listed material is installers option, unless otherwise indicated in duct material schedule on drawings.

B. Service: Rectangular ducts, exposed

1. 2 inch thick (max 250 F) mineral fiberboard, all service jacket

END OF SECTION 230701

SECTION 230702 – PIPE INSULATION

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. Division 23 Common Work Results for HVAC and Basic HVAC Materials and Methods sections apply to work specified in this section.

1.2 SUMMARY

A. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds, as applicable to this project.

B. Related Sections include the following:

1. Division 23 Section “Basic HVAC Materials and Methods” for firestopping materials and requirements for penetrations through fire and smoke barriers.

2. Division 23 Section “Basic HVAC Materials and Methods” for sound stopping materials and requirements.

3. Division 23 Section “HVAC Duct Insulation” for insulation for ducts, flues and plenums.

4. Division 23 Section “Hangers and Supports for HVAC Piping and Equipment” for pipe insulation shields and protection saddles.

1.3 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 3 years successful installation experience on projects with mechanical insulations similar to that required for this project.

C. Fire-Test-Response Characteristics: as determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

B. Protect insulation against dirt, water, chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site. Insulation made wet or damaged even after installation shall be removed and replaced.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section “Hangers and Supports for HVAC Piping and Equipment”.

B. Coordinate clearance requirements with piping installer for insulation application.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after testing piping systems and, where required, after installing and testing heat-trace tape. Insulation application may begin on segments of piping that have satisfactory test results.

2. PRODUCTS

2.1 MANUFACTURERS

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

1. Flexible Elastomeric Thermal Insulation:

Armstrong World industries, inc.

Rubatex Corp.

2.2 INSULATION MATERIALS

A. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials, max k=0.28 at 75 F mean, up to 200 F.

1. Adhesive: As recommended by insulation material manufacturer.

2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

B. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.3 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils (0.5 mm) thick; roll stock ready for shop or field cutting and forming, white.

C. Heavy PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 30-mil- (0.75-mm-) thick, high-impact, ultraviolet-resistant PVC.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.

2. Adhesive: As recommended by insulation material manufacturer.

2.4 ACCESSORIES AND ATTACHMENTS

A. Bands: 3/4 inch (19 mm) wide, in one of the following materials compatible with jacket:

1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch (0.5 mm) thick.

2. Galvanized Steel: 0.005 inch (0.13 mm) thick.

3. Aluminum: 0.007 inch (0.18 mm) thick.

4. Brass: 0.010 inch (0.25 mm) thick.

5. Nickel-Copper Alloy: 0.005 (0.13 mm) thick.

B. Wire: 0.080-inch (2.0 mm), nickel-copper alloy; 0.062-inch (1.6 mm), soft-annealed, stainless steel; or 0.062-inch (1.6-mm), soft-annealed, galvanized steel.

2.5 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

3. EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system. Unless otherwise indicated, furnish and install insulations of the same type for the same service throughout this work.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.

E. Apply multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

H. Keep insulation materials clean and dry during application and finishing.

I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

J. Apply insulation with the least number of joints practical.

K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties. Insulate flanges, unions, strainer outlets and plug valve plugs with pressure fit removable and replaceable covers. Do not restrict valve operation in any way.

L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.

1. Apply insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches (300 mm) from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

M. Insulation Terminations: Taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder, and to seal fiberglass. No exposed fiberglass will be permitted.

N. Apply adhesives and mastics at the manufacturer’s recommended coverage rate.

O. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.

2. Circumferential Joints: Cover with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches (100 mm) o.c.

3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches (40 mm). Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.

a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.

4. Vapor Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.

5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

P. Roof Penetrations: Unless otherwise detailed, apply insulation for interior applications to a point even with top of roof flashing.

1. Seal penetrations with vapor-retarder mastic.

2. Apply insulation for exterior applications tightly joined to interior insulation ends.

3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.

4. Seal metal jacket to roof flashing with vapor retarder mastic.

Q. Exterior Wall Penetrations: Unless otherwise detailed, for penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.

R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partition. Refer also to sound stopping requirements.

S. Fire-Rated Wall and Partition Penetrations: Apply insulation through penetrations of fire-rated walls and partitions. Refer to drawing details and fire and sound stopping specification requirements.

T. Floor Penetrations: Apply insulation continuously through floor assembly.

1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder. Maintain fire rating as applicable.

3.4 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Follow manufacturer's written instructions for applying insulation.

2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to flanges as follows:

1. Apply pipe insulation to outer diameter of pipe flange.

2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

5. Flanges at equipment connections at temperatures less than 220 deg F which must be regularly accessed for equipment servicing (e.g. chiller connections), shall be insulated with minimum 3/4" thick flexible elastomeric, factory fabricated removable/reusable covers. Covers to be tight fitting, complete with velcro closures. Covers to be as manufactured by Corick, (504) 356-5830.

C. Apply insulation to fittings and elbows as follows:

1. Apply mitered sections of pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

D. Apply insulation to valves and specialties as follows:

1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.

2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to strainer basket.

3. Apply insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid opening in insulation that will allow passage of air to the pipe surface.

5. As an alternative to the valve as specialties insulation methods indicated above, insulate the following valves and specialties in sizes 2-1/2" and larger handling media at temperatures less than 220 deg F with minimum 3/4" flexible elastomeric insulation insulation or factory fabricated removable/reusable covers. Covers to be tight fitting, conforming to device contours with velcro closures. Covers to be as manufactured by Corick, (504) 356-5830.
   a. Valves.
   b. Strainers (provide removable/reusable section for basket removal if entire cover is not easily removable/reusable).
   c. Suction diffusers (provide removable/reusable section for basket removal if entire cover is not easily removable/reusable).
   d. Flexible connectors.

E. Coat exposed outdoor flexible elastomeric insulation after adhesive has fully cured with two coats of manufacturer's recommended protective white coating.

3.5 FIELD APPLIED JACKET APPLICATION

A. Apply PVC jacket where indicated, with 1-inch (25 mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive for a completely sealed waterproof installation. Completely sealed system shall comply with requirements of USDA and FDA.

3.6 PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment as applicable:

1. Flexible connectors on other than cold piping systems.

2. Fire-suppression piping (exclusive).

3. Drainage piping located in crawl spaces, unless otherwise indicated.

4. Below-grade piping, unless otherwise indicated.

5. Chrome-plated pipes and fittings, unless potential for personnel injury.

C. Plumbing Insulation Omitted: Unless otherwise indicated, omit insulation on chrome-plated exposed piping, shock absorbers, unions, strainers, check valves, flow regulators, drain lines from water coolers, drainage piping located in crawl spaces or tunnels, and pre-insulated equipment. See plumbing specifications for possible additional insulation requirements. Trap primer insulation may be omitted on trap primer piping in walls or underground.

D. HVAC Insulation Omitted: Omit insulation on hot piping within radiation enclosures or unit cabinets; on cold piping within unit cabinet provided piping is located over drain pan; and on heating water piping unions, flanges, strainers 2 inch and smaller, heating water piping flexible connectors and expansion joints 2 inches and smaller.

3.7 FIELD QUALITY CONTROL

A. Inspection: Perform the following field quality-control inspections, after installing insulation materials, jackets, and finishes, to determine compliance with requirements:

1. Inspect insulation assembly of fittings and valves randomly selected by Architect/Engineer.

B. Insulation applications will be considered defected if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.

C. Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.

D. All wet or damaged insulation shall be removed and replaced.

3.8 INSULATION APPLICATION SCHEDULE, GENERAL

A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.

B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements. Where more than one material is indicated for a particular service, choice of listed material is installer’s option, unless otherwise specifically indicated.

3.9 INTERIOR PIPE INSULATION APPLICATION SCHEDULE

A. Air Conditioning Condensate Drain Piping (35 to 75 deg F):

1. Flexible elastomeric; 3/4 inch thick, sizes up through 8 inches.

B. Refrigerant Suction, and Hot Gas Liquid Piping (35 to 120 deg F):

1. Flexible elastomeric; 3/4 inch thick.

3.10 EXTERIOR PIPE INSULATION

A. This application schedule is for aboveground insulation outside the building.

B. Exterior refrigerant suction, hot gas, and liquid piping (35 to 50 deg F):

1. Flexible elastomeric; 3/4 inch thick sizes, 1 inch and smaller, 1 inch thick for sizes over 1 inch, with two coats manufacturer’s white exterior protective finish and field applied PVC jacket.

END OF SECTION 230702

SECTION 230900 - ELECTRIC CONTROL SYSTEMS

1. ___GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including General and Supplementary Conditions, Special Conditions and the requirements of the Construction Manager's "Purchase Requisitions", Division 01 Specification Sections and Drawings, apply to this Section.

B. Division 23 Basic Mechanical Requirements and Basic Mechanical Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK

A. Extent of electric/electronic control systems work required by this section is indicated on drawings and schedules, and by requirements of this section.

1. Control sequences are on the temperature control drawings.

2. Direct Digital Control Systems are specified in Division-23 Section "Direct Digital Control Systems".

B. Refer to other Division 23 sections for installation of instrument wells, valve bodies, and dampers in mechanical systems; not work of this section.

C. Refer to Division 26 sections for the following work; not work of this section.

1. Power supply wiring for power source to power connection on controls and/or unit control panels. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

D. Provide the following electrical work as work of this section, complying with requirements of Division-26 sections:

1. Control wiring between field-installed controls, indicating devices, and unit control panels.

2. Interlock wiring between electronically-operated equipment units; and between equipment and field-installed control devices.

a. Interlock wiring specified as factory-installed is work of this section.

1.3 QUALITY ASSURANCE

A. Qualifications: Firms regularly engaged in the manufacturer and installation of electric/electronic control equipment, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards:

1. Electrical Standards: Provide electrical products which have been tested, listed and labeled by UL and comply with NEMA standards.

2. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for electric/electronic control systems.

3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions.

B. Shop Drawings: Refer to Division 23 section "Sequence of Operation" for shop drawings; not work of this section.

C. Maintenance Data: Submit maintenance instructions and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 01.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Provide factory shipping cartons for each piece of equipment, and control device. Maintain cartons through shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protected from weather.

2. ___ PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide electric control systems of one of the following:

Johnson Controls, Inc. – Youngstown Branch (Ed Dunkerly)

2.2 BASIC MATERIALS AND EQUIPMENT

A. General: Provide electric control products in sizes and capacities indicated, consisting of valves, dampers, thermostats, clocks, sensors, controllers, and other components as required for complete installation. Except as otherwise indicated, provide manufacturer's standard control system components as indicated by published product information, designed and constructed as recommended by manufacturer. Provide electric/electronic control systems with the following functional and construction features as indicated.

1. Low-Voltage On-Off Thermostats: Comply with general requirement indicated for line-voltage thermostats. Provide thermostats of bimetal operated non-mercury-switch type, with either adjustable or fixed universal anticipation heater.

2. Low Voltage Modulating Thermostat: Provide potentiometer type, operated by vapor-filled bellows.

B. Remote-Bulb Thermostats: Provide remote-bulb thermostats of on-off or modulating type, as required by sequence of operation. Provide liquid-filled units designed to compensate for changes in ambient temperature at instrument case. Provide capillary and bulb of copper unless otherwise indicated. Equip bulbs in water lines with separate wells of same material as bulb. Support bulbs installed in air ducts securely, to prevent damage and noise from vibrations. Provide averaging bulbs where shown or specified in operational sequence, consisting of copper tubing not less than 8'-0" in length with either single or multiple-unit elements. Extend tubing to cover full width of duct or unit, and support adequately.

1. Provide scale settings and differential settings where applicable, which are clearly visible and adjustable from front of instrument.

2. Equip on-off remote-bulb thermostats with precision snap switches, and with electrical ratings as required by application.

3. Provide modulating remote-bulb thermostats of potentiometer type constructed so that complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

C. Low-Temperature Protection Thermostats: Provide low-temperature protection thermostats of manual-reset type, with sensing elements 8'-0" or 20'-0" in length. Provide thermostat designed to operate in response to coldest 1'-0" length of sensing element, regardless of temperature at other parts of element. Support element properly to cover entire duct width. Provide separate thermostats for each 25 sq. ft. of coil face area or fraction thereof.

D. Provide complete, self-contained, variable capacitance type differential pressure transmitters equal to a Setra Systems Series 264. Wiring terminals and electronics shall be in separate compartments, so the electronics remain sealed during installation. Reverse polarity protection shall be included to keep wiring mishaps from damaging the transmitter. Wiring installed by the contractor between the control system and the transmitters shall be Belden 9320, two wire, shielded twisted cable, and shall not be included in conduit containing AC circuit wiring. Design range shall be as required by system. External zero and span adjustments, over-pressure to 2,000 PSI, and no humidity effects. Minimum accuracy shall be +/-0.25% of calibrated span. Includes combined effects of linearity, hysteresis and repeatability. Stability shall be +/-0.25% of upper range limit for six months. No internal mechanical linkages shall be used in the transmitter(s).

E. Temperature Sensors: Provide temperature sensors of the following types:

1. Provide master space-temperature sensors and other space-temperature indicating sensors of linear output type, 50 to 100 deg. F range, with blank locking covers.

2. Provide duct-mounting or immersion type sensors with 50-100-200 deg F range, as required for 3 to 15 psig pressure change.

3. Provide averaging-element sensors with minimum of 8’ total capillary element, with either single or multiple unit elements.

4. Provide temperature sensors of rigid-stem type using bi-metallic sensing elements except where averaging is required.

5. Provide corrosion resistant construction, tamper-proof sensors suitable for mounting on vibrating surface. For capillary type sensors, provide exposed capillary with temperature-compensated, armor or protective tubing.

6. Provide water pipe mounted sensing elements of rod-and-tube type for linear output, furnished complete with separable protecting wells filled with heat conductive compound, factory calibrated and tamper-proof. Locate adjustable controllers inside metal enclosures with cylinder lock and key to prevent unauthorized setting.

3. ___ EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which electric control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF ELECTRIC CONTROL SYSTEMS

A. General: Install systems and materials in accordance with manufacturer's instructions and roughing-in drawings, and details on drawings. Install electrical components and use electrical products complying with requirements of applicable Division-26 sections of these specifications. Mount controllers at convenient locations and heights.

B. Control Wiring: The term "control wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connecting electric/electronic control devices.

C. Wiring System: Install complete control wiring system for electric control systems. Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed. Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.

D. Number-code or color-code conductors, excluding those used for local individual room controls, appropriately for future identification and servicing of control system.

E. Reset Limit Controls: Install manual-reset limit controls to be independent of power controllers.

3.3 ADJUSTING AND CLEANING

A. Start-Up: Start-up, test, and adjust electric control systems in presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

C. Final Adjustment: After completion of installation, adjust thermostats, control valves, motors and similar equipment provided as work of this section.

1. Final adjustment shall be performed by specially trained personnel in direct employ of manufacturer of primary temperature control system.

END OF SECTION 230900

SECTION 230910 - BUILDING AUTOMATION SYSTEMS

1. GENERAL

1.1 SCOPE OF WORK

A. The Building Automation System (BAS) manufacturer shall furnish and install a fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems as herein specified. Complete temperature control system as specified herein.

B. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and not custom designed specially for this project. All systems and components shall have been thoroughly tested and proven in actual use for at least two years.

C. BAS manufacturer shall be responsible for all BAS and Temperature Control wiring for a complete and operable system. All wiring shall be done in accordance with all local and national codes.

D. Substitutions to system herein specified will not be acceptable.

1.2 WORK BY OTHERS

A. Mechanical contractor installs all wells, valves, taps, dampers, Air flow stations, etc. furnished by BAS manufacturer.

B. Electrical Contractor provides:

1. 120V power to all BAS an/or Temperature control panels

2. 120V power to Junction Boxes for VAV Terminal units for extension by T.C.C. (See electrical drawings for exact location of Junction boxes)

3. Wiring of all power feeds through all disconnect starters to electrical motor.

4. Wiring of any remote start/stop switches and manual or automatic motor speed control devices not furnished by BAS manufacturer.

C. Products integrated to, but not furnished under this section:

1. Fire / Life Safety

1.3 RELATED WORK

A. Division 010000 General and Special Conditions

B. Division 230000 Mechanical

C. Division 260000 Electrical

1.4 QUALITY ASSURANCE

A. The BAS system shall be designed and installed, commissioned and serviced by manufacturer employed, factory trained personnel. Manufacturer shall have an in-place support facility within 100 miles of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment. Distributors or licensed installing contractors are not acceptable.

B. The manufacturer shall provide an experienced project manager for this work, responsible for direct supervision of the design, installation, start up and commissioning of the B.M.S.

C. The Bidder shall be regularly engaged in the manufacturing, installation and maintenance of BMS systems and shall have a minimum of ten (10) years of demonstrated technical expertise and experience in the manufacture, installation and maintenance of B.M.S. systems similar in size and complexity to this project. A maintained service organization consisting of at least ten (10) competent servicemen for a period of not less than ten years and provide a list of 10 projects, similar in size and scope to this project, completed within the last five years.

D. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.

E. All BAS peer-to-peer network controllers, central system controllers and local user displays shall be UL Listed under Standard UL 916, category PAZX; Standard ULC C100, category UUKL7; and under Standard UL 864, categories UUKL, UDTZ, and QVAX. and be so listed at the time of bid. All floor level controllers shall comply, at a minimum, with UL Standard UL 91 6 category PAZX; Standard UL 864, categories UDTZ, and QVAX. and be so listed at the time of Bid.

F. The BAS peer-to-peer network controllers and local user display shall also comply with the Australian Electromagnetic Compatibility (EMC) Framework, and bear the C-Tic Mark to show compliance. The purpose of the regulation is to minimize electromagnetic interference between electronic products, which may diminish the performance of electrical products or disrupt essential communications.

G. DDC peer-to-peer controllers shall be compliant with the European EMC Directive, Standards EN 50081-2 and EN 50082-2, at the Industrial Levels. Additionally the equipment shall be compliant with the European LVD Directive and bear the CE mark in order to show compliance to both Directives."

H. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.

I. The manufacturer of the building automation system shall provide documentation supporting compliance with ISO-9002 (Model for Quality Assurance in Production, Installation, and Servicing) and ISO-140001 (The application of well-accepted business management principles to the environment). The intent of this specification requirement is to ensure that the products from the manufacturer are delivered through a Quality System and Framework that will assure consistency in the products delivered for this project.

J. This system shall have a documented history of compatibility by design for a minimum of 15 years. Future compatibility shall be supported for no less than 10 years. Compatibility shall be defined as the ability to upgrade existing field panels to current level of technology, and extend new field panels on a previously installed network.

K. Compatibility shall be defined as the ability for any existing field panel microprocessor to be connected and directly communicate with new field panels without bridges, routers or protocol converters.

1.5 SUBMITTALS

A. Submit (8) complete sets of documentation in the following phased delivery schedule:

1. Valve and damper schedules

2. Equipment data cut sheets
3. System schematics, including:
   a. sequence of operations
   b. point names
   c. point addresses
   d. interface wiring diagrams
   e. panel layouts.
   f. system riser diagrams
4. Auto-CAD compatible as-built drawings

B. Upon project completion, submit operation and maintenance manuals, consisting of the following:

1. Index sheet, listing contents in alphabetical order
2. Manufacturer's equipment parts list of all functional components of the system, Auto-CAD disk of system schematics, including wiring diagrams
3. Description of sequence of operations
4. As-Built interconnection wiring diagrams
5. Operator's Manual
6. Trunk cable schematic showing remote electronic panel locations, and all trunk data
7. List of connected data points, including panels to which they are connected and input device (ionization detector, sensors, etc.)

1.6 WARRANTY

A. Provide all services, materials and equipment necessary for the successful operation of the entire BAS system for a period of one year after beneficial use.

B. The adjustment, required testing, and repair of the system includes all computer equipment, transmission equipment and all sensors and control devices.

C. The on-line support services shall allow the local BAS subcontractor to dial out over telephone lines to monitor and control the facility's building automation system. This remote connection to the facility shall be within 2 hours of the time that the problem is reported. This coverage shall be extended to include normal business hours, after business hours, weekends and holidays.

D. If the problem cannot be resolved on-line by the local office, the national office of the building automation system manufacturer shall have the same capabilities for remote connection to the facility. If the problem cannot be resolved with on-line support services, the BAS manufacturer

shall dispatch the appropriate personnel to the job site to resolve the problem within 3 hours of the time that the problem is reported.

2. PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Johnson Controls, Inc.

2.2 NETWORKING COMMUNICATIONS

A. The design of the BAS shall network operator workstations and stand-alone DDC Controllers. The network architecture shall consist of multiple levels for communication efficiency, a campus-wide (Management Level Network) Ethernet network based on TCP/IP protocol, high performance peer-to-peer building level network(s) and DDC Controller floor level local area networks with access being totally transparent to the user when accessing data or developing control programs.

B The design of BAS shall allow the co-existence of new DDC Controllers with existing DDC Controllers in the same network without the use of gateways or protocol converters. The design of the new BAS shall incorporate the existing chilled water system interface as shown on H701, including all air handling units, devices, etc.

C. Peer-to-Peer Building Level Network:

1. All operator devices either network resident or connected via dial-up modems shall have the ability to access all point status and application report data or execute control functions for any and all other devices via the peer-to-peer network. No hardware or software limits shall be imposed on the number of devices with global access to the network data at any time.

2. The peer-to-peer network shall support a minimum of 100 DDC controllers and PC workstations

3. Each PC workstation shall support a minimum of 4 peer-to-peer networks hardwired or dial up.

4. The system shall support integration of third party systems (fire alarm, security, lighting, PCL, chiller, boiler) via panel mounted open protocol processor. This processor shall exchange data between the two systems for inter-process control. All exchange points shall have full system functionality as specified herein for hardwired points.

5. Telecommunication Capability:

a. Auto-dial/auto-answer communications shall be provided to allow DDC Controllers to communicate with remote operator stations and/or remote terminals via telephone lines, as indicated in the sequence of operations.

b. Auto-dial DDC Controllers shall automatically place calls to workstations to report alarms or other significant events. The auto-dial program shall include provisions for handling busy signals, "no answers" and incomplete data transfers.

c. Operators at dial-up workstations shall be able to perform all control functions, all report functions and all database generation and modification functions as described for workstations connected via the network. Routines shall be provided to automatically answer calls from remote DDC Controllers. The fact that

communications are taking place with remote DDC Controllers over telephone lines shall be completely transparent to an operator.

D. Management Level Network (MLN)

1. All Ethernet-capable PCs shall simultaneously direct connect to the Ethernet Management Level Network without the use of an interposing device.

2. Operator Workstation shall be capable of simultaneous direct connection and communication with the Apogee MLN networks without the use of interposing devices.

3. The Management Level Network shall not impose a maximum constraint on the number of operator workstations.

4. When appropriate, any controller residing on the peer-to-peer building level networks shall connect to Ethernet network without the use of a PC or a gateway with a hard drive.

5. Any PC on the Ethernet Management Level Network shall have transparent communication with controllers on the building level networks connected via Ethernet, as well as, directly connected building level networks. Any PC shall be able to interrogate any controller on the building level network.

6. Any break in Ethernet communication from the PC to the controllers on the building level networks shall result in an alarm notification at the PC.

7. The standard client and server workstations on the Management Level Network shall reside on industry standard Ethernet utilizing standard TCP/IP, IEEE 802.3

8. Any break in Ethernet communication between the standard client and server workstations on the Management Level Network shall result in a notification within the Windows taskbar at each workstation.

9. Access to the system database shall be available from any standard client workstation on the Management Level Network.

10. Client access to client-server workstation configurations over low-bandwidth network technologies shall be available via Windows Terminal Services. Remote client access via Windows Terminal Services shall provide multiple, independent sessions of the workstations software – Terminal Services clients shall have workstation software access, without the need to install the workstation software on the local hard drive.

2.3 DDC CONTROLLER FLOOR LEVEL NETWORK:

A. This level communication shall support a family of application specific controllers and shall communicate with the peer-to-peer network through DDC Controllers for transmission of global data.

2.4 DDC & HVAC MECHANICAL EQUIPMENT CONTROLLERS

A. The DDC & HVAC Mechanical Equipment Controllers shall reside on the Building Level Network.

B. DDC & HVAC Mechanical Equipment Controllers shall use the same programming language and tools. DDC & HVAC Mechanical Equipment Controllers which require different programming language or tools on a network are not acceptable.

C. DDC & HVAC Mechanical Equipment Controllers which do not meet the functions specified in Section 2.4.1 and Section 2.5 for DDC Controllers or Section 2.4.2 and Section 2.5 for HVAC Mechanical Equipment Controllers are not acceptable.

2.5 DDC CONTROLLERS

A. DDC Controllers shall be a 16-bit stand-alone, multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules. Controller size shall be sufficient to fully meet the requirements of this specification and the attached point I/O schedule. Each controller shall support a minimum of three (3) Floor Level Application Specific Controller Device Networks.

B. Each DDC Controller shall have sufficient memory to support its own operating system and databases, including:

1. Control processes
2. Energy management applications
3. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
4. Historical/trend data for points specified
5. Maintenance support applications
6. Custom processes
7. Operator I/O
8. Dial-up communications
9. Manual override monitoring

C. Each DDC Controller shall support firmware upgrades without the need to replace hardware.

D. Provide all processors, power supplies and communication controllers so that the implementation of a point only requires the addition of the appropriate point input/output termination module and wiring.

E. DDC Controllers shall provide a minimum two RS-232C serial data communication ports for operation of operator I/O devices such as industry standard printers, operator terminals, modems and portable laptop operator's terminals. DDC Controllers shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers or terminals.

F. As indicated in the point I/O schedule, the operator shall have the ability to manually override automatic or centrally executed commands at the DDC Controller via local, point discrete, on-board hand/off/auto operator override switches for digital control type points and gradual switches for analog control type points.

1. Switches shall be mounted either within the DDC Controllers key-accessed enclosure, or externally mounted with each switch keyed to prevent unauthorized overrides.

2. DDC Controllers shall monitor the status of all overrides and inform the operator that automatic control has been inhibited. DDC Controllers shall also collect override activity information for reports.

G. DDC Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Graduated intensity LEDs or analog indication of value shall also be provided for each analog output. Status indication shall be visible without opening the panel door.

H. Each DDC Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all panel components. The DDC Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.

I. In the event of the loss of normal power, there shall be an orderly shutdown of all DDC Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 60 days.

1. Upon restoration of normal power, the DDC Controller shall automatically resume full operation without manual intervention.

2. Should DDC Controller memory be lost for any reason, the user shall have the capability of reloading the DDC Controller via the local RS-232C port, via telephone line dial-in or from a network workstation PC.

J. Provide a separate DDC Controller for each AHU or other HVAC system as indicated in Section 3.02. It is intended that each unique system be provided with its own point resident DDC Controller.

K. Minimum Approved Building Controllers. BMS Contractors shall furnish Building Controllers as listed below. Providing an approved controller does not release the contractor from meeting all performance, software and hardware specifications for Building Controllers and system operations.

1. Siemens Building Technologies Inc. - Modular Building/Equipment Controllers (MBC/MEC).

2. Johnson Controls Inc., Metasys Extended Architecture- (with NAE-55 and DX-9100s mounted in a common enclosure as a DDC panel).

2.6 HVAC MECHANICAL EQUIPMENT CONTROLLERS

A. HVAC Mechanical Equipment Controllers shall be a 12-bit stand-alone, multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors.

B. Each HVAC Mechanical Controller shall have sufficient memory to support its own operating system and databases, including:

1. Control processes

2. Energy management applications

3. Alarm management applications including custom alarm messages for each level alarm for each point in the system.

4. Historical/trend data for points specified

5. Maintenance support applications

6. Custom processes

7. Operator I/O

8. Dial-up communications

C. Each HVAC Mechanical Equipment Controller shall support firmware upgrades without the need to replace hardware.

D. HVAC Mechanical Equipment Controllers shall provide a RS-232C serial data communication port for operation of operator I/O devices such as industry standard printers, operator terminals, modems and portable laptop operator's terminals.

E. HVAC Mechanical Equipment Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device.

F. Each HVAC Mechanical Equipment Controller shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all components. The HVAC Mechanical Equipment Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.

G. In the event of the loss of normal power, there shall be an orderly shutdown of all HVAC Mechanical Equipment Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.

1. Upon restoration of normal power, the HVAC Mechanical Equipment Controller shall automatically resume full operation without manual intervention.

2. Should HVAC Mechanical Equipment Controller memory be lost for any reason, the user shall have the capability of reloading the HVAC Mechanical Equipment Controller via the local RS-232C port, via telephone line dial-in or from a network workstation PC.

2.7 DDC & HVAC MECHANICAL EQUIPMENT CONTROLLER RESIDENT SOFTWARE FEATURES

A. General:

1. The software programs specified in this Section shall be provided as an integral part of DDC and HVAC Mechanical Equipment Controllers and shall not be dependent upon any higher-level computer for execution.

2. All points shall be identified by up to 30- character point name and 16-character point descriptor. The same names shall be used at the PC workstation.

3. All digital points shall have user defined two-state status indication (descriptors with minimum of 8 characters allowed per state (i.e. summer/winter).

B. Control Software Description:

1. The DDC and HVAC Mechanical Equipment Controllers shall have the ability to perform the following pre-tested control algorithms:

a. Two-position control

b. Proportional control

c. Proportional plus integral control

d. Proportional, integral, plus derivative control

e. Automatic tuning of control loops

C. DDC and HVAC Mechanical Equipment Controllers shall provide the following energy management routines for the purpose of optimizing energy consumption while maintaining occupant comfort.

1. Start-Stop Time Optimization (SSTO) shall automatically be coordinated with event scheduling. The SSTO program shall start HVAC equipment at the latest possible time that will allow the equipment to achieve the desired zone condition by time of occupancy. The SSTO program shall also shut down HVAC equipment at the earliest possible time before the end of the occupancy period, and still maintain desired comfort conditions.

a. The SSTO program shall operate in both the heating and cooling seasons.

1) It shall be possible to apply the SSTO program to individual fan systems.

2) The SSTO program shall operate on both outside weather conditions as well as inside zone conditions and empirical factors.

b. The SSTO program shall meet the local code requirements for minimum outside air while the building is occupied.

2. Event Scheduling: Provide a comprehensive menu driven program to automatically start and stop designated points or groups of points according to a stored time.

a. It shall be possible to individually command a point or group of points.

b. For points assigned to one common load group, it shall be possible to assign variable time delays between each successive start or stop within that group.

c. The operator shall be able to define the following information:

1) Time, day

2) Commands such as on, off, auto, and so forth.

3) Time delays between successive commands.

4) There shall be provisions for manual overriding of each schedule by an appropriate operator.

d. It shall be possible to schedule events up to one year in advance.

1) Scheduling shall be calendar based.

2) Holidays shall allow for different schedules.

3. Enthalpy switchover (economizer). The Energy Management Control Software (EMCS) will control the position of the air handler relief, return, and outside air dampers. If the outside air dry bulb temperature falls below changeover set point the EMCS will modulate the dampers to provide 100 percent outside air. The user will be able to quickly changeover to an economizer system based on dry bulb temperature and will be able to override the economizer cycle and return to minimum outside air operation at any time.

4. Temperature-compensated duty cycling.

a. The DCCP (Duty Cycle Control Program) shall periodically stop and start loads according to various patterns.

b. The loads shall be cycled such that there is a net reduction in both the electrical demands and the energy consumed.

5. Automatic Daylight Savings Time Switchover: The system shall provide automatic time adjustment for switching to/from Daylight Savings Time.

6. Night setback control: The system shall provide the ability to automatically adjust setpoints for night control.

7. The Peak Demand Limiting (PDL) program shall limit the consumption of electricity to prevent electrical peak demand charges.

a. PDL shall continuously track the amount of electricity being consumed, by monitoring one or more electrical kilowatt-hour/demand meters. These meters may measure the electrical consumption (kWh), electrical demand (kW), or both.

b. PDL shall sample the meter data to continuously forecast the demand likely to be used during successive time intervals.

c. If the PDL forecasted demand indicates that electricity usage is likely to exceed a user preset maximum allowable level, then PDL shall automatically shed electrical loads.

d. Once the demand peak has passed, loads that have been shed shall be restored and returned to normal control.

D. DDC and HVAC Mechanical Equipment Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.

1. A single process shall be able to incorporate measured or calculated data from any and all other DDC and HVAC Mechanical Equipment Controllers on the network. In addition, a single process shall be able to issue commands to points in any and all other DDC and HVAC Mechanical Equipment Controllers on the network. Database shall support 30 character, English language point names, structured for searching and logs.

2. Processes shall be able to generate operator messages and advisories to operator I/O devices. A process shall be able to directly send a message to a specified device or cause the execution of a dial-up connection to a remote device such as a printer or pager.

3. DDC and HVAC Mechanical Equipment Controller shall provide a HELP function key, providing enhanced context sensitive on-line help with task orientated information from the user manual.

4. DDC and HVAC Mechanical Equipment Controller shall be capable of comment lines for sequence of operation explanation.

E. Alarm management shall be provided to monitor and direct alarm information to operator devices. Each DDC and HVAC Mechanical Equipment Controller shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic and prevent alarms from being lost. At no time shall the DDC and HVAC Mechanical Equipment Controllers ability to report alarms be affected by either operator or activity at a PC workstation, local I/O device or communications with other panels on the network.

1. All alarm or point change reports shall include the point's English language description and the time and date of occurrence.

2. The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of six priority levels shall be provided for each point. Point priority levels shall be combined with user definable destination categories (PC, printer, DDC Controller, etc.) to provide full flexibility in defining the handling of system alarms. Each DDC and HVAC Mechanical Equipment Controller shall automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point.

3. Alarm reports and messages will be directed to a user-defined list of operator devices or PCs based on time (after hours destinations) or based on priority.

4. In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 200 character alarm message to more fully describe the alarm condition or direct operator response.

5. In dial-up applications, operator-selected alarms shall initiate a call to a remote operator device.

F. A variety of historical data collection utilities shall be provided to manually or automatically sample, store and display system data for points as specified in the I/O summary.

1. Any point, physical or calculated may be designated for trending. Any point, regardless of physical location in the network, may be collected and stored in each DDC and HVAC Mechanical Equipment Controllers point group. Two methods of collection shall be allowed: either by a pre-defined time interval or upon a pre-defined change of value. Sample intervals of l minute to 7 days shall be provided. Each DDC and HVAC Mechanical Equipment Controller shall have a dedicated RAM-based buffer for trend data and shall be capable of storing a minimum of _ data samples. All trend data shall be available for transfer to a Workstation without manual intervention.

2. DDC and HVAC Mechanical Equipment Controllers shall also provide high resolution sampling capability for verification of control loop performance. Operator-initiated automatic and

manual loop tuning algorithms shall be provided for operator-selected PID control loops as identified in the point I/O summary.

a. Loop tuning shall be capable of being initiated either locally at the DDC and HVAC Mechanical Equipment Controller, from a network workstation or remotely using dial-in modems. For all loop tuning functions, access shall be limited to authorized personnel through password protection.

G. DDC and HVAC Mechanical Equipment Controllers shall be capable of automatically accumulating and storing run-time hours for digital input and output points and automatically sample, calculate and store consumption totals for analog and digital pulse input type points, as specified in the point I/O schedule.

H. The peer-to-peer network shall allow the DDC and HVAC Mechanical Equipment Controllers to access any data from or send control commands and alarm reports directly to any other DDC and HVAC Mechanical Equipment Controller or combination of controllers on the network without dependence upon a central or intermediate processing device. DDC and HVAC Mechanical Equipment Controllers shall send alarm reports to multiple workstations without dependence upon a central or intermediate processing device. The peer-to-peer network shall also allow any DDC and HVAC Mechanical Equipment Controller to access, edit, modify, add, delete, back up, and restore all system point database and all programs.

I. The peer-to-peer network shall allow the DDC and HVAC Mechanical Equipment Controllers to assign a minimum of 50 passwords access and control priorities to each point individually. The logon password (at any PC workstation or portable operator terminal) shall enable the operator to monitor, adjust and control the points that the operator is authorized for. All other points shall not be displayed on the PC workstation or portable terminal (e.g. all base building and all tenant points shall be accessible to any base building operators, but only tenant points shall be accessible to tenant building operators). Passwords and priorities for every point shall be fully programmable and adjustable.

2.8 FLOOR LEVEL NETWORK APPLICATION SPECIFIC CONTROLLERS (ASC)

A. Each DDC Controller shall be able to extend its performance and capacity through the use of remote application specific controllers (ASCs) through Floor Level LAN Device Networks.

B. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor. Each ASC shall be capable of control of the terminal device independent of the manufacturer of the terminal device.

C. Terminal Equipment Controllers:

1. Provide for control of each piece of equipment, including, but not limited to, the following:

a. Variable Air Volume (VAV) boxes

b. Constant Air Volume (CAV) boxes

c. Fan Powered (FPVAV) Terminal Boxes

2. Controllers shall include all point inputs and outputs necessary to perform the specified control sequences. Analog outputs shall be industry standard signals such as 24V floating control, 3-15 psi pneumatic, 0-10v, allowing for interface to a variety of modulating actuators.

3. All controller sequences and operation shall provide closed loop control of the intended application. Closing control loops over the FLN, BLN or MLN is not acceptable

2.9 PERSONAL COMPUTER OPERATOR INTERFACE

A. Workstation hardware:

1. Personal computer operator workstations shall be provided for command entry, information management, system monitor, alarm management and database management functions. All real-time control functions shall be resident in the Building Controllers to facilitate greater distribution, fault tolerance and reliability of the building automation control.

a. Provide workstation(s) as located on plans.

b. Workstation shall consist of a personal computer with minimum 512MB RAM, hard drive with 80 GB available space, video card with 64 MB RAM capable of supporting a minimum of 1280 × 1024 resolution with a minimum of 32 Bit color, CD-RW, and DVD-ROM Drive, mouse and 101-key enhanced keyboard. Personal computer shall be a Windows XP, 2000 or comparable operating system and shall include a minimum 3.0 GHz Pentium processor.

c. The PC monitor shall be of flat panel type and shall support a minimum display resolution of no less than 1280 × 1024 pixels. The display shall have a minimum of 17" visible area in diagonal measurement. Separate controls shall be provided for color, contrasts and brightness. The screen shall be non-reflective.

d. Provide an Epson FX-870 or equivalent printer at each workstation location or on the network (Ethernet) for recording alarms, operator transactions and systems reports.

e. Provide a color printer for printing of dynamic trend graph report, Excel reports, graphics and any other screen displays. Printer shall include as a minimum Okidata Microline 590 or equivalent.

f. Alarm Display shall list the alarms with highest priority at the top of the display. The alarm display shall provide selector buttons for display of the associated point graphic and message. The alarm display shall provide a mechanism for the operator to sort alarms.

B. Server hardware:

1. The Server hardware shall be of equal or better capability as that of Workstation and shall be equipped as follows.

a. Locate server as located on plans.

b. Provide a minimum 2GB RAM, with two hard drives of 160 GB available space each, with a RAID controller, a video card with 64 MB RAM capable of supporting a minimum of 1280 × 1024 resolution with a minimum of 32 Bit color, CD-RW, and DVD-ROM Drive, mouse and 101-key enhanced keyboard. Server shall be a Windows 2003 or comparable operating system, and shall include a minimum 3.0 GHz Pentium processor.

c. Provide a monitor of flat panel type and shall support a minimum display resolution of no less than 1280 × 1024 pixels. The display shall have a minimum of 17" visible area

in diagonal measurement. Separate controls shall be provided for color, contrasts and brightness. The screen shall be non-reflective.

2.10 WORKSTATION OPERATOR INTERFACE SOFTWARE

A. Basic Interface Description

1. Workstation operator interface will be acceptable for resident only for the new hospital only with the ability to communicate with the existing Youngstown Hospital via web-based system.

2. Operator workstation interface software shall minimize operator training through the use of user-friendly and interactive graphical applications, 30-character English language point identification, on-line help, and industry standard Windows application software. Interface software shall simultaneously communicate with and share data between any combination of dedicated, modem autodial, and Ethernet-connected building level networks. The software shall provide, as a minimum, the following functionality:

a. Real-time graphical viewing and control of the BAS environment

b. Reporting

c. Scheduling and override of building operations

d. Collection and analysis of historical data

e. Point database editing, storage and downloading of controller databases.

f. Alarm reporting, routing, messaging, and acknowledgment

g. “Collapsible tree,” dynamic system architecture diagram application:

- Showing the real-time status and definition details of all workstations and devices on a management level network

- Showing the real-time status and definition details of all DDC and HVAC Mechanical Controllers at the building level

- Showing the status and definition details of all field-level application controllers

h. Definition and construction of dynamic color graphic displays.

i. Online, context-sensitive help, including an index, glossary of terms, and the capability to search help via keyword or phrase.

j. On-screen access to User Documentation, via online help or PDF-format electronic file.

k. Automatic database backup at the workstation for database changes initiated at DDC Controller operator interface terminals.

l. Display dynamic trend data graphical plot

- Must be able to run multiple plots simultaneously

- Each plot must be capable of supporting 10 pts/plot minimum

- Must be able to command points directly off dynamic trend plot application.
- Must be able to plot both real-time and historical trend data

m. Program editing

n. Transfer trend data to 3rd party spreadsheet software

o. Scheduling reports

p. Operator Activity Log

2. Provide a graphical user interface that shall minimize the use of keyboard through the use of a mouse or similar pointing device, with a "point and click" approach to menu selection and a “drag and drop” approach to inter-application navigation. Selection of applications within the workstation software shall be via a graphical toolbar menu – the application toolbar menu shall have the option to be located in a docked position on any of the four sides of the visible desktop space on the workstation display monitor, and the option to automatically hide itself from the visible monitor workspace when not being actively manipulated by the user.

3. The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. BAS software shall run on a Windows XP or NT 32 bit operating system. Standard Windows applications shall run simultaneously with the BAS software. The mouse or Alt-Tab keys shall be used to quickly select and switch between multiple applications. The operator shall be able to work in Microsoft Word, Excel, and other Windows based software packages, while concurrently annunciating on-line BAS alarms and monitoring information.

   a. Provide functionality such that any of the following may be performed simultaneously on-line, and in any combination, via adjustable user-sized windows. Operator shall be able to drag and drop information between the following applications, reducing the number of steps to perform a desired function (e.g., Click on a point on the alarm screen and drag it to the dynamic trend graph application to initiate a dynamic trend on the desired point):

      1. Dynamic color graphics application
      2. Alarm management application
      3. Scheduling application
      4. Dynamic trend graph data plotter application
      5. Dynamic system architecture diagram application
      6. Control Program and Point database editing applications
      7. Reporting applications

   b. Report and alarm printing shall be accomplished via Windows Print Manager, allowing use of network printers.

4. Operator-specific password access protection shall be provided to allow the administrator/manager to limit users’ workstation control, display and data base manipulation

capabilities as deemed appropriate for each user, based upon an assigned password. Operator privileges shall "follow" the operator to any workstation logged onto (up to 999 user accounts shall be supported). The administrator/manager shall be able to grant discrete levels of access and privileges, per user, for each point, graphic, report, schedule, and BAS workstation application. And each BAS workstation user account shall use a Windows 2000/NT user account as a foundation.

a. The workstation software shall also include an application to track the actions of each individual operator, such as alarm acknowledgement, point commanding, schedule overriding, database editing, and logon/logoff. The application shall list each of the actions in a tabular format, and shall have sorting capabilities based on parameters such as ascending or descending time of the action, or name of the object on which the action was performed. The application shall also allow querying based on object name, operator, action, or time range.

5. Dynamic Color Graphics application shall include the following:

a. Must include graphic editing and modifying capabilities

b. A library of standard control application graphics and symbols must be included

c. Must be able to command points directly off graphics application

d. Graphic display shall include the ability to depict real-time point values dynamically with animation, symbol association, or dynamic informational text-blocks

e. Navigation through various graphic screens shall be optionally achieved through a hierarchical “tree” structure

f. Graphics viewing shall include zoom capabilities

g. Graphics shall automatically display the HAND status of points that have been overridden by a field HAND switch, for points that have been designed to provide a field HAND override capability.

6. Reports shall be generated on demand or via pre-defined schedule, and directed to CRT displays, printers or file. As a minimum, the system shall allow the user to easily obtain the following types of reports:

a. A general listing of all or selected points in the network

b. List of all points currently in alarm

c. List of all points currently in override status

d. List of all disabled points

e. List of all points currently locked out

f. List of user accounts and access levels

g. List all weekly schedules and events

h. List of holiday programming

i. List of control limits and dead-bands

j. Custom reports from 3rd party software

k. System diagnostic reports including, list of DDC panels on line and communicating, status of all DDC terminal unit device points

l. List of programs

m. List of point definitions

n. List of alarm strategy definitions

o. List of DDC Control panels

p. Point totalization report

q. Point Trend data listings

r. Initial Values report

s. User activity report

7. Scheduling and override: Provide a calendar type format for simplification of time and date scheduling and overrides of building operations. Schedule definitions reside in the PC workstation, DDC Controller, and HVAC Mechanical Equipment Controller to ensure time equipment scheduling when PC is off-line -- PC is not required to execute time scheduling. Provide override access through menu selection, graphical mouse action or function key. Provide the following capabilities as a minimum:

   a. Weekly schedules

   b. Zone schedules

   c. Event schedules – an event consists of logical combinations of equipment and/or zones

   d. Report schedules

   e. Ability to schedule for a minimum of up to 365 days in advance

      Additionally, the scheduling application shall:

   a. Provide filtering capabilities of schedules, based on name, time, frequency, and schedule type (event, zone, report)

   b. Provide sorting capabilities of schedules, based on name, time and type of schedule (zone, event, report)

   c. Provide searching capabilities of schedules based on name – with wildcarding options

8. Collection and Analysis of Historical Data

   a. Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals (up to four time-based definitions per point) or change of value, both of which shall be user-definable. Trend data shall be collected stored on hard disk for future diagnostics and reporting. Automatic Trend collection

may be scheduled at regular intervals through the same scheduling interface as used for scheduling of zones, events, and reports. Additionally, trend data may be archived to network drives or removable disk media for future retrieval.

b. Trend data reports shall be provided to allow the user to view all trended point data. Reports may be customized to include individual points or predefined groups of selected points. Provide additional functionality to allow predefined groups of up to 250 trended points to be easily transferred on-line to Microsoft Excel. DDC contractor shall provide custom designed spreadsheet reports for use by the owner to track energy usage and cost, equipment run times, equipment efficiency, and/or building environmental conditions. DDC contractor shall provide setup of custom reports including creation of data format templates for monthly or weekly reports.

c. Provide additional functionality that allows the user to view real-time trend data on trend graphical plot displays. A minimum of ten points may be plotted, of either real-time or historical data. The dynamic graphs shall continuously update point values. At any time the user may redefine sampling times or range scales for any point. In addition, the user may pause the graph and take "snapshots" of plot screens to be stored on the workstation disk for future recall and analysis. Exact point values may be viewed and the graphs may be printed. A minimum of 8 true graphs shall run simultaneously. Operator shall be able to command points directly on the trend plot by double clicking on the point. Operator shall be able to zoom in on a specific time range within a plot. The dynamic trend plotting application shall support the following types of graphs, with option to graph in 3D: line graph, area graph, curve graph, area-curve graph, step graph, and scatter graph. Each graph may be customized by the user, for graph type, graph text, titles, line styles and weight, colors, and configurable x- and y-axes.

B. Dynamic Color Graphic Displays

1. Create (1) color graphic floor plan displays and system schematics for each piece of mechanical equipment, including air handling units, chilled water systems and hot water boiler systems, and room level terminal units, shall be provided by the BAS contractor as indicated in the point I/O schedule of this specification to optimize system performance, analysis and speed alarm recognition.

2. The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection, point alarm association, or text-based commands. Graphics software shall permit the importing of Auto-cad or scanned pictures for use in the system.

3. Dynamic temperature values, humidity values, flow values and status indication shall be shown in their actual respective locations within the system schematics or graphic floor plan displays, and shall automatically update to represent current conditions without operator intervention and without pre-defined screen refresh rates.

a. Provide the user the ability to display real-time point values by animated visual representation. Animation shall depict movement of mechanical equipment, or air or fluid flow. A library (set) of animation symbols shall be included within the workstation software’s graphics application. Animation shall reflect, ON or OFF conditions, and shall also be optionally configurable for up to five rates of animation speed.

b. Sizable analog bars shall be available for monitor and control of analog values; high and low alarm limit settings shall be displayed on the analog scale. The user shall be able to "click and drag" the pointer to change the setpoint.

c. Provide the user the ability to display blocks of point data by defined point groups; alarm conditions shall be displayed by flashing point blocks.

d. Equipment state or values can be changed by clicking on the associated point block or graphic symbol and selecting the new state (on/off) or setpoint.

e. State text for digital points can be user-defined up to eight characters.

4. Colors shall be used to indicate status and change as the status of the equipment changes. The state colors shall be user definable.

5. The windowing environment of the PC operator workstation shall allow the user to simultaneously view several applications at a time to analyze total building operation or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.

6. Off the shelf graphic software, Microgafx Designer or Corel Draw software shall be provided to allow the user to add, modify or delete system graphic background displays.

7. A clipart library of HVAC application and automation symbols shall be provided including fans, valves, motors, chillers, AHU systems, standard ductwork diagrams and laboratory symbols. The user shall have the ability to add custom symbols to the clipart library. The clipart library shall include a minimum of 400 application symbols. In addition, a library consisting of a minimum of 700 graphic background templates shall be provided.

8. The Graphics application shall include a set of standard Terminal Equipment controller application-specific background graphic templates. Templates shall provide the automatic display of a selected Terminal Equipment controller's control values and parameters, without the need to create separate and individual graphic files for each controller.

C. System Configuration & Definition

1. A" Collapsible tree," dynamic system architecture diagram/display application of the site-specific BAS architecture showing status of controllers, PC workstations and networks shall be provided. This application shall include the ability to add and configure workstations, DDC Controllers or HVAC Mechanical Equipment controllers, as well as 3rd-party integrated components. Symbols/Icons representing the system architecture components shall be user-configurable and customizable, and a library of customized icons representing 3rd-party integration solutions shall be included. This application shall also include the functionality for real-time display, configuration and diagnostics of dial-up modems to DDC Controllers.

2. Network wide control strategies shall not be restricted to a single DDC Controller or HVAC Mechanical Equipment controller, but shall be able to include data from any and all other network panels to allow the development of Global control strategies.

3. Provide automatic backup and restore of all DDC controller and HVAC Mechanical Equipment controller databases on the workstation hard disk. In addition, all database changes shall be performed while the workstation is on-line without disrupting other system operations. Changes shall be automatically recorded and downloaded to the appropriate DDC Controller or HVAC Mechanical Equipment Controller. Changes made at the user-interface of DDC

Controllers or HVAC Mechanical Equipment Controllers shall be automatically uploaded to the workstation, ensuring system continuity.

4. System configuration, programming, editing, graphics generation shall be performed on-line. If programming and system back-up must be done with the PC workstation off-line, the BAS contractor shall provide at least 2 operator workstations.

5. Point database configuration shall be available to the user within a dedicated point database editor application included in the workstation software. The editor shall allow the user to create, view existing, modify, copy, and delete points from the database. The point editor shall also allow the user to configure the alarm management strategy for each point. The editor shall provide the option for editing the point database in an online or offline mode with the DDC Controllers.

    a. The workstation software shall also provide the capability to perform bulk modification of point definition attributes to a single or multiple user-selected points. This function shall allow the user to choose the properties to copy from a selected point to another point or set of points. The selectable attributes shall include, but are not limited to, Alarm management definitions and Trend definitions.

6. Control program configuration shall be available to the user within a dedicated control program editor application included in the workstation software. The editor shall allow for creation, modification and deletion of control programs. The editor shall include a programming assistance feature that interactively guides the user through parameters required to generate a control program. The editor shall also include the ability to automatically compile the program to ensure its compatibility with the DDC Controllers. The editor shall provide the option for editing the control programs in an online or offline mode, and also the ability to selectively enable or disable the live program execution within the DDC Controllers.

D. Alarm Management

1. Alarm Routing shall allow the user to send alarm notification to selected printers or workstation location(s) based on time of day, alarm severity, or point type.

2. Alarm Notification shall be presented to each workstation in a tabular format application, and shall include the following information for each alarm point: name, value, alarm time & date, alarm status, priority, acknowledgement information, and alarm count. Each alarm point or priority shall have the ability to sound a discrete audible notification.

3. Alarm Display shall have the ability to list & sort the alarms based on alarm status, point name, ascending or descending alarm time.

4. Directly from the Alarm Display, the user shall have the ability to acknowledge, silence the alarm sound, print, or erase each alarm. The interface shall also have the option to inhibit the erasing of active acknowledged alarms, until they have returned to normal status. The user shall also have the ability to command, launch an associated graphic or trended graphical plot, or run a report on a selected alarm point directly on the Alarm Display.

5. Each alarm point shall have a direct link from the Alarm Display to further user-defined point informational data. The user shall have the ability to also associate real-time electronic annotations or notes to each alarm.

6. Alarm messages shall be customizable for each point, or each alarm priority level, to display detailed instructions to the user regarding actions to take in the event of an alarm. Alarm messages shall also have the optional ability to individually enunciate on the workstation display via a separate pop-up window, automatically being generated as the associated alarm condition occurs.

7. Alarm Display application shall allow workstation operators to send and receive real-time messages to each other, for purposes of coordinating Alarm and BAS system management.

8. Remote notification of messages:

   a. Workstation shall be configured to send out messages to numeric pagers, alphanumeric pagers, phones (via text to speech technology), and email accounts based on a point's alarm condition.

   b. There shall be no limit to the number of points that can be configured for remote notification of alarm conditions and no limit on the number of remote devices, which can receive messages from the system.

   c. On a per point basis, system shall be configurable to send messages to an individual or group and shall be configurable to send different messages to different remote devices based on alarm message priority level.

   d. Remote devices may be scheduled as to when they receive messages from the system to account for operators' work schedules.

   e. System must be configurable to send messages to an escalation list so that if the first device does not respond, the message is sent on to the next device after a configurable time has elapsed.

   f. Message detail shall be configurable on a per user basis.

   g. Workstation shall have the ability to send manual messages allowing an operator to type in a message to be sent immediately.

   h. Workstation shall have a feature to send a heartbeat message to periodically notify users that they have communication with the system.

2.11 FIELD DEVICES

A. Temperature Sensors - with accuracy of + 5 deg F @ 77 deg F (Match existing in Hospital)

1. Digital room sensors shall have LCD display, day / night override button, and setpoint slide adjustment override options. The setpoint slide adjustment can be software limited by the automation system to limit the amount of room adjustment.

2. Built-in port allows connection of Portable operator terminal to query and modify operating parameters on room level sensor.

3. Room sensors shall have sensing accuracy of +.5 deg F, display accuracy and resolution shall be a minimum of + 1 deg F.

4. Duct temperature sensors - Precision platinum RTD element. All duct cross sections greater than 10 square feet shall have serpentine averaging element to adequately average stratified air temperatures.

B. Air differential pressure transmitter - Setra C264 or equal. Select range for application. Accuracy +/- 1% full scale.

C. Airflow Measurement Station

1. Flow measuring station shall be of the Pitot averaging type. The Pitot array shall be encased in a flanged section (spool piece) with airflow straightening vanes mounted at the inlet. Flange to flange dimensions shall be 12 inches. Casing and flanges shall be constructed of galvanized steel or 304SS/316SS. Pitot array shall be constructed of brazed copper or welded 304SS/316SS.

2. Airflow straightening vanes shall have 3/8-inch hexagon cells with a Length/Diameter Ratio of 7 to 9. Sensing ports shall be per ASHRAE design. Static pressure shall be measured by hemispherical tipped static wands, aligned parallel with the direction of flow. Accuracy/Repeatability shall be +/- 1.0% / +/- 0.10% with a flow turndown range of 25:1.

D. Isolation Room Pressure Monitors

1. Room pressure monitor - The differential pressure monitor shall include normal and alarm status lights, a local audible alarm, alarm silence button, local LED pressure display in inches of water and selector key switch.

2. Alarms - The BAS shall receive an alarm should the room lose isolation status (either protective or infectious) as determined by the measured differential pressure monitor. Provide time delay for alarms to prevent nuisance alarms during entering or exiting mode or setpoint changes.

3. Addressable Device-The Room Pressure Monitor shall be compatible with the Building Automation Systems local area network. All alarms, pressure values, pressure changes, key switch position and pressure mode shall be recorded and trended by the Building Automation System Workstation.

3. EXECUTION

3.1 PROJECT MANAGEMENT

A. Provide a designated project manager who will be responsible for the following:

1. Construct and maintain project schedule

2. On-site coordination wit all applicable trades and subcontractors

3. Authorized to accept and execute orders or instructions from owner/architect

4. Attend project meetings as necessary to avoid conflicts and delays

5. Make necessary field decisions relating to this scope of work

6. Coordination/Single point of contact

3.2 ELECTRICAL INSTALLATION

A. All temperature control devices herein specified shall be electric/electronic and shall be installed in accordance with all local and national electrical codes.

B. Wiring of valves, switches, relays and other interlock wiring required for a complete operation of

temperature control equipment furnished under Division 15 shall be by this contractor.

B. All exposed and concealed temperature control wiring shall be installed in conduit and follow the Division 26 specifications for proper product application. All low voltage wiring in concealed and accessible areas may be plenum rated cable.

3.3 START-UP AND COMMISSIONING

A. When installation of the system is complete, calibrate equipment and verify transmission media operation before the system is placed on-line. All testing, calibrating, adjusting and final field tests shall be completed by the installer. Verify that all systems are operable from local controls in the specified failure mode upon panel failure or loss of power.

B. Provide any recommendation for system modification in writing to owner. Do not make any system modification, including operating parameters and control settings, without prior approval of owner.

3.4 EXISTING CONTROL DEVICES

A. The bid for the control work shall be based on the premise that existing control devices are operational and are not in need of repair or replacement, unless otherwise noted.

B. This subcontractor shall notify the owner's representative of existing control devices that need to be replaced or repaired that may be noted in the process of installation of the new work.

3.5 TRAINING

A. The contractor shall provide factory trained instructor to give full instruction to designated personnel in the operation of the system installed. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. The contractor shall provide all students with a student binder containing product specific training modules for the system installed. All training shall be held during normal working hours of 8:00 am to 4:30 PM weekdays.

B. Provide 4 hours of training for Owner's designated operating personnel in maximum 4 hour long sessions. Training shall include:

1. Explanation of drawings, operations and maintenance manuals
2. Walk-through of the job to locate control components
3. Operator workstation and peripherals
4. DDC controller and ASC operation/function
5. Operator control functions including graphic generation and field panel programming
6. Operation of portable operator's terminal
7. Explanation of adjustment, calibration and replacement procedures
8. Student binder with training modules.

END OF SECTION 230910

SECTION 232113 - HYDRONIC PIPING

1. ___GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to this section.

B. The requirements of the following Division 23 Sections apply to this Section:

Common Work Results for HVAC.

Basic HVAC Materials and Methods.

General Duty Valves for HVAC.

Hangers and Supports for HVAC Piping and Equipment.

Meters and Gauges for HVAC Equipment

HVAC Piping Insulation

1.2 SUMMARY

A. This section includes hydronic piping systems for building systems. Types of systems include:

1. Hydronic systems:

a. Air conditioning condensate drain piping

B. Piping materials and equipment specified in this section include:

1. Piping, tubing, pipe fittings and tube fittings.

1.3 DEFINITIONS

A. Pipe and tube sizes used in this specification are Nominal Pipe Size (NPS).

1.4 SUBMITTALS

A. Product data, including rated capacities and pressure drops where applicable, furnished options and accessories, and installation instructions for hydronic specialties indicated.

B. Shop drawings, detailing dimensions, method of assembly of components, and location and size of piping connections.

C. Maintenance data, including data for hydronic specialties. Refer to Division 01 and Division 23 section "Common Work Results for HVAC" for detailed requirements.

D. Welders' certificates certifying that welders comply with the quality requirements specified in Quality Assurance below.

E. Certification of compliance with ASTM, ASME and ANSI manufacturing requirements for pipe, fittings, and specialties.

F. Reports specified in Part 3 of this section.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following:

1. Welding: Qualify welding procedures, welders and operators in accordance with ASME B31.1, or ASME B31.9, as applicable, for shop and project site welding of piping work.

2. 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.

3. All pressure piping systems shall be installed to conform to the requirements of the State of Ohio Pressure Piping Systems, Chapter 4101:8.

4. The Ohio Building Code (OBC).

2. PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide hydronic piping system products from one of the following in each category:

1. Copper Press Fittings: Viega Company or Ridge Tool Company

2.2 PIPING AND TUBING MATERIALS

A. General: Refer to Part 3 Article "PIPE APPLICATIONS" for identification of where the below materials are used.

B. Drawn Temper Copper Tubing: ASTM B 88, Type L.

2.3 FITTINGS

A. Unions: ANSI B16.39 malleable-iron, hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends. Threads shall conform to ANSI B1.20.1.

B. Dielectric Union: Threaded or soldered end connections to suit application; constructed to isolate dissimilar metals, prevent galvanic action, and prevent corrosion.

C. Press Fittings: Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM.

D. Wrought-Copper Fittings: ANSI B16.22, streamlined pattern.

E. Cast Bronze Flanges: ANSI B16.24, Class 150; raised ground face, bolt holes spot faced.

2.4 JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, 95-5 Tin-Antimony.

B. Brazing Filler Metals: AWS A5.8, Classification BAg 1 (Silver).

C. Welding Materials: Comply with Section II, Part C. ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

D. Pipe Flange Gasket Material: ANSI B16.21 full-faced for cast iron and cast bronze flanges, and raised face for steel flanges. Thickness, material, and type suitable for design temperatures and pressures.

2.5 GENERAL DUTY VALVES

A. General duty valves (i.e., gate, globe, check, ball, and butterfly valves) are specified in Division 23 Section "General Duty Valves for HVAC Piping" Special duty valves are specified in this Article by their generic name; refer to Part 3 and drawings for specific uses and applications for each valve specified.

3. __EXECUTION

3.1 PIPE APPLICATIONS:

A. General : Where more than one material and/or method is specified for an application, material and method selected shall be at this contractor's option from the choices provided.

B. The following piping systems shall be fabricated from copper piping, wrought copper fittings and solder joints:

1. Air conditioning condensate drain piping, all sizes.

C. Heating Water Systems 3 inches and Smaller: Press connections. Copper press fittings shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.

D. Relief vent or valve piping shall be the same material specified for the piping for the device vented.

3.2 PIPING INSTALLATIONS

A. General:

1. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

2. Use fittings for all changes in direction and all branch connections.

3. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated. All vertical risers shall be installed plumb and straight.

4. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

5. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

6. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

7. Make reductions in pipe sizes using eccentric reducer fitting installed with the level side up.

8. Unless otherwise indicated, install branch connections to mains using Tee fittings in main with take-off out the bottom of the main, except for up-feed risers which shall have take-off out the top of the main line.

9. Anchor piping to ensure proper direction of expansion and contraction.

10. All piping shall be installed with a pitch in the direction of flow of not less than one inch in forty feet, except as otherwise shown. It must be possible to drain every portion of the piping system.

11. Run lines as direct as possible avoiding unnecessary offsets. However, if offsets are required in order to obtain maximum headroom or to avoid conflict with other work, they shall be made as required or as requested by the Engineer without additional cost to the Owner. The Engineer reserves the right to make minor changes in the location of piping and equipment during the roughing-in, without additional cost to the Owner. All changes proposed by others shall be approved by the Engineer.

12. Lines shall be cut accurately to measurement at the site and worked into place without springing or forcing. Sufficient offsets, pipe loops or expansion joints between anchor points shall be provided as needed, whether or not shown, to limit stresses and control movement of lines subject to thermal expansion.

13. Before any piping is installed, it shall be up-ended and pounded to remove any foreign matter present, and shall be swabbed, if necessary, for thorough cleaning. After installation and before final connections are made, all piping systems shall be flushed with a material that is not injurious to either pipe or equipment.

14. Drain valves shall be provided at all low points, trapped sections, and on the equipment side of all branch valves to permit draining of all parts and all liquid piping systems. Furnish and install drain valves at the base of all new chilled and heating water risers. See Section 230523 for drain valve requirements. Drain piping shall be provided from pump glands, relief valves, etc., to spill at the floor over floor drains or other acceptable discharge points. The drain line shall terminate with plain, unthreaded end.

15. Taps (half couplings or tees) shall be provided as necessary to permit the installation of temperature control instruments, thermometers, pressure gages, air vents, etc.

16. Air vents shall be provided at all high points, trapped sections and on equipment connections where indicated. See Section 230523 for manual air vent valve requirements. Note: Air vents are typically not indicated on drawings since high points cannot always be determined. This Contractor shall determine high points during construction and vent accordingly.

17. Any piping resting on or coming in contact with building structure shall be insulated at that point to prevent telegraphing of sound.

B. Unions and Flanges:

1. Unions or companion flanges shall be installed in all connections to equipment, automatic valves, etc., as necessary to permit removal of equipment and specialties for servicing, repairing or cleaning. It shall be possible to remove any piece of equipment by removing only one or two sections of piping.

2. Install unions in pipes 2 inch and smaller.

3. Unions are not required in installations using grooved mechanical joint couplings. (The couplings shall serve as unions and disconnect points.)

4. Install dielectric unions or nipples to joint dissimilar metals.

5. Install flanges on valves, apparatus, and equipment having 2-1/2 inch and larger connections.

C. Dielectric Separation and Copper and Ferrous Materials:

1. Connections between copper and ferrous materials shall be made as follows:

a. For stationary non-rotating, non-vibrating equipment connections shall be made with dielectric unions.

b. For rotating or vibrating equipment connections shall be made with cast brass adapter and bronze flanges with dielectric separation of flanges and bolts.

c. Connections between copper ferrous equipment flanges shall be made using bronze companion flange with dielectric separation of flanges and bolts.

d. Brass or bronze valves separating copper ferrous materials will not require dielectric separation.

2. Dielectric Separation of Copper Piping and Building Elements:

a. Isolate copper piping from metal building elements such as steel studs, pipe sleeves, beams, joists, and metal deck with plastic grommets or vinyl tape.

D. Wall Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity. Refer to Section 230501 for special sealers and materials. Refer to Section 230519 for pipe sleeve requirements.

3.3 HANGERS AND SUPPORTS

A. General: Hanger, supports, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Conform to the table in that section for maximum spacing supports.

3.4 PIPE JOINT CONSTRUCTION

A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual." Surfaces to be soldered shall be cleaned bright, properly fluxed and made with 95-5 tin-antimony solder.

B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."

1. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.

2. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before brazing.

3. Fill the pipe and fittings during brazing, with an inert gas (i.e., nitrogen or carbon dioxide) to prevent formation of scale.

4. Heat joints to proper and uniform temperature.

3.5 VALVE AND STRAINER APPLICATIONS

A. Install general duty valves and strainers as indicated on drawings and as specified in Section 230523.

3.6 INSTALLATION OF HYDRONIC SPECIALTIES

A. General: Examine areas and conditions under which hydronic specialties are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.7 FIELD QUALITY CONTROL

A. All hydrostatic and/or air tests shall be made before piping is concealed or covered. This Contractor shall be responsible for completely draining the systems after hydrostatic tests are performed. Any damage from freezing prior to acceptance of the completed installation shall be repaired at the sole expense of this Contractor.

B. Preparation for Testing: Prepare piping in accordance with ASME B 31.9 and as follows:

1. Leave joints including welds uninsulated and exposed for examination during the test.

2. Flush system as specified. Clean strainers where present.

3. Isolate equipment that is not to be subjected to the test pressure from the piping. If a valve is used to isolate the equipment, its closure shall be capable of sealing against the test pressure without damage to the valve. Flanged joints at which binds are inserted to isolate equipment need not be tested.

C. Testing: Test pressurized piping as follows:

1. Use ambient temperature water as the testing medium, except where there is a risk of damage due to freezing. Another liquid may be used if it is safe for workmen and compatible with the piping system components.

2. Examine system to see that equipment and parts that cannot with-stand test pressures are properly isolated. Examine test equipment to ensure that it is tight and that low pressure filling lines are disconnected.

3. Subject piping system to a hydrostatic test pressure which at every point in the system is not less than 1.5 times the design pressure. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve, or other components in the system under test. Make a check to verify that the stress due to pressure at the bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength, or 1.7 times the "SE" value in Appendix A of ASME B31.9, Code For Pressure Piping, Building Services Piping.

4. After the hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks.

3.8 ADJUSTING AND CLEANING

A. General: Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers and other strainers where applicable.

B. Heating Water Systems Cleaning Procedure: Fill entire system and add commercial chemical cleaning agent at the minimum rate of two (2) pounds per 100 gallons of system water for four (4) hours. Vent system during cleaning. Drain system to remove all foreign matter; remove and clean all strainers. Fill system and add chemical treatment after analysis of system water is made.

3.9 COMMISSIONING

A. After cleaning, fill system and perform initial chemical treatment where specified.

B. Check expansion tanks to determine proper operation and check that the system is completely full of water.

C. Before operating the system perform these steps:

1. Open valves to full open position.
2. Remove and clean strainers where applicable.
3. Check and set automatic fill valves required for system pressure.
4. Check operation of automatic bypass valves.
5. Check operation of new and existing equipment connected to piping system and specified or indicated elsewhere.

END OF SECTION 23 21 13

SECTION 232300 – REFRIGERANT PIPING

1. GENERAL

1.1 RELATED DOCUMENTS

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

B. Requirements of the following Division 23 Sections apply to this section:

Basic HVAC Materials and Methods.

Common Work Results for HVAC.

Hangers and Supports for HVAC Piping and Equipment.

1.2 SUMMARY

A. This Section includes refrigerant piping used for air conditioning applications. This Section includes:

1. Pipes, tubing, and fittings.
2. Special duty valves.
3. Refrigerant specialties.
4. Refrigerants.

B. Related Sections: The following Sections, as well as other Division 23 sections, contain requirements that relate to this section:

1. Division 23, Section "Hangers and Supports for HVAC Piping and Equipment " for roof curbs, piping supports, and roof penetration boots, not furnished with equipment.
2. Division 23, Section "Identification For HVAC Piping and Equipment " for labeling and identification of refrigerant piping.
3. Division 23, Section "HVAC Piping Insulation" for pipe insulation.

C. Products installed but not furnished under this Section include pre-charged tubing, refrigerant specialties, and refrigerant accessories furnished as an integral part of or separately with packaged air conditioning equipment.

1.3 SUBMITTALS

A. Product data for each type of product specified in this section.

B. Shop Drawings showing layout of refrigerant piping, specialties, and fittings including, but not necessarily limited to, pipe and tube sizes, valve arrangements and locations, slopes of horizontal runs, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and proximate to equipment.

C. Maintenance data for products specified in this section, for inclusion in Operating and Maintenance Manual specified in Division 01 and Division 23 Section "Common Work Results for HVAC."

1.4 QUALITY ASSURANCE

A. Qualify brazing processes and brazing operators in accordance with ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications".

B. Regulatory Requirements: Comply with provisions of the following codes:

1. ANSI B31.5: ASME Code for Pressure Piping - Refrigerant Piping.

2. ANSI/ASHRAE Standard 15: Safety Code for Mechanical Refrigeration.

3. Ohio Building Code (OBC).

1.5 SEQUENCING AND SCHEDULING

A. Coordinate the installation of roof piping supports, and roof penetrations.

2. PRODUCTS

2.1 MANUFACTURERS

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

1. Refrigerant Valves and Specialties:

Alco Controls Div., Emerson Electric.

Danfoss Electronics, Inc.

EATON Corporation, Control Div.

Henry Valve Company.

Parker-Hannifin Corporation, Refrigeration and Air Conditioning Division.

Sporlan Valve Company

2.2 PIPE AND TUBING MATERIALS

A. General: Refer to Part 3, Article "PIPE APPLICATION" for identification of systems where the below specified pipe and fitting materials are used.

B. Copper Tubing: ASTM B 280, Type ACR, hard-drawn straight lengths, and soft-annealed coils, seamless copper tubing. Tubing shall be factory cleaned, ready for installation, and have ends capped to protect cleanliness of pipe interiors prior to shipping.

C. Copper Tubing: ASTM B 88, Type L, hard-drawn straight lengths, and soft-annealed coils, seamless copper tubing.

2.3 FITTINGS

A. Wrought-Copper Fittings: ANSI B16.22, streamlined pattern. Elbows shall be long radius type.

2.4 JOINING MATERIALS

A. Joints: Copper to copper joints shall be made using phosphorous bearing alloy such as "Sil-phos" without flux. Copper to brass or steel joints shall be made using a 45% silver alloy such as "Easy-flo" with flux.

2.5 VALVES

A. General: Complete valve assembly shall be UL-listed and designed to conform to ARI 760.

B. Ball Valves: 500 psig maximum operating pressure, temperature range -40 deg F to +300 deg F, forged brass body, brass ball with equalizing orifice, Teflon ball seals, mechanical stem stops providing positive ball port position, sealed blow-out proof stem and seal cap, flow direction arrows.

C. Check Valves - Smaller than 7/8 inch: 500 psig maximum operating pressure, 300 deg F maximum operating temperature; cast brass body with removable piston, Teflon seat, and stainless steel spring; straight through globe design. Valve shall be straight through pattern, with solder-end connections.

D. Check Valves - 7/8 inch and Larger: 450 psig maximum operating pressure, 300 deg F maximum operating temperature; cast bronze body, with cast bronze or forged brass bolted bonnet; floating piston with mechanically retained Teflon seat disc. Valve shall be straight through or angle pattern, with solder-end connections.

E. Solenoid Valves: 250 deg F temperature rating, 400 psig working pressure; forged brass, with Teflon valve seat, two-way straight through pattern, and solder end connections. Provide manual operator to open valve. Furnish complete with NEMA 1 solenoid enclosure with 1/2 inch conduit adaptor, and (unless otherwise indicated) 24 volt, 60 HZ. normally closed holding coil.

F. Thermal Expansion Valves: Thermostatic adjustable, modulating type, size as required for specific evaporator requirements, and factory set for proper evaporator superheat requirements. Valves shall have copper fittings for solder end connections; complete with sensing bulb, a distributor having a side connection for hot gas bypass line, and an external equalizer line.

G. Hot Gas Bypass Valve: Adjustable type, sized to provide capacity reduction beyond the last step of compressor unloading; and wrought copper fittings for solder end connection.

2.6 REFRIGERANT PIPING SPECIALTIES

A. General: Complete refrigerant piping specialty assembly shall be UL-listed and designed to conform to ARI 760.

B. Moisture/liquid Indicators: 500 psig maximum operation pressure, 200 deg F maximum operating temperature; forged brass body, with replaceable polished optical viewing window, and solder end connections.

C. Filter-driers: 500 psig maximum operation pressure; steel shell, flange ring, and spring, ductile iron cover plate with steel capscrews, and wrought copper fittings for solder end connections. Furnish complete with replaceable filter-drier core kit, including gaskets, as follows:

1. High capacity desiccant sieves to provide micronic filtration and extra drying capacity.

D. Suction Line Filter-Drier: 350 psig maximum operation pressure, 225 deg F maximum operating temperature; steel shell, and wrought copper fittings for solder end connections. Permanent filter element shall be molded felt core surrounded by a desiccant for removal of acids and moisture for refrigerant vapor.

E. Flexible Connectors: 500 psig maximum operating pressure; seamless tin bronze or stainless steel core, high tensile bronze braid covering, solder connections, and synthetic covering; dehydrated, pressure tested, minimum 7 inch in length.

2.7 REFRIGERANT

A. Refrigerant type per manufacturer's equipment in accordance with ASHRAE Standard, meeting current refrigerant regulations.

B. Coordinate component sizing with refrigeration equipment manufacturer.

3. EXECUTION

3.1 EXAMINATION

A. Examine rough-in for refrigerant piping systems to verify actual locations of piping connections prior to installation.

3.2 PIPE APPLICATIONS

A. Use Type L, or Type ACR drawn copper tubing with wrought copper fittings and brazed joints. Mechanical fittings (crimp or flair) are not permitted.

B. If other than Type ACR tubing is used, clean and protect inside of tubing as specified in Article "CLEANING" below.

3.3 PIPING INSTALLATIONS

A. General: Install refrigerant piping in accordance with ASHRAE Standard 15 - "The Safety Code for Mechanical Refrigeration."

B. Piping shall be cut using a tubing cutter only. Hack saw cuts are prohibited.

C. Install piping in as short and direct arrangement as possible to minimize pressure drop.

D. Install piping for minimum number of joints using as few elbows and other fitting as possible.

E. Arrange piping to allow normal inspection and servicing of compressor and other equipment. Install valves and specialties in accessible locations to allow for servicing and inspection.

F. Provide adequate clearance between pipe and adjacent walls and hanger, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full thickness insulation.

G. Install branch tie-in lines to parallel compressors equal length, and pipe identically and symmetrically.

H. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.

I. Slope refrigerant piping as follows:

1. Install horizontal hot gas discharge piping with 1/2" per 10 feet downward slope away from the compressor.

2. Install horizontal suction lines with 1/2 inch per 10 feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.

3. Install traps and double risers where indicated, and where required to entrain oil in vertical runs.

4. Liquid lines may be installed level, unless otherwise indicated.

J. Use fittings for all changes in direction and all branch connections.

K. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

L. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

M. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

N. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1 inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

O. Locate groups of piper parallel to each other, spaced to permit applying insulation and servicing of valves.

P. Fire and Smoke Barrier Penetrations: Where pipes pass through fire or smoke rated walls, partitions, ceilings, and floors, maintain the fire rated integrity. Refer to other Division 23 section for special sealers and materials.

Q. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.

R. Install flexible connectors at the inlet and discharge connection of compressors.

3.4 HANGERS AND SUPPORTS

A. General: Hanger, supports, and anchors are specified in Division 23 Section "HANGERS, SUPPORTS AND ANCHORS." Conform to the table in that section for maximum spacing of supports:

B. Isolate hangers from piping to eliminate transmission of pipe vibration and sound.

3.5 PIPE JOINT CONSTRUCTION

A. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."

1. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.

2. CAUTION: When solenoid valves are being installed, remove the coil to prevent damage. When sight glasses are being installed, remove the glass. Remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties before brazing. Do not apply heat near the bulb of the expansion valve.

B. Fill the pipe and fittings during brazing, with an inert gas (ie., nitrogen or carbon dioxide) to prevent formation of scale.

C. Heat joints using oxy-acetylene torch. Heat to proper and uniform brazing temperature.

3.6 VALVE INSTALLATIONS

A. General: Install refrigerant valves where indicated, and in accordance with manufacturer's instructions.

B. Thermostatic expansion valves may be mounted in any position, as close as possible to the evaporator.

1. Where refrigerant distributors are used, mount the distributor directly on the expansion valve outlet.

2. Install the valve in such a location so that the diaphragm case is warmer than the bulb.

3. Secure the bulb to a clean, straight, horizontal section of the suction line using two bulb straps. Do not mount bulb in a trap or at the bottom of the line.

4. Where external equalizer lines are required make the connection where it will clearly reflect the pressure existing in the suction line at the bulb location.

3.7 EQUIPMENT CONNECTIONS

A. The Drawings indicate the general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow servicing and maintenance, and in accordance with equipment manufacturer's recommendations.

3.8 FIELD QUALITY CONTROL

A. Inspect, test, and perform corrective action of refrigerant piping in accordance with ASME Code B31.5. Chapter VI.

B. Repair leaking joints using new materials, and retest for leaks.

3.9 CLEANING

A. Before installation of copper tubing other than Type ACR tubing, clean the tubing and fitting using following cleaning procedure:

1. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through the tubing by means of a wire or an electrician's tape.

2. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.

3. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.

4. Finally, draw a clean, dry, lintless cloth through the tube or pipe.

3.10 ADJUSTING

A. Verify actual evaporator applications and operating conditions, and adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

B. Adjust controls and safeties. Replace damaged or malfunctioning controls and equipment with new materials and products.

3.11 COMMISSIONING

A. Charge system using the following procedure:

1. Install core in filter dryer after leak test but before evacuation.

2. Evacuate refrigerant system with vacuum pump; until temperature of 35 deg F is indicated on vacuum dehydration indicator.

3. During evacuation, apply heat to pockets, elbows, and low spots in piping.

4. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.

5. Break vacuum with refrigerant gas, allow pressure to build up to 2 psi.

6. Complete charging of system, using new filter dryer core in charging line. Provide full operating charge.

B. Train Owner's maintenance personnel on procedures and schedules related to start-up and shut-down, troubleshooting, servicing, and preventative maintenance of refrigerant piping valves and refrigerant piping specialties.

C. Review data in Operating and Maintenance Manuals. Refer to Division 01 section "Project Closeout", and Section 230500.

D. Schedule training with Owner through the Architect/Engineer, with at least 7 days advance notice.

END OF SECTION 23 23 00

SECTION 233113 - METAL DUCTWORK AND ACCESSORIES

1. GENERAL

1.1 RELATED DOCUMENTS

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

B. Division 23 Common Work Results for HVAC and Basic HVAC Materials and Methods sections apply to work specified in this section.

C. Division 23 Vibration and Seismic Control for HVAC Piping and Equipment section applies to work of this section.

1.2 DESCRIPTION OF WORK

A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

B. Refer to other Division 23 sections for exterior insulation of metal ductwork; not work of this section.

C. Refer to other Division 23 section for automatic temperature dampers control furnished under that section but installed as work of this section.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. OBC: Comply with the latest edition of The Ohio Building Code (OBBC), Mechanical Code.

2. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems".

3. SMACNA Standards: Comply with the latest edition of SMACNA's "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork, except where exceeded by this specification.

4. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for type of equipment and material used. Include details of construction, joining methods, and materials and methods showing compliance with each item of this specifications section.

B. Shop Drawings: Submit scaled layout drawings (not smaller than scale used on contract documents) of metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials, and rigidity are not reduced.

C. Record Drawings: At project closeout, submit record drawings of installed metal ductwork and ductwork products, in accordance with requirements of Divisions 01 and 23.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Storage: Store all ductwork inside, protected from weather.

2. ___PRODUCTS

2.1 DUCTWORK MATERIALS

A. Provide ductwork of materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting.

B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A527, lock-forming quality; with G 90 zinc coating in accordance with ASTM A527 and ASTM A924; and mill phosphatized for painted locations.

2.2 MISCELLANEOUS DUCTWORK MATERIALS

A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork. Duct sealant shall be UL classified and tested in accordance with UL Standard 723. Duct sealant shall meet NFPA 90A Class I requirements (flamespread of 25 and smoke developed 50) when applied in a manner consistent with its intended use. Duct sealant shall be furnished and installed in accordance with SMACNA Standards, Paragraph S1.8 and S1.9. Oil based sealing compounds are not acceptable.

C. Ductwork Support Materials: Comply with SMACNA Standards Section 4. Except as otherwise indicated, provide hot-dipped galvanized steel or zinc plated fasteners, anchors, rods, straps, trim and angles for support of ductwork. "C" clamps without a beam retaining strap shall not be used to attach hanging devices.

2.3 DUCTWORK FABRICATION

A. General:

1. Factory fabricate or shop fabricate ductwork as indicated on the drawings and in schedules.

2. Shop fabricate ductwork in 4, 8, 10 or 12-ft lengths, unless otherwise indicated or required to complete runs. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.

3. Shop fabricate ductwork of gages and reinforcement strictly complying with the 1985 edition of SMACNA "HVAC Duct Construction Standards", for pressure classification indicated on the drawings and in schedules. If not indicated elsewhere, ductwork shall be constructed to a minimum standard of 2 inch water column.

4. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to 1-1/2 times associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.

5. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible.

6. Joint reinforcement manufactured by Ductmate Industries or other such manufacturers will be acceptable as long as all duct gages, intermediate reinforcement and all other characteristics strictly comply with SMACNA standards. The duct joints only will be permitted to vary from SMACNA standards.

B. Factory -Fabricated Ductwork:

1. General: All factory fabricated ductwork shall be considered "high pressure" ductwork and shall be constructed to SMACNA Standards for 10 inch water column pressure classification, unless otherwise scheduled on the drawings.

2. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 20 degree change of direction per section. Unless specifically detailed otherwise, use 45 degree laterals and 45 degree elbows for branch takeoff connections. Where 90 degree branches are indicated, provide conical type tees.

3. Round Ductwork: Construct of galvanized sheet steel complying with ASTM A527 by the following methods and in minimum gages listed.

Diameter	Minimum Gage	Method of Manufacture
3” to 14"	26	Spiral Lockseam
15” to 26"	24	Spiral Lockseam
27” to 36"	22	Spiral Lockseam
37” to 50"	20	Spiral Lockseam
51” to 60"	18	Spiral Lockseam
Over 60"	16	Longitudinal Seam

a. Provide locked seams for spiral duct; fusion-welded butt seam for longitudinal seam duct.

b. Fittings and Couplings: Construct of minimum gages listed. Provide continuous welds along seams.

Diameter	Minimum Gage
3” to 36"	20
38” to 50"	18
Over 50"	16

4. Optional Ducts and Fittings: At Installer's option, provided that certified tests by Manufacturer show that rigidity and performance is equivalent to SMACNA and/or ASHRAE standard gage ductwork, provide ducts and fittings as follows:

   a. Ducts: Construct of Manufacturer's standard gage, with spiral lock seam and intermediate standing rib.

   b. Fittings: Construct by fabricating with spot welding and bonding with neoprene-base cement in lieu of continuous weld seams.

5. Manufacturers: Subject to compliance with requirements, provide factory-fabricated ductwork of one of the following:

   Ajax Mfg. Inc.

   Lindab

   LaPine Products.

   Semco Mfg., Inc.

   SET Duct

   Tangent Air

   United Sheet Metal Div., United McGill Corp.

2.4 DUCTWORK ACCESSORIES

A. General: Unless otherwise indicated, all duct accessories shall be manufactured of the same materials as the surrounding ductwork, and shall be designed for the same pressure rating and application. All duct accessories shall be manufactured in accordance with SMACNA HVAC Duct Construction Standards unless otherwise specified herein.

B. Manual Balancing Devices: Furnish and install all manual balancing devices, as shown on the drawings or required to properly distribute the air. Provide standoffs on insulated ductwork to allow access to operator and insulation to be continuous. Unless noted otherwise on the drawings, all manual balancing dampers in ducts with area greater than one square foot shall be the multiple opposed blade type. Balancing dampers in ducts one square foot and smaller may be of a single blade, minimum 18 gage galvanized steel or, duct gage, whichever is heavier.

   1. All accessible manual balancing devices shall be controlled by one of the following:

      a. Chrome plated locking nut operators similar to Ventfabrics No. 688.

      b. Self-locking lever operators similar to Ventfabrics No. 641.

      c. Locking quadrant operators similar to Ventfabrics Nos. 555 and 560.

   2. All inaccessible manual balancing devices shall be controlled by chrome plated locking nut operators similar to Ventfabrics No. 688 with top bearings and/or gear drives required for the remote installation of the regulator.

C. Access Doors: Furnish and install access doors in sheet metal ductwork of size and type as shown on the drawings. Access doors to be factory insulated for insulated ductwork. Access doors shall have flush frames for uninsulated or lined ductwork and shall have extended frames for externally insulated ductwork equal to insulation thickness. All access doors larger than 12" in any dimension

shall be hinged, except where obstructed by other services or ceilings. Other access doors shall be cam lock type. All access doors must be fitted for airtight closure and shall be easily opened and closed.

1. Access doors downstream of fire or smoke dampers shall be of the negative pressure relief type.

D. Turning Vanes:

1. Fabricated Turning Vanes: Provide fabricated turning vanes and vane runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards".

E. Flexible Connections: Provide flexible duct connections where shown on the Drawings, and wherever ductwork connects to vibration isolated equipment. Construct flexible connections of flameproof fabric crimped into duct stripes or flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment. Metal connection material to match duct material.

1. Conventional indoor flexible connections to be glass fabric double coated with polychloroprene, suitable for temperatures from -10 to +200 deg F.

2. Outdoor flexible connections to be glass fabric coated with DuPont hypalon or other synthetic. Rubber waterproof coating resistant to the sun's ultraviolet rays and ozone environment, suitable for temperatures from -10 to +250 deg F.

2.5 AIR DIFFUSERS, REGISTERS AND GRILLES

A. General: Except as otherwise indicated, provide manufacturer's standard air diffusers, registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide air diffusers, registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data and as scheduled on the drawings.

C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.

D. Appearance: Diffusers, registers, and grilles which are not similar in appearance to model numbers specified will be rejected.

E. Manufacturer: Subject to compliance with requirements, provide diffusers, registers and grilles of one of the following:

Anemostat Products Div.; Dynamics Corp. of America.

Carnes Co.

Krueger Mfg. Co.

Price Co.

Titus Products Div.; Phillips Industries, Inc.

3. __EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which metal ductwork and accessories are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

B. Drawings show the general layout of ductwork and accessories, but do not necessarily show all required fittings and offsets that may be necessary to connect ducts to equipment, terminal units, diffusers, etc. and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the Owner. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grids where applicable. Duct sizes on drawings are external sizes which shall be altered by contractor (with approval of Engineer) to other dimensions with the same or better area and friction characteristics where necessary to avoid interferences and clearance difficulties.

3.2 INSTALLATION OF METAL DUCTWORK

A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (2% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Construct and install each duct system for the specific duct pressure classification indicated. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at a maximum interval of 16 feet, and at every floor.

B. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceiling and lighting layouts and similar finished work.

C. Electrical Equipment Spaces: Do not route ductwork through transformer vaults and other electrical equipment spaces and enclosures unless ductwork serves these areas.

D. Penetrations: See Section 230501 regarding duct penetrations. Where ducts penetrate interior and exterior walls and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on four sides by at least 1-1/2 inches.

E. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment controls and other associated work of ductwork system.

F. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards, unless requirements are exceeded in this specification.

3.3 SEALING OF DUCTWORK

A. General: Apply duct sealant to joints in accordance with SMACNA HVAC Duct Construction Standard and where indicated herein.

B. Seal non-welded seams and joints as follows:

1. Duct Pressure Class From -2" W.C. to +2" W.C.: Seal all transverse joints and longitudinal seams. Sealant may be omitted from longitudinal seams of supply ductwork downstream of terminal units when the total length of the duct run from the terminal unit is less than 20 feet.

2. All Other Ductwork: Seal all transverse joints, longitudinal seams and duct penetrations.

C. Seal externally insulated ducts prior to insulation installation.

D. Seal ductwork prior to start-up of fans, per sealant manufacturer's recommendations. Ventilate areas as required to prevent build up of sealant odors in occupied spaces.

3.4 FACTORY-FABRICATED DUCTWORK

A. Install in accordance with SMACNA HVAC Duct Construction Standards, and in compliance with manufacturer's recommendations.

3.5 INSTALLATION OF DUCTWORK ACCESSORIES

A. General: Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Manual Balancing Devices: Install manual balancing devices where indicated on the drawings or as required to provide adequate means of adjusting air flow.

1. Regulators: Install regulators on all manual balancing devices. If ductwork is accessible, mount the regulator on the ductwork. If ductwork will be inaccessible after the installation of the ceiling or walls, regulators shall be mounted in a steel, flush mounted box specifically designed for this purpose. Provide all linkage, top bearings and/or gear drives required for the remote installation of the regulator.

C. Temperature Control Dampers: Install all temperature control dampers where indicated on the drawings unless factory installed in air handling equipment.

1. Provide necessary transitions required to install dampers larger than duct size. Do not install control dampers smaller than duct size.

2. Assemble multiple section dampers with required interconnecting linkage and extend required number of shafts through duct for external mounting of damper motors.

3. See drawings for furnishing recommendation for temperature control dampers.

D. Turning Vanes: Install turning vanes in square or rectangular 90 degree elbows in supply air systems, and elsewhere as indicated.

E. Flexible Connections: Connect metal ductwork to equipment as indicated. Provide flexible connection for each ductwork connection to equipment mounted on vibration isolators and/or equipment containing rotating machinery, and elsewhere as indicated.

F. Coordination: Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.6 INSTALLATION OF AIR DIFFUSERS, REGISTERS AND GRILLES

A. General: Install air diffusers, registers and grilles in ceilings where indicated in accordance with manufactures instructions and recognized industry practices to insure that products serve intended purpose.

B. Location: Locate air diffusers, registers and grilles as indicated on architectural "Reflected Ceiling Plans". Unless otherwise indicated, locate units in the center of acoustical ceiling tiles.

C. Coordination: Coordinate installation of air diffusers, registers and grilles with other trades installing devices in the ceiling.

3.7 DUCTWORK IDENTIFICATION:

A. General: Identify air supply, return, exhaust, intake and relief ductwork with duct markers including its connected equipment (AHU-1, RF-2, EX-2-1, etc); or provide stenciled signs and arrows, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color).

B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50 ft. spacings along exposed runs.

C. Access Doors: Provide duct markers or stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.

D. Concealed Doors: Where access doors are concealed above acoustical ceilings or similar concealment, plasticized tags may be installed for identification in lieu of specified signs, at Installer's option.

3.8 ADJUSTING AND CLEANING

A. General: Clean ductwork internally, unit by unit before operation, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

B. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.

C. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

D. Balancing: Refer to Division-15 section "Testing, Adjusting, and Balancing" for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent in balancing process. Coordinate with Balance Contractor in pressure testing of ductwork where specified. Compensate Balance Contractor for re-testing ductwork when ductwork fails initial pressure test.

3.9 INSPECTION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.10 FIELD QUALITY CONTROL

A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leak-proof performance.

B. Seal all visible openings in ducts. Particularly at notches on rectangular duct joints. Seal air leaks audible at system operating conditions.

END OF SECTION 233113

SECTION 238119 - ENVIRONMENTAL CONDITIONING UNITS (ECU-1&2 BASE BID)

1. __GENERAL

1.1 SUMMARY

A. This Section includes the following types of environmental conditioning units:

1. Split system DX units with electric reheat.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate single line diagrams, electrical and capacity data, electrical connection drawings, dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For computer-room air-conditioning units to include in emergency, operation, and maintenance manuals.

E. Warranties: Special warranties specified in this Section.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

C. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

D. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

E. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

1.4 COORDINATION

A. Coordinate layout and installation of environmental conditioning units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of computer-room air-conditioning units that fail in materials or workmanship within specified warranty period.

B. Warranty Period for Compressors: Manufacturer's standard, but not less than 5 years from date of Substantial Completion.

2. PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. Liebert

B. Frame

1. The frame shall be MIG welded, formed sheet metal. It shall be protected against corrosion using the autophoretic coating process. The frame shall be capable of being separated into three parts in the field to accommodate rigging through small spaces.

C. Upflow Air Supply

1. The supply air shall exit from the top of the cabinet with the air throw toward the front.

D. Air Return

1. The return air shall enter the front factory installed grilles.

E. Exterior Panels

1. The exterior panels shall be insulated with a minimum 1 in. (25mm), 1.5 lb. (0.68 kg) density fiber insulation. The main front panel shall have captive 1/4 turn fasteners.

F. Filters

1. The filter chamber shall be located within the cabinet, and filters shall be removable from the top of the unit. Filters shall be arranged in a V-bank configuration to minimize air pressure drop.

2. Filters shall be deep pleated 4" filters with an ASHRAE 52.2 MERV8 rating (45% ASHRAE 52.1).

3. Provide one extra set(s) of filters shall be provided per system.

G. Centrifugal Blower Section

1. The fans are the centrifugal type, double-width and double-inlet, and shall be dynamically balanced as a completed assembly. The shaft shall be heavy duty steel with self-aligning, permanently sealed, pillow block bearing with a minimum L3 life of 200,000 hours. The fans shall draw air through the V-frame coil to ensure even air distribution and maximum coil performance. A static regain duct shall be factory-installed on the bottom of the blower.

H. Motors

1. The fan motors shall be 7.5 hp at 1750 rpm @ 60 Hz, mounted to an automatic, spring-tensioning base. The motors shall be removable from the front of the cabinet.

I. Reheat

1. The environmental control unit shall include a factory-installed reheat to control temperature during dehumidification.

2. The three stage electric reheat coils shall be low watt density, 304/304 stainless steel fin tubular construction, protected by thermal safety switches controlled in three stages. The reheat elements shall be removable from the front of the cabinet.

J. Dual Refrigeration System

1. Each unit shall include two (2) independent refrigeration circuits and shall include hot gas mufflers (semi-hermetic compressors units only), liquid line filter driers, refrigerant sight glass with moisture indicator, externally equalized expansion valves and liquid line solenoid valves. Compressors shall be located outside the airstream and shall be removable and serviceable from the front of the unit.

K. Scroll Compressors

1. The compressor shall be scroll-type. The compressor shall be suction gas cooled motor, vibration isolators, thermal overloads, automatic reset high pressure switch with lockout after three failures, rotalock service valves, pump down low pressure transducer, suction line strainer and a maximum operating speed of 3500 RPM. The compressors shall include crankcase heaters, factory wired and powered from the indoor unit electric panel.

L. Evaporator Coil

1. The evaporator coil shall be A-frame design with offset orientation and be three rows deep. It shall be constructed of rifled copper tubes and aluminum fins. A stainless steel condensate drain pan shall be provided.

M. R-407C Refrigerant

1. The system shall be designed for use with R-407C refrigerant, which meets the EPA clean air act for phase-out of HCFC refrigerants.

N. Liebert iCOM™ Microprocessor Control With Large Graphic Display

1. The Liebert iCOM unit control shall be factory-set for Intelligent Control, which uses “fuzzy logic” and “expert systems” methods. Proportional and Tunable PID shall also be user-selectable options. Internal unit component control shall include the following:

a. Compressor Short Cycle Control - Prevents compressor short-cycling and needless compressor wear.

b. System Auto Restart - The auto restart feature shall automatically restart the system after a power failure. Time delay is programmable.

c. Sequential Load Activation - On initial startup or restart after power failure, each operational load is sequenced with a minimum of one second delay to minimize total inrush current.

d. Hot Water/Econ-O-Coil Flush Cycles - Hot water reheat coils and Econ-O-Coils are periodically flushed to prevent a buildup of contaminants.

e. Predictive Humidity Control - calculates the moisture content in the room and prevents unnecessary humidification and dehumidification cycles by responding to changes in dew point temperature. Dew point and relative humidity control methods shall be available for humidity control within the conditioned space.

2. The Liebert iCOM control shall be compatible with all Liebert remote monitoring and control devices. Options are available for BMS interface via Modbus, Jbus, BACnet, Profibus and SNMP.

3. The Liebert iCOM control processor shall be microprocessor based with a 9" color touchscreen display and mounted in an ergonomic, aesthetically pleasing housing. The Liebert iCOM control processor shall display and control keys for user inputs mounted in an ergonomic, aesthetically pleasing housing. The display and housing shall be viewable while the unit panels are open or closed. The controls shall be menu-driven. The display shall be organized into three main sections: User Menus, Service Menus and Advanced Menus. The system shall display user menus for active alarms, event log, graphic data, unit view/status overview (including the monitoring of room conditions, operational status in % of each function, date and time), total run hours, various sensors, display setup and service contacts. A password shall be required to make system changes within the service menus. Service menus shall include setpoints, standby settings (lead/lag), timers/sleep mode, alarm setup, sensor calibration, maintenance/wellness settings, options setup, system/network setup, auxiliary boards and diagnostics/service mode. A password shall be required to access the advanced menus, which include the factory settings and password menus.

4. The User Menus Shall be Defined as Follows:

    a. Active Alarms: Unit memory shall hold the 200 most recent alarms with time and date stamp for each alarm.

    b. Event Log: Unit memory shall hold the 400 most recent events with ID number, time and date stamp for each event.

    c. Graphic Data View: Eight graphic records shall be available: return air temperature, return air humidity, supply air temperature, outdoor temperature and four custom graphs.

    d. Unit View - Status Overview: Simple or Graphical "Unit View" summary displays shall include temperature and humidity values, active functions (and percent of operation) and any alarms of the host unit.

    e. Total Run Hours: Menu shall display accumulative component operating hours for major components including compressors, Econ-O-Coil (FC), fan motor, humidifier and reheat.

    f. Various Sensors: Menu shall allow setup and display of optional custom sensors. The control shall include four customer-accessible analog inputs for sensors provided by others. The analog inputs shall accept a 4 to 20 mA signal. The user shall be able to change the input to 0 to 5VDC or 0 to 10VDC if desired. The gains for each analog input shall be programmable from the front display. The analog inputs shall be able to be monitored from the front display.

    g. Diagnostics/Service Mode: The Liebert iCOM control shall be provided with self-diagnostics to aid in troubleshooting. The microcontroller board shall be diagnosed and reported as pass/not pass. Control inputs shall be indicated as On or Off at the front display. Control outputs shall be able to be turned On or Off from the front display without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.

5. Service Contacts: Menu shall allow display of local service contact name and phone number.

    a. The Service Menus Shall be Defined as Follows:

b. Setpoints: Menu shall allow setpoints within the following ranges:

- Temperature Setpoint: 65-85ºF (18-29ºC)*
- Temperature Sensitivity: +1-10ºF (0.6-5.6ºC)
- Humidity Setpoint: 20-80% RH*
- Humidity Sensitivity: 1-30% RH
- High Temperature Alarm: 35-90ºF (2-32ºC)
- Low Temperature Alarm: 35-90ºF (2-32ºC)
- High Humidity Alarm: 15-85% RH
- Low Humidity Alarm: 15-85% RH

* The microprocessor may be set within these ranges, however, the unit may not be able to control to extreme combinations of temperature and humidity.

6. Standby Settings/Lead-Lag: Menu shall allow planned rotation or emergency rotation of operating and standby units.

a. Timers/Sleep Mode: Menu shall allow various customer settings for turning On/Off unit.

b. Alarm Setup: Menu shall allow customer settings for alarm notification (audible/local/remote). The following alarms shall be available:

- High Temperature
- Low Temperature
- High Humidity
- Low Humidity
- EC Fan Fault
- Loss of Airflow
- Loss of Power
- Compressor Overload
- Main Fan Overload
- High Head Pressure
- Change Filter
- Fan Failure
- Low Suction Pressure
- Smoke Detected
- Unit Off

c. Audible Alarm: The audible alarm shall annunciate any alarm that is enabled by the operator.

d. Common Alarm: A programmable common alarm shall be provided to interface user-selected alarms with a remote alarm device.

e. Remote Monitoring: All alarms shall be communicated to the Liebert monitoring system with the following information: date and time of occurrence, unit number and present temperature and humidity.

f. Sensor Calibration: Menu shall allow unit sensors to be calibrated with external sensors.

g. Maintenance/Wellness Settings: Menu shall allow reporting of potential component problems before they occur.

h. Options Setup: Menu shall provide operation settings for the installed components.

i. System/Network Setup: Menu shall allow Unit-to-Unit (U2U) communication and setup for Teamwork modes of operation (up to 32 units).

j. Teamwork Modes of Operation: Saves energy by preventing operation of units in opposite modes multiple units.

k. Auxiliary Boards: Menu shall allow setup of optional expansion boards.

l. Diagnostics/Service Mode: The Liebert iCOM control shall be provided with self-diagnostics to aid in troubleshooting. The microcontroller board shall be diagnosed and reported as pass/not pass. Control inputs shall be indicated as on or off at the front display. Control outputs shall be able to be turned on or off from the front display without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.

7. Advanced Menus

a. Factory Settings: Configuration settings shall be factory-set based on the pre-defined component operation.

b. Change Passwords: Menu shall allow new passwords to be set or changed.

8. Multi-Unit Coordination

a. Liebert iCOM teamwork shall save energy by preventing multiple units in an area from operating in opposing modes. Teamwork allows the control to optimize a group of connected cooling units equipped with Liebert iCOM using the U2U (Unit-to-Unit) network. There shall be three modes of teamwork operation:

- Teamwork Mode 1: Is best in small rooms with balanced heat loads. The controlling temperature and humidity sensor readings of all units in operation (fan On) are collected to be used for an average or worst-case sensor reading (user-selectable). The master unit shall send the operating requirements to all operating units in the group. The control band (temperature, fan and humidity) is divided and shared among the units in the group.
- Teamwork Mode 2: The Liebert iCOM calculates the worse-case demand for heating, cooling humidification and dehumidification. Based on the greatest demand within the group, each unit operates independently, meaning that the

unit may respond to the thermal load and humidity conditions based on the unit's controlling sensors.

- Teamwork Mode 3 - Optimized Aisle: May be employed in large and small rooms with varying heat loads. Optimized Aisle is the most efficient teamwork mode that allows the unit to match cooling capacity with heat load. In the Optimized Aisle mode, the fans operate in parallel. Fans can be controlled exclusively by remote temperature or using static pressure with a secondary remote temperature sensor(s) as an override to ensure that the inlet rack temperature is being met. Cooling (Compressors or Economizer) is controlled through unit supply air conditions. Liebert iCOM calculates the average or worst-case sensor reading (user-selectable) for heating, cooling humidification and dehumidification. Based on the demand within the group, units will be allowed to operate within that mode until room conditions are satisfied.

b. The Liebert iCOM® shall allow scheduled rotation to keep equal run time on units and provide automated emergency rotation of operating and standby units.

O. Miscellaneous Options

1. Locking Disconnect Switch - The manual disconnect switch shall be mounted in the high voltage section of the electrical panel. The switch shall be accessible from the outside of the unit with the door closed and prevent access to the high voltage electrical components until switched to the "OFF" position. Provide disconnects for both the indoor evaporator section and outdoor condenser sections.

2. High Temperature Sensor - The firestat shall be factory-installed in the unit and shall be factory-set to 125ºF (52ºC). It shall immediately shut down the environmental control system when activated. The sensor shall be mounted with the sensing element in the return air.

3. Smoke Sensor - The smoke sensor shall immediately shut down the environmental control system and activate the alarm system when activated. The smoke sensor shall be mounted in the electrical panel with the sensing element in the return air compartment. The smoke sensor is not intended to function as or replace any room smoke detection system that may be required by local or national codes. The smoke sensor shall include a supervision contact closure.

4. Condensate Pump, Dual Float – The condensate pump shall have a minimum capacity of 145 GPH (548 l/h) at 20 ft. (58 kPa) head. It shall be complete with integral dual-float switches, pump-and-motor assembly and reservoir. The secondary float shall send a signal to the local alarm and shut down the unit upon high water condition. The condensate pump shall be factory installed and wired.

5. Low Voltage Terminal Package - Factory-installed and wired terminals shall be provided for customer connection to lock out the reheat and humidifier upon contact closure. Two (2) extra N/O common alarm contacts shall be provided. Two (2) extra remote shutdown terminals shall be provided.

6. The controls shall allow the use of a virtual back-draft damper, eliminating the need for a mechanical damper. This shall allow the fans to spin slower (15% or less) to act as a damper.

7. LT460-Z45 Zone leak sensor; One per unit.

8. Wired Supply Sensor - Each unit shall have one factory-supplied and connected supply air sensor that may be used as a controlling sensor or reference. When multiple sensors are applied for control purposes, the user shall be able to control based on a maximum or average temperature reading.

9. Virtual Master shall allow for a virtual master that coordinates operation. The Virtual Master function shall provide smooth control operation if the group's communication is compromised. When the lead unit, which is in charge of component staging in teamwork, unit staging and standby rotation, becomes disconnected from the network, the controls shall automatically assign a virtual master. The virtual master shall assume the same responsibilities as the master until communication is restored.

P. Air-Cooled Systems

1. The indoor evaporator unit shall include refrigerant piping, with a factory holding charge of nitrogen. The hot-gas and liquid lines shall be spun shut and shall include a factory-installed Schrader valve. Field-relief of the Schrader valve shall indicate a leak-free system.

Q. Air-Cooled Condenser

1. The Liebert-manufactured outdoor air-cooled condenser shall be the low profile, multiple direct drive, EC fan types. The condenser shall balance the heat rejection of the compressor at 95 °F (°C) ambient. The condenser shall be constructed of aluminum and contain a copper tube, aluminum fin coil arranged for (vertical) air discharge. The condenser shall have premium efficiency condenser control with enhanced monitoring, alarming and diagnostics. The condenser control shall have an automated, low-noise mode and fan reversal for cleaning mode.

R. Fan Speed Control

1. The winter control system for the air-cooled condenser shall be Liebert Fan Speed Control. The variable speed motor shall operate from 0 to 230 volts single phase, 10 to 1050 RPM. It shall be designed with ball bearings, permanent lubrication, internal overload protection, 40°C rise at full speed, 65°C rise at 10 RPM. The control system shall be complete with transducers, thermostats and electrical control circuit, factory prepackaged in the integral condenser control box. The transducer shall automatically sense the highest head pressure of either operating compressor and control the variable speed fan on the air-cooled condenser to properly maintain the head pressure. The Liebert Fan Speed Control system shall provide positive startup and operation in ambient temperatures as low as -20°F (-28.9°C). The units shall ship standard with advanced freeze protection monitoring the pressure of each circuit using a transducer and prevent the unit coil from freezing if circuit suction pressure drops.

2. Condenser Disconnect Switch - A disconnect switch shall be factory-mounted and wired to the condenser control panel, accessible from the exterior (standard on Quiet-Line models).

3. EXECUTION

3.1 INSTALLATION

A. Install air conditioning unit in accordance with manufacturer's installation instructions. Install unit plumb and level, firmly anchored to support the unit's weight in location indicated and maintain manufacturer's recommended clearances. Do not mount units above sensitive electronic equipment to minimize risk of water overflow/leakage damage and improve maintenance/service access.

B. Install and connect electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's electrical connection diagram submittal to electrical contractor.

C. Install and connect devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's piping connection diagram submittal to piping contractor.

D. Connect water supply and drains to air conditioning unit. Unit drain shall be trapped internally and shall not be trapped externally.

E. Install all ship loose accessories per manufacturers requirements.

F. Install air-cooled condensing unit on outside roof equipment supports.

3.2 CONNECTIONS

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

B. Install piping adjacent to machine to allow service and maintenance.

C. Drainage Connections: Provide adequate connections for condensate drain.

D. Electrical System Connections: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.

E. Ground equipment according to Division 26 Section "Grounding and Bonding."

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Verify that room air-conditioning units are installed and connected according to manufacturer's written instructions and the Contract Documents.

C. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.

D. Complete installation and startup checks according to manufacturer's written instructions.

E. After startup service and performance test, change filters and flush humidifier.

3.5 ADJUSTING

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose, without additional cost.

D. Manufacturer’s service technician to adjust hot gas bypass at startup to match load.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain environmental conditioning units. Refer to Division 1 Section "Closeout Procedures"" and Section 230100.

END OF SECTION 238119

SECTION 238120 - ENVIRONMENTAL CONDITIONING UNITS (ECU-1&2 ALTERNATE 1)

1. ___GENERAL

1.1 SUMMARY

A. This Section includes the following types of environmental conditioning units:

1. Split system DX units with electric reheat and econophase pump.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate single line diagrams, electrical and capacity data, electrical connection drawings, dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For computer-room air-conditioning units to include in emergency, operation, and maintenance manuals.

E. Warranties: Special warranties specified in this Section.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

C. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

D. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

E. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

1.4 COORDINATION

A. Coordinate layout and installation of environmental conditioning units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of computer-room air-conditioning units that fail in materials or workmanship within specified warranty period.

B. Warranty Period for Compressors: Manufacturer's standard, but not less than 5 years from date of Substantial Completion.

2. PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. Liebert

B. Frame

1. The frame shall be MIG welded, formed sheet metal. It shall be protected against corrosion using the autophoretic coating process. The frame shall be capable of being separated into three parts in the field to accommodate rigging through small spaces.

C. Upflow Air Supply

1. The supply air shall exit from the top of the cabinet with the air throw toward the front.

D. Air Return

1. The return air shall enter the front factory installed grilles.

E. Exterior Panels

1. The exterior panels shall be insulated with a minimum 1 in. (25mm), 1.5 lb. (0.68 kg) density fiber insulation. The main front panel shall have captive 1/4 turn fasteners.

F. Filters

1. The filter chamber shall be located within the cabinet, and filters shall be removable from the top of the unit. Filters shall be arranged in a V-bank configuration to minimize air pressure drop.

2. Filters shall be deep pleated 4" filters with an ASHRAE 52.2 MERV8 rating (45% ASHRAE 52.1).

3. Provide one extra set(s) of filters shall be provided per system.

G. Electronically Commutated (EC) Fan

1. The fans are plug/plenum type, single inlet and shall be dynamically balanced. The drive package shall be direct drive, electronically commutated and variable speed. The fans shall be located to draw air over the A-frame coil to ensure even air distribution and maximum coil performance.

H. Motors

1. The fan motors shall be 4.15 hp, mounted to an automatic, spring-tensioning base. The motors shall be removable from the front of the cabinet.

I. Reheat

1. The environmental control unit shall include a factory-installed reheat to control temperature during dehumidification.

2. The three stage electric reheat coils shall be low watt density, 304/304 stainless steel fin tubular construction, protected by thermal safety switches controlled in three stages. The reheat elements shall be removable from the front of the cabinet.

J. Dual Refrigeration System

1. Each unit shall include two (2) independent refrigeration circuits and shall include hot gas mufflers (semi-hermetic compressors units only), liquid line filter driers, refrigerant sight glass with moisture indicator, externally equalized expansion valves and liquid line solenoid valves. Compressors shall be located outside the airstream and shall be removable and serviceable from the front of the unit. Each compressor circuit shall be connected to the full-face area of the evaporator coil.

K. Digital Scroll Compressors

L. The compressor shall be scroll-type with a variable capacity operation capability. Compressor solenoid valve shall unload the compressor and allow for variable capacity operation. The compressor shall be suction gas cooled motor, vibration isolators, thermal overloads, automatic reset high pressure switch with lockout after three failures, rotalock service valves, pump down low pressure transducer, suction line strainer, and a maximum operating speed of 3500 RPM. The compressor motor shall be suction gas cooled. The compressors shall include crankcase heaters, factory wired and powered from the indoor unit electric panel. The controller shall monitor the status of the digital scroll sensors. If the control senses the thermistor becomes disconnected, shorted, or the reading goes out of range, the user will be notified through an event on the local display and remote monitoring.Evaporator Coil

1. The evaporator coil shall be A-frame design and be six rows deep, with each circuit feeding three rows. It shall be constructed of rifled copper tubes and aluminum fins. A stainless steel condensate drain pan shall be provided.

M. R-410A Refrigerant

1. The system shall be designed for use with R-410A refrigerant, which meets the EPA clean air act for phase-out of HCFC refrigerants.

N. Econophase Cycle

1. During cold outdoor temperatures, refrigerant pumps shall circulate refrigerant through the cooling system, in lieu of operating the compressors. The compressors shall ramp down during EconoPhase operation, and if able to completely offset the load, the control system shall shut the compressors off. Dual refrigerant pumps shall be housed in an enclosure, with each pump dedicated to its own refrigerant circuit. The EconoPhase system shall include a variable speed drive on each refrigerant pump to enable the pumps' speed to adjust in response to the load.

O. Liebert iCOM™ Microprocessor Control With Large Graphic Display

1. The Liebert iCOM unit control shall be factory-set for Intelligent Control, which uses "fuzzy logic" and "expert systems" methods. Proportional and Tunable PID shall also be user-selectable options. Internal unit component control shall include the following:

a. Compressor Short Cycle Control - Prevents compressor short-cycling and needless compressor wear.

b. System Auto Restart - The auto restart feature shall automatically restart the system after a power failure. Time delay is programmable.

c. Sequential Load Activation - On initial startup or restart after power failure, each operational load is sequenced with a minimum of one second delay to minimize total inrush current.

d. Hot Water/Econ-O-Coil Flush Cycles - Hot water reheat coils and Econ-O-Coils are periodically flushed to prevent a buildup of contaminants.

e. Predictive Humidity Control - calculates the moisture content in the room and prevents unnecessary humidification and dehumidification cycles by responding to changes in dew point temperature. Dew point and relative humidity control methods shall be available for humidity control within the conditioned space.

2. The Liebert iCOM control shall be compatible with all Liebert remote monitoring and control devices. Options are available for BMS interface via Modbus, Jbus, BACnet, Profibus and SNMP.

3. The Liebert iCOM control processor shall be microprocessor based with a 9" color touchscreen display and mounted in an ergonomic, aesthetically pleasing housing. The Liebert iCOM control processor shall display and control keys for user inputs mounted in an ergonomic, aesthetically pleasing housing. The display and housing shall be viewable while the unit panels are open or closed. The controls shall be menu-driven. The display shall be organized into three main sections: User Menus, Service Menus and Advanced Menus. The system shall display user menus for active alarms, event log, graphic data, unit view/status overview (including the monitoring of room conditions, operational status in % of each function, date and time), total run hours, various sensors, display setup and service contacts. A password shall be required to make system changes within the service menus. Service menus shall include setpoints, standby settings (lead/lag), timers/sleep mode, alarm setup, sensor calibration, maintenance/wellness settings, options setup, system/network setup, auxiliary boards and diagnostics/service mode. A password shall be required to access the advanced menus, which include the factory settings and password menus.

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a. Active Alarms: Unit memory shall hold the 200 most recent alarms with time and date stamp for each alarm.

b. Event Log: Unit memory shall hold the 400 most recent events with ID number, time and date stamp for each event.

c. Graphic Data View: Eight graphic records shall be available: return air temperature, return air humidity, supply air temperature, outdoor temperature and four custom graphs.

d. Unit View - Status Overview: Simple or Graphical "Unit View" summary displays shall include temperature and humidity values, active functions (and percent of operation) and any alarms of the host unit.

e. Total Run Hours: Menu shall display accumulative component operating hours for major components including compressors, Econ-O-Coil (FC), fan motor, humidifier and reheat.

f. Various Sensors: Menu shall allow setup and display of optional custom sensors. The control shall include four customer-accessible analog inputs for sensors provided by others. The analog inputs shall accept a 4 to 20 mA signal. The user shall be able to change the input to 0 to 5VDC or 0 to 10VDC if desired. The gains for each analog

input shall be programmable from the front display. The analog inputs shall be able to be monitored from the front display.

g. Diagnostics/Service Mode: The Liebert iCOM control shall be provided with self-diagnostics to aid in troubleshooting. The microcontroller board shall be diagnosed and reported as pass/not pass. Control inputs shall be indicated as On or Off at the front display. Control outputs shall be able to be turned On or Off from the front display without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.

5. Service Contacts: Menu shall allow display of local service contact name and phone number.

   a. The Service Menus Shall be Defined as Follows:

   b. Setpoints: Menu shall allow setpoints within the following ranges:

      - Temperature Setpoint: 65-85ºF (18-29ºC)*
      - Temperature Sensitivity: +1-10ºF (0.6-5.6ºC)
      - Humidity Setpoint: 20-80% RH*
      - Humidity Sensitivity: 1-30% RH
      - High Temperature Alarm: 35-90ºF (2-32ºC)
      - Low Temperature Alarm: 35-90ºF (2-32ºC)
      - High Humidity Alarm: 15-85% RH
      - Low Humidity Alarm: 15-85% RH

      * The microprocessor may be set within these ranges, however, the unit may not be able to control to extreme combinations of temperature and humidity.

6. Standby Settings/Lead-Lag: Menu shall allow planned rotation or emergency rotation of operating and standby units.

   a. Timers/Sleep Mode: Menu shall allow various customer settings for turning On/Off unit.

   b. Alarm Setup: Menu shall allow customer settings for alarm notification (audible/local/remote). The following alarms shall be available:

      - High Temperature
      - Low Temperature
      - High Humidity
      - Low Humidity
      - EC Fan Fault
      - Loss of Airflow
      - Loss of Power

- Compressor Overload
- Main Fan Overload
- High Head Pressure
- Change Filter
- Fan Failure
- Low Suction Pressure
- Smoke Detected
- Unit Off

c. Audible Alarm: The audible alarm shall annunciate any alarm that is enabled by the operator.

d. Common Alarm: A programmable common alarm shall be provided to interface user-selected alarms with a remote alarm device.

e. Remote Monitoring: All alarms shall be communicated to the Liebert monitoring system with the following information: date and time of occurrence, unit number and present temperature and humidity.

f. Sensor Calibration: Menu shall allow unit sensors to be calibrated with external sensors.

g. Maintenance/Wellness Settings: Menu shall allow reporting of potential component problems before they occur.

h. Options Setup: Menu shall provide operation settings for the installed components.

i. System/Network Setup: Menu shall allow Unit-to-Unit (U2U) communication and setup for Teamwork modes of operation (up to 32 units).

j. Teamwork Modes of Operation: Saves energy by preventing operation of units in opposite modes multiple units.

k. Auxiliary Boards: Menu shall allow setup of optional expansion boards.

l. Diagnostics/Service Mode: The Liebert iCOM control shall be provided with self-diagnostics to aid in troubleshooting. The microcontroller board shall be diagnosed and reported as pass/not pass. Control inputs shall be indicated as on or off at the front display. Control outputs shall be able to be turned on or off from the front display without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.

7. Advanced Menus

a. Factory Settings: Configuration settings shall be factory-set based on the pre-defined component operation.

b. Change Passwords: Menu shall allow new passwords to be set or changed.

8. Multi-Unit Coordination

a. Liebert iCOM teamwork shall save energy by preventing multiple units in an area from operating in opposing modes. Teamwork allows the control to optimize a group of connected cooling units equipped with Liebert iCOM using the U2U (Unit-to-Unit) network. There shall be three modes of teamwork operation:
   - Teamwork Mode 1: Is best in small rooms with balanced heat loads. The controlling temperature and humidity sensor readings of all units in operation (fan On) are collected to be used for an average or worst-case sensor reading (user-selectable). The master unit shall send the operating requirements to all operating units in the group. The control band (temperature, fan and humidity) is divided and shared among the units in the group.
   - Teamwork Mode 2: The Liebert iCOM calculates the worse-case demand for heating, cooling humidification and dehumidification. Based on the greatest demand within the group, each unit operates independently, meaning that the unit may respond to the thermal load and humidity conditions based on the unit's controlling sensors.
   - Teamwork Mode 3 - Optimized Aisle: May be employed in large and small rooms with varying heat loads. Optimized Aisle is the most efficient teamwork mode that allows the unit to match cooling capacity with heat load. In the Optimized Aisle mode, the fans operate in parallel. Fans can be controlled exclusively by remote temperature or using static pressure with a secondary remote temperature sensor(s) as an override to ensure that the inlet rack temperature is being met. Cooling (Compressors or Economizer) is controlled through unit supply air conditions. Liebert iCOM calculates the average or worst-case sensor reading (user-selectable) for heating, cooling humidification and dehumidification. Based on the demand within the group, units will be allowed to operate within that mode until room conditions are satisfied.

b. The Liebert iCOM® shall allow scheduled rotation to keep equal run time on units and provide automated emergency rotation of operating and standby units.

P. Miscellaneous Options

1. Locking Disconnect Switch - The manual disconnect switch shall be mounted in the high voltage section of the electrical panel. The switch shall be accessible from the outside of the unit with the door closed and prevent access to the high voltage electrical components until switched to the "OFF" position. Provide disconnects for both the indoor evaporator section and outdoor condenser sections.

2. High Temperature Sensor - The firestat shall be factory-installed in the unit and shall be factory-set to 125ºF (52ºC). It shall immediately shut down the environmental control system when activated. The sensor shall be mounted with the sensing element in the return air.

3. Smoke Sensor - The smoke sensor shall immediately shut down the environmental control system and activate the alarm system when activated. The smoke sensor shall be mounted in the electrical panel with the sensing element in the return air compartment. The smoke sensor is not intended to function as or replace any room smoke detection system that may be required by local or national codes. The smoke sensor shall include a supervision contact closure.

4. Condensate Pump, Dual Float – The condensate pump shall have a minimum capacity of 145 GPH (548 l/h) at 20 ft. (58 kPa) head. It shall be complete with integral dual-float switches, pump-and-motor assembly and reservoir. The secondary float shall send a signal to the local alarm and shut down the unit upon high water condition. The condensate pump shall be factory installed and wired.

5. Low Voltage Terminal Package - Factory-installed and wired terminals shall be provided for customer connection to lock out the reheat and humidifier upon contact closure. Two (2) extra N/O common alarm contacts shall be provided. Two (2) extra remote shutdown terminals shall be provided.
6. The controls shall allow the use of a virtual back-draft damper, eliminating the need for a mechanical damper. This shall allow the fans to spin slower (15% or less) to act as a damper.
7. LT460-Z45 Zone leak sensor; One per unit.
8. Wired Supply Sensor - Each unit shall have one factory-supplied and connected supply air sensor that may be used as a controlling sensor or reference. When multiple sensors are applied for control purposes, the user shall be able to control based on a maximum or average temperature reading.
9. Virtual Master shall allow for a virtual master that coordinates operation. The Virtual Master function shall provide smooth control operation if the group's communication is compromised. When the lead unit, which is in charge of component staging in teamwork, unit staging and standby rotation, becomes disconnected from the network, the controls shall automatically assign a virtual master. The virtual master shall assume the same responsibilities as the master until communication is restored.

Q. Air-Cooled Systems

1. The indoor evaporator unit shall include refrigerant piping, with a factory holding charge of nitrogen. The hot-gas and liquid lines shall be spun shut and shall include a factory-installed Schrader valve. Field-relief of the Schrader valve shall indicate a leak-free system.

R. Air-Cooled Condenser

1. The Liebert-manufactured outdoor air-cooled condenser shall be the low profile, multiple direct drive, EC fan types. The condenser shall balance the heat rejection of the compressor at 95 °F (°C) ambient. The condenser shall be constructed of aluminum and contain a copper tube, aluminum fin coil arranged for (vertical) air discharge. The condenser shall have premium efficiency condenser control with enhanced monitoring, alarming and diagnostics. The condenser control shall have an automated, low-noise mode and fan reversal for cleaning mode.

S. Fan Speed Control

1. The winter control system for the air-cooled condenser shall be Liebert Fan Speed Control. The variable speed motor shall operate from 0 to 230 volts single phase, 10 to 1050 RPM. It shall be designed with ball bearings, permanent lubrication, internal overload protection, 40°C rise at full speed, 65°C rise at 10 RPM. The control system shall be complete with transducers, thermostats and electrical control circuit, factory prepackaged in the integral condenser control box. The transducer shall automatically sense the highest head pressure of either operating compressor and control the variable speed fan on the air-cooled condenser to properly maintain the head pressure. The Liebert Fan Speed Control system shall provide positive startup and operation in ambient temperatures as low as -20°F (-28.9°C). The units shall ship standard with advanced freeze protection monitoring the pressure of each circuit using a transducer and prevent the unit coil from freezing if circuit suction pressure drops.

2. Condenser Disconnect Switch - A disconnect switch shall be factory-mounted and wired to the condenser control panel, accessible from the exterior (standard on Quiet-Line models).

3. EXECUTION

3.1 INSTALLATION

A. Install air conditioning unit in accordance with manufacturer's installation instructions. Install unit plumb and level, firmly anchored to support the unit's weight in location indicated and maintain manufacturer's recommended clearances. Do not mount units above sensitive electronic equipment to minimize risk of water overflow/leakage damage and improve maintenance/service access.

B. Install and connect electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's electrical connection diagram submittal to electrical contractor.

C. Install and connect devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's piping connection diagram submittal to piping contractor.

D. Connect water supply and drains to air conditioning unit. Unit drain shall be trapped internally and shall not be trapped externally.

E. Install all ship loose accessories per manufacturers requirements.

F. Install air-cooled condensing unit on outside roof equipment supports.

3.2 CONNECTIONS

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

B. Install piping adjacent to machine to allow service and maintenance.

C. Drainage Connections: Provide adequate connections for condensate drain.

D. Electrical System Connections: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.

E. Ground equipment according to Division 26 Section "Grounding and Bonding."

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Verify that room air-conditioning units are installed and connected according to manufacturer's written instructions and the Contract Documents.

C. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.

D. Complete installation and startup checks according to manufacturer's written instructions.

E. After startup service and performance test, change filters and flush humidifier.

3.5 ADJUSTING

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose, without additional cost.

D. Manufacturer’s service technician to adjust hot gas bypass at startup to match load.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain environmental conditioning units. Refer to Division 1 Section "Closeout Procedures”" and Section 230100.

END OF SECTION 238119

SECTION 238120 - ENVIRONMENTAL CONDITIONING UNITS (ECU-1&2 ALTERNATE 1)

1. __GENERAL

1.1 SUMMARY

A. This Section includes the following types of environmental conditioning units:

1. Split system DX units with electric reheat and econophase pump.

1.2 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate single line diagrams, electrical and capacity data, electrical connection drawings, dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For computer-room air-conditioning units to include in emergency, operation, and maintenance manuals.

E. Warranties: Special warranties specified in this Section.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

C. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

D. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

E. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

1.4 COORDINATION

A. Coordinate layout and installation of environmental conditioning units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of computer-room air-conditioning units that fail in materials or workmanship within specified warranty period.

B. Warranty Period for Compressors: Manufacturer's standard, but not less than 5 years from date of Substantial Completion.

2. PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. Liebert

B. Cabinet Construction

1. The exterior panels shall be 20 gauge steel and powder-coated with RAL 7021 black color paint to protect against corrosion. The exterior panels shall be insulated with 1", 1-1/2 lb. (0.68 kg) insulation. Front and side panels shall have captive, quarter-turn fasteners. The cabinet shall be designed so that all components are serviceable and removable using the front and right sides of the unit.

C. Upflow Air Supply

1. The supply air shall exit from the top of the cabinet.

D. Air Return

1. The return air shall enter the front factory installed grilles.

E. Exterior Panels

1. The exterior panels shall be internally lined with 20 gauge galvanized steel, sandwiching the insulation between the panels for easy cleaning.

F. Filters

1. The filter shall be an integral part of the system and located within the cabinet. The filter shall be deep-pleated, 2 in. (51mm) thick with a MERV 8 rating efficiency based on ASHRAE 52.2-2007. A filter clog switch shall be included. Mesh type, cleanable filters shall be unacceptable.

2. Provide one extra set(s) of filters shall be provided per system.

G. Thermostatic Expansion Valve

1. A manual adjustable externally equalized expansion valve thermostatic expansion valve (TXV) shall control the flow of liquid refrigerant entering the direct expansion coil. The TXV shall maintain consistent superheat of the refrigerant vapor at the outlet of the evaporator coil over the unit's operating range. The TXV shall prevent liquid refrigerant from returning to the compressor.

H. Fan and Motor

1. The unit must be equipped with one plug fan: integral direct driven fan with backward-curved blades and electronically commutated DC motor; commonly referred to as EC fan. The fan speed shall be variable and automatically regulated by the Liebert iCOM through all modes of operation. The fan shall have a dedicated motor, fault monitoring circuitry, and speed controller, which shall provide a level of redundancy. The impeller shall be made of aluminum and dynamically balanced. The EC fan shall be located within the unit. The EC fan shall also provide greater energy savings than forward curved centrifugal fan and variable speed drives. The EC fan shall be factory mounted in the upper portion of the unit.

I. Reheat

1. The environmental control unit shall include a factory-installed reheat to control temperature during dehumidification.

2. The three stage electric reheat coils shall be low watt density, 304/304 stainless steel fin tubular construction, protected by thermal safety switches controlled in two stages. The reheat elements shall be removable from the right side of the cabinet.

J. Refrigeration System

1. Single refrigeration circuit shall include a liquid line filter drier, a refrigerant sight glass with moisture indicator, an expansion valve, pressure safety switches, and a liquid line solenoid valve. The indoor evaporator refrigerant piping shall be filled with a nitrogen holding charge and spun shut. Field relief of the Schrader valve shall indicate a leak-free system.

K. Digital Scroll Compressors

1. The The compressor must be an R-410A Copland Digital scroll-type with variable capacity operation from 20-100%. No alternate compressors will be accepted. The compressor solenoid valve shall unload the digital scroll compressor to provide variable capacity operation. The compressor shall have a suction gas cooled motor, EPDM Rubber vibration isolators, internal thermal overloads, automatic reset high pressure switch with lockout after three failure occurrences, rota-lock service valves, low pressure transducer, and crankcase heater. The compressor shall be removable and serviceable from the front of the unit. The crankcase heater and a discharge check valve shall be provided for additional system protection from refrigerant migration during Off cycles.
2. The compressor sound jacket shall reduce the level of sound emitted from the digital scroll compressor. It shall consist of a 3/8 inch closed cell polymeric 4.5 - 8.5 lb/ft3 density jacket that encloses the compressor.

L. Evaporator Coil

1. The direct-expansion, tilted-slab evaporator cooling coil shall be constructed of copper tubes and hydrophilic-coated aluminum fins. The hydrophilic coating shall significantly improve the speed of condensate drainage from the fins and shall provide superior water carryover resistance. One stainless steel condensate drain pan shall be provided.

M. R-410A Refrigerant

1. The system shall be designed for use with R-410A refrigerant, which meets the EPA clean air act for phase-out of HCFC refrigerants.

N. Liebert iCOM™ Microprocessor Control With Large Graphic Display

1. The Liebert iCOM unit control shall be factory-set for Intelligent Control, which uses “fuzzy logic” and “expert systems” methods. Proportional and Tunable PID shall also be user-selectable options. Internal unit component control shall include the following:

   a. Compressor Short Cycle Control - Prevents compressor short-cycling and needless compressor wear.

   b. System Auto Restart - The auto restart feature shall automatically restart the system after a power failure. Time delay is programmable.

c. Sequential Load Activation - On initial startup or restart after power failure, each operational load is sequenced with a minimum of one second delay to minimize total inrush current.

d. Hot Water/Econ-O-Coil Flush Cycles - Hot water reheat coils and Econ-O-Coils are periodically flushed to prevent a buildup of contaminants.

e. Predictive Humidity Control - calculates the moisture content in the room and prevents unnecessary humidification and dehumidification cycles by responding to changes in dew point temperature. Dew point and relative humidity control methods shall be available for humidity control within the conditioned space.

2. The Liebert iCOM control shall be compatible with all Liebert remote monitoring and control devices. Options are available for BMS interface via Modbus, Jbus, BACnet, Profibus and SNMP.

3. The Liebert iCOM control processor shall be microprocessor based with a 9" color touchscreen display and mounted in an ergonomic, aesthetically pleasing housing. The Liebert iCOM control processor shall display and control keys for user inputs mounted in an ergonomic, aesthetically pleasing housing. The display and housing shall be viewable while the unit panels are open or closed. The controls shall be menu-driven. The display shall be organized into three main sections: User Menus, Service Menus and Advanced Menus. The system shall display user menus for active alarms, event log, graphic data, unit view/status overview (including the monitoring of room conditions, operational status in % of each function, date and time), total run hours, various sensors, display setup and service contacts. A password shall be required to make system changes within the service menus. Service menus shall include setpoints, standby settings (lead/lag), timers/sleep mode, alarm setup, sensor calibration, maintenance/wellness settings, options setup, system/network setup, auxiliary boards and diagnostics/service mode. A password shall be required to access the advanced menus, which include the factory settings and password menus.

4. The User Menus Shall be Defined as Follows:

a. Active Alarms: Unit memory shall hold the 200 most recent alarms with time and date stamp for each alarm.

b. Event Log: Unit memory shall hold the 400 most recent events with ID number, time and date stamp for each event.

c. Graphic Data View: Eight graphic records shall be available: return air temperature, return air humidity, supply air temperature, outdoor temperature and four custom graphs.

d. Unit View - Status Overview: Simple or Graphical "Unit View" summary displays shall include temperature and humidity values, active functions (and percent of operation) and any alarms of the host unit.

e. Total Run Hours: Menu shall display accumulative component operating hours for major components including compressors, Econ-O-Coil (FC), fan motor, humidifier and reheat.

f. Various Sensors: Menu shall allow setup and display of optional custom sensors. The control shall include four customer-accessible analog inputs for sensors provided by others. The analog inputs shall accept a 4 to 20 mA signal. The user shall be able to change the input to 0 to 5VDC or 0 to 10VDC if desired. The gains for each analog

input shall be programmable from the front display. The analog inputs shall be able to be monitored from the front display.

g. Diagnostics/Service Mode: The Liebert iCOM control shall be provided with self-diagnostics to aid in troubleshooting. The microcontroller board shall be diagnosed and reported as pass/not pass. Control inputs shall be indicated as On or Off at the front display. Control outputs shall be able to be turned On or Off from the front display without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.

5. Service Contacts: Menu shall allow display of local service contact name and phone number.

   a. The Service Menus Shall be Defined as Follows:

   b. Setpoints: Menu shall allow setpoints within the following ranges:

      - Temperature Setpoint: 65-85ºF (18-29ºC)*
      - Temperature Sensitivity: +1-10ºF (0.6-5.6ºC)
      - Humidity Setpoint: 20-80% RH*
      - Humidity Sensitivity: 1-30% RH
      - High Temperature Alarm: 35-90ºF (2-32ºC)
      - Low Temperature Alarm: 35-90ºF (2-32ºC)
      - High Humidity Alarm: 15-85% RH
      - Low Humidity Alarm: 15-85% RH

      * The microprocessor may be set within these ranges, however, the unit may not be able to control to extreme combinations of temperature and humidity.

6. Standby Settings/Lead-Lag: Menu shall allow planned rotation or emergency rotation of operating and standby units.

   a. Timers/Sleep Mode: Menu shall allow various customer settings for turning On/Off unit.

   b. Alarm Setup: Menu shall allow customer settings for alarm notification (audible/local/remote). The following alarms shall be available:

      - High Temperature
      - Low Temperature
      - High Humidity
      - Low Humidity
      - EC Fan Fault
      - Loss of Airflow
      - Loss of Power

- Compressor Overload
- Main Fan Overload
- High Head Pressure
- Change Filter
- Fan Failure
- Low Suction Pressure
- Smoke Detected
- Unit Off

c. Audible Alarm: The audible alarm shall annunciate any alarm that is enabled by the operator.

d. Common Alarm: A programmable common alarm shall be provided to interface user-selected alarms with a remote alarm device.

e. Remote Monitoring: All alarms shall be communicated to the Liebert monitoring system with the following information: date and time of occurrence, unit number and present temperature and humidity.

f. Sensor Calibration: Menu shall allow unit sensors to be calibrated with external sensors.

g. Maintenance/Wellness Settings: Menu shall allow reporting of potential component problems before they occur.

h. Options Setup: Menu shall provide operation settings for the installed components.

i. System/Network Setup: Menu shall allow Unit-to-Unit (U2U) communication and setup for Teamwork modes of operation (up to 32 units).

j. Teamwork Modes of Operation: Saves energy by preventing operation of units in opposite modes multiple units.

k. Auxiliary Boards: Menu shall allow setup of optional expansion boards.

l. Diagnostics/Service Mode: The Liebert iCOM control shall be provided with self-diagnostics to aid in troubleshooting. The microcontroller board shall be diagnosed and reported as pass/not pass. Control inputs shall be indicated as on or off at the front display. Control outputs shall be able to be turned on or off from the front display without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.

7. Advanced Menus

a. Factory Settings: Configuration settings shall be factory-set based on the pre-defined component operation.

b. Change Passwords: Menu shall allow new passwords to be set or changed.

O. Miscellaneous Options

1. Locking Disconnect Switch - The manual disconnect switch shall be mounted in the high voltage section of the electrical panel. The switch shall be accessible from the outside of the unit with the door closed and prevent access to the high voltage electrical components until switched to the “OFF” position. Provide disconnects for both the indoor evaporator section and outdoor condenser sections.

2. High Temperature Sensor - The firestat shall be factory-installed in the unit and shall be factory-set to 125ºF (52ºC). It shall immediately shut down the environmental control system when activated. The sensor shall be mounted with the sensing element in the return air.

3. Smoke Sensor - The smoke sensor shall immediately shut down the environmental control system and activate the alarm system when activated. The smoke sensor shall be mounted in the electrical panel with the sensing element in the return air compartment. The smoke sensor is not intended to function as or replace any room smoke detection system that may be required by local or national codes. The smoke sensor shall include a supervision contact closure.

4. Condensate Pump, Dual Float – The condensate pump shall have a minimum capacity of 145 GPH (548 l/h) at 20 ft. (58 kPa) head. It shall be complete with integral dual-float switches, pump-and-motor assembly and reservoir. The secondary float shall send a signal to the local alarm and shut down the unit upon high water condition. The condensate pump shall be factory installed and wired.

5. Low Voltage Terminal Package - Factory-installed and wired terminals shall be provided for customer connection to lock out the reheat and humidifier upon contact closure. Two (2) extra N/O common alarm contacts shall be provided. Two (2) extra remote shutdown terminals shall be provided.

6. The controls shall allow the use of a virtual back-draft damper, eliminating the need for a mechanical damper. This shall allow the fans to spin slower (15% or less) to act as a damper.

7. LT460-Z45 Zone leak sensor; One per unit.

8. Wired Supply Sensor - Each unit shall have one factory-supplied and connected supply air sensor that may be used as a controlling sensor or reference. When multiple sensors are applied for control purposes, the user shall be able to control based on a maximum or average temperature reading.

P. Air-Cooled Systems

1. The indoor evaporator unit shall include refrigerant piping, with a factory holding charge of nitrogen. The hot-gas and liquid lines shall be spun shut and shall include a factory-installed Schrader valve. Field-relief of the Schrader valve shall indicate a leak-free system.

Q. Air-Cooled Condenser

1. The Liebert-manufactured outdoor air-cooled condenser shall be the low profile, multiple direct drive, EC fan types. The condenser shall balance the heat rejection of the compressor at 95 °F (°C) ambient. The condenser shall be constructed of aluminum and contain a copper tube, aluminum fin coil arranged for (vertical) air discharge. The condenser shall have premium efficiency condenser control with enhanced monitoring, alarming and diagnostics. The condenser control shall have an automated, low-noise mode and fan reversal for cleaning mode.

R. Fan Speed Control

1. The winter control system for the air-cooled condenser shall be Liebert Fan Speed Control. The variable speed motor shall operate from 0 to 230 volts single phase, 10 to 1050 RPM. It shall be designed with ball bearings, permanent lubrication, internal overload protection, 40°C rise at full speed, 65°C rise at 10 RPM. The control system shall be complete with transducers, thermostats and electrical control circuit, factory prepackaged in the integral condenser control box. The transducer shall automatically sense the highest head pressure of either operating compressor and control the variable speed fan on the air-cooled condenser to properly maintain the head pressure. The Liebert Fan Speed Control system shall provide positive startup and operation in ambient temperatures as low as -20°F (-28.9°C). The units shall ship standard with advanced freeze protection monitoring the pressure of each circuit using a transducer and prevent the unit coil from freezing if circuit suction pressure drops.

2. Condenser Disconnect Switch - A disconnect switch shall be factory-mounted and wired to the condenser control panel, accessible from the exterior (standard on Quiet-Line models).

3. EXECUTION

3.1 INSTALLATION

A. Install air conditioning unit in accordance with manufacturer's installation instructions. Install unit plumb and level, firmly anchored to support the unit's weight in location indicated and maintain manufacturer's recommended clearances. Do not mount units above sensitive electronic equipment to minimize risk of water overflow/leakage damage and improve maintenance/service access.

B. Install and connect electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's electrical connection diagram submittal to electrical contractor.

C. Install and connect devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's piping connection diagram submittal to piping contractor.

D. Connect water supply and drains to air conditioning unit. Unit drain shall be trapped internally and shall not be trapped externally.

E. Install all ship loose accessories per manufacturers requirements.

F. Install air-cooled condensing unit on outside roof equipment supports.

3.2 CONNECTIONS

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

B. Install piping adjacent to machine to allow service and maintenance.

C. Drainage Connections: Provide adequate connections for condensate drain.

D. Electrical System Connections: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.

E. Ground equipment according to Division 26 Section "Grounding and Bonding."

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Verify that room air-conditioning units are installed and connected according to manufacturer's written instructions and the Contract Documents.

C. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.

D. Complete installation and startup checks according to manufacturer's written instructions.

E. After startup service and performance test, change filters and flush humidifier.

3.5 ADJUSTING

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose, without additional cost.

D. Manufacturer’s service technician to adjust hot gas bypass at startup to match load.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain environmental conditioning units. Refer to Division 1 Section "Closeout Procedures"" and Section 230100.

END OF SECTION 238119

SECTION 260100 - BASIC ELECTRICAL REQUIREMENTS

1. GENERAL

1.1. GENERAL REFERENCE

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

B. This Contractor is also referred to the Structural, Mechanical and all other drawings and specifications pertinent to this project. All of the above mentioned drawings and specifications are considered a part of the Contract Documents.

C. This section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 26. It expands and supplements the requirements specified in sections of Division 01.

1.2. SUMMARY

A. This Section includes general administrative and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:

Shop drawings

Definitions

Discrepancies

Record documents

Equipment

Substitutions

Codes and permits

Interferences

Delivery, storage and handling

Punchlists

Operating and maintenance

Warranties

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

1. Division 23 Section "ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT", for factory-installed motors, controllers, accessories, and connections.
2. Division 26 Section "BASIC ELECTRICAL MATERIALS AND METHODS", for materials and methods common to the remainder of Division 26.

1.3. SHOP DRAWINGS

A. This Contractor shall review, stamp and sign with his approval and submit, with reasonable promptness and in orderly sequence so as to cause no delay in the work or in the work of any other Contractor, all submittal information and samples required by the contract documents. Submittal information not stamped with Contractor approval will be returned for reprocessing.

1. In approving the submittals, the Contractor guarantees that the submittals accurately and completely represent the equipment and materials to be installed.
2. Shop drawings shall be submitted for ALL material items as outlined in these specifications. Any deviations from contract requirements must be clearly indicated on shop drawings, and justification for their consideration must be included.

3. Acceptance of submittal items will not preclude rejection of those items upon later discovery that their suitability for the application or ability to meet the requirements of these specifications was misrepresented in the submittals.
4. Submittals for equipment shall include detailed dimensional drawings which completely and accurately represent the specific piece of equipment to be supplied. When more than one piece of similar equipment is to be supplied, provide accurate dimensional drawings for each unique size and/or configuration of the equipment.

B. In checking shop drawings, the Engineer will make every effort to detect and correct errors, omissions and inaccuracies in such drawings, but his failure to detect errors, omissions and inaccuracies shall not relieve the Contractor of responsibility for the proper and complete installation in accordance with the intent of the Contract Documents.

C. Shop drawings shall be submitted for ALL material items as outlined in these specifications. Any deviations from contract requirements must be shown on shop drawings, and justification for their consideration must be included.

D. Approval or acceptance of submittal items will not preclude rejection of those items upon discovery of defects in them prior to final acceptance of complete work.

E. Submit 1 electronic copy (preferred) or 5 prints of each of shop drawings to the Engineer. The Engineer shall retain one (1) print and return the remainder to the Contractor who shall print and distribute copies as required to properly conduct the work; including requirements of the operating manual.

F. Shop drawings are required on the following items, where such items are a part of the Electrical Contract:

1. Wiring devices
2. Equipment identification nameplates
3. Fire stopping materials

1.4. DEFINITIONS

A. To achieve brevity in Specification and on Drawings, certain words and phrases not contributing to clarity have been omitted. Unless mentioned specifically as work to be done by Other Trades, all requirements contained in the Specifications and shown on the Drawings shall be performed by the Principal Contractor for this Division of the Contract. The following definitions shall apply:

1. Where the word "provide" is used in connection with a system, equipment, or item, it shall be construed to mean the furnishing and installing of the system, equipment, or item.
2. Where the phrase "as directed" is used it shall be construed to mean as directed by the Architect (Owner) (Engineer) or his authorized representative.

B. The term "Contractor" as applied to work specified, shown or reasonably implied in the contract documents for Division 26 shall be defined as the prime contractor who is responsible for the work specified, or indicated. All work subcontracted to each prime contractor must be incorporated by and coordinated by each prime contractor. The electrical prime contract for this project shall include the following:

Prime Contract	Specification Sections	Drawings
Electrical	All 26 Series	All E-Series Drawings

1.5. DISCREPANCIES

A. Should it appear that there is a duplication on the Drawings or in the Specifications, wherein the same work or items are shown or specified as being provided under different contracts, subcontracts or supply orders, and such duplication is not clarified by Addendum during the bidding period, it shall be assumed that the prime contractors have included duplicate quotations in their proposal to the Owner.

The Engineer shall have the option of selecting the contract, subcontract or supply order under which the work or items are to be provided and a credit shall be due the Owner for the duplicate work or items.

B. Where a discrepancy exists within the specifications, among the drawings, or between the specifications and the drawings, refer to project supplementary conditions.

C. The design drawings, as submitted, are diagrammatic and are not intended to show exact location of equipment, electrical devices, etc. unless dimensions are given. Drawings are not to be scaled.

1. Equipment shall be installed along the general arrangement indicated on the drawings, and in accordance with the manufacturer's instructions.

a. Provide at least the minimum manufacturer's recommended and code required clearance around the equipment for normal maintenance.

b. Locate and arrange equipment in relationship to other system components to assure that the equipment will be operating under the best possible conditions to meet the scheduled performance requirements.

2. Raceways are to be installed along the general plans shown on the drawings keeping in mind the constraints of the available space and the need to coordinate with the work of other trades. Additional bends, pull and splice boxes shall be provided as necessary to meet space constraints and to facilitate the work of other trades.

D. Electrical equipment, specified hereinafter as shown on the drawings shall be furnished and installed by this Contractor, unless specifically indicated to the contrary.

E. Occasionally, certain references may be indicated on the Drawings to items which are suggested to be furnished and/or installed by various subcontractors. This is done to assist the applicable Prime Contractor in organizing his subcontractor's bids. However, no attempt has been made, nor is it implied, that this specification or plans are attempting to specifically divide all responsibilities for subcontractors. It is the Prime Contractor's responsibility that all items covered on electrical plans and Division 26 specifications are included in his bid and are coordinated with his subcontractors. No consideration will be given for Prime Contractor's failure to include all applicable electrical work in his bid.

F. Where more than one manufacturer is named for major items of equipment, the manufacturer noted on the Drawings has been used as a basis for design. If another manufacturer is used, other than the one named on the Drawings, it shall be the responsibility of this contractor to ensure that the equipment will fit the space with all legal clearances, or bear the expense to change the space and structure to accommodate equipment used.

1.6. RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements of this division.

B. This Contractor shall record all changes from original design drawings which were made during the installation of the work. These changes shall be recorded in red ink on a designated set of prints. Changes shall be accurately dimensioned and/or drawn to scale.

C. This Contractor shall keep an updated set of specifications and prints, including changes on the job site, at all times and shall submit one (1) set of updated and legible prints to the {Architect} {Engineer} when the work is complete.

1.7. EQUIPMENT

A. Before entering into a contract, the successful bidder may be required to submit satisfactory evidence to show that an equipment manufacturer has been regularly engaged in the manufacture of such equipment for three (3) years and have not less than three (3) installations of a similar type which have been in successful operation under conditions similar to those specified for not less than two (2) years.

1.8. SUBSTITUTIONS

A. Bids concerning the use of substitute products must be accompanied by complete specifications and performance characteristics covering these products, together with such available test data and experience records as may be helpful to the Engineer in evaluating the quality and/or suitability of the proposed products.

B. Where more than one make or name is mentioned as being acceptable, it shall be understood that only the name or make referring to the manufacturer's model numbers or sizes shall be considered the "Specified Standard". It shall be further understood that other makes and names, even though mentioned, have not been checked for detail and that their size and arrangement are the Contractor's responsibility the same as a proposed substitute item.

C. The intent of this paragraph is to make the specifications open to all available makes of material and apparatus during the bidding period. Certain definite makes or kinds of items are specified as "standards of quality" and character required. This Contractor is required to bid upon the basis of furnishing the makes specified. He is also invited to bid on any other similar makes he (the Contractor) may desire to propose as substitutions, stating any difference in cost (if any) for each proposed substitution on either the Proposal or the Voluntary Substitution Sheets. If the Engineer shall decide to accept any of the proposed substitutions, proper notations thereof shall be made in the written contract. Where several makes are mentioned in the specifications and the Contractor fails to state that he prefers a particular make in his bid, the Owner shall have the right to choose any of the makes mentioned without change in price. No consideration will be given to proposals for alternative products unless submitted with the original bids.

1.9. CODES AND PERMITS

A. All equipment, materials, and installation shall comply with the National Fire Protection Association's "National Fire Codes" and "National Electrical Code". Equipment shall bear the "UL" label as required by these codes.

B. Install work in full accordance with rules and regulations of State, County and City authorities having jurisdiction over premises. This shall include safety requirements of Ohio State Department of Industrial Relations. Do not construe this as relieving Contractor from compliance with any requirements of specifications which are in excess of Code requirements and not in conflict therewith.

C. Unless otherwise indicated, secure and pay for all permits and certificates of inspection incidental to this work required by foregoing authorities. Be responsible for payments to all public utilities for temporary service work performed by them in connection with provision of temporary service required under this DIVISION of specifications. Deliver all certificates to Engineer in duplicate.

1.10. INTERFERENCES

A. Before installing any work, this Contractor shall see that it does not interfere with clearance required for finish on beams, columns, pilasters, walls or other structural or architectural members, as shown on Architectural Drawings. If any work is so installed and it later develops that Architectural design cannot be followed, Contractor shall, at his own expense, make such changes in his work as the Engineer may direct to permit completion of Architectural work in accordance with plans and specifications.

B. Install additional conduit, pullboxes, spliceboxes, etc. where required to obtain maximum headroom or to avoid conflict with other work without additional cost to the Owner. Where mounting heights are not detailed or dimensioned, install electrical conduit and overhead equipment to provide the maximum headroom possible.

C. Report any interferences between work under this division and that of any other Contractors to the Engineer as soon as they are discovered. The Engineer will determine which equipment shall be relocated, regardless of which was first installed, and his decision shall be final.

1.11. DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall make provisions for the delivery and safe storage of his materials and equipment in coordination with the work of others. Materials and equipment shall be delivered at such stages of the work as will expedite the work as a whole and shall be marked and stored in such a way as to be easily checked and inspected. The arrival and placing of large equipment items shall be scheduled early enough to permit entry and setting when there is no restriction or problem due to size and weight.

1.12. PUNCHLISTS

A. From time to time throughout the course of the work, or upon completion of the work the Design Professional may perform site observations resulting in written documentation of deviations in the work from the Contract Documents. In such cases the Contractor shall respond in writing to each and every item on this written documentation stating the specific action taken to remedy the deviation. A response shall be provided by the Contractor for each separate observation. This work shall not be considered complete until such satisfactory written response is received by the Design Professional. Contractor shall submit the responses to these items as part of the closeout documentation.

1.13. OPERATING AND MAINTENANCE

A. This Contractor shall furnish competent personal instruction to the Owner's operating personnel for a period of hours as indicated in individual Division 26 specification sections in the proper operation of the electrical equipment. He shall also supply the Owner with three (3) hardbound copies of an operation manual containing the following:

1. Step-by-step procedures for start-up and operation for each system and piece of equipment.
2. Performance data, curves, ratings.
3. Wiring diagrams.
4. Manufacturer's descriptive literature.
5. Manufacturer's maintenance and service manuals.
6. Spare parts and replacement parts list for each piece of equipment.
7. Name of service agency and installer complete with an emergency service phone number for nights, weekends and holidays.
8. Final approved shop drawings.

1.14. WARRANTIES

A. This Contractor shall warranty all materials, workmanship and the successful operation of all equipment and apparatus installed by him for a period of one year from the date of the final acceptance of the entire work and shall guarantee to repair or replace at his own expense any part of the apparatus which may show defect during that time provided such defect is, in the opinion of the Engineer, due to imperfect material or workmanship and not to carelessness or improper use. Compile and assemble the warranties specified in Division 26 into a separated set of vinyl covered three-ring binders, tabulated and indexed for easy reference.

2. PRODUCTS (Not Applicable)

3. EXECUTION (Not Applicable)

END OF SECTION 260100

SECTION 260500 - BASIC ELECTRICAL MATERIALS AND METHODS

1. GENERAL

1.1. RELATED DOCUMENTS:

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

B. Division 26 Basic Electrical Requirements and Basic Electrical Materials and Methods section apply to work specified in this section.

1.2. DESCRIPTION OF WORK:

A. Extent of electrical related work required by this section is indicated on drawings and/or specified in other Division 26 sections.

B. Furnish and install all miscellaneous steel required for supports, hangers, anchors, etc., required for installation of equipment and materials furnished and installed under this Division. Steel used in a damp or wet environment shall be hot dipped galvanized unless otherwise noted.

C. Furnish and install fire stopping for sealing around electrical penetrations through fire or smoke barriers, and floors.

D. This Contractor shall perform all selective Division 26 related and indicated demolition including: Nondestructive removal of materials and equipment for re-use or salvage as indicated. All equipment removed shall be offered to the Owner for his retention. If the Owner elects to retain equipment, it shall be turned over to the Owner at the site. If not, the equipment shall be removed from the premises by this Contractor. Refer to Division 02 Section for additional requirements.

1.3. SUMMARY:

A. This section includes a limited scope of general construction materials and methods pertaining to Division 26 applications of the following items:

Rough-ins
Electrical installations
Cutting and patching
Fire stopping
Selective demolition and alterations

1.4. PROJECT CONDITIONS:

A. Conditions Affecting Demolition: The following project conditions apply:

1. Protect adjacent materials to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
2. Locate, identify, and protect electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

1.5. SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including the recommended installation method, all in accordance with Division 01 and Section 260100 requirements.

B. Electrical Penetration Seals: Submit the following:

1. Shop drawings showing each condition requiring penetration seals. Indicate proposed UL systems materials, anchorage, methods of installation, and actual adjacent construction.

2. A copy of UL illustration of each proposed system indicating manufacturer approved modifications.

3. Manufacturer's specifications, recommendations, installation instructions and maintenance instructions.

1.6. SEQUENCE AND SCHEDULING:

A. Coordinate the shut-off and disconnection of electrical service and/or power with the Owner and the utility company. All associated work to be done at Owner's convenience.

B. Notify the Engineer at least 5 working days prior to commencing demolition operations.

C. Perform demolition in phases as required by Engineer.

2. PRODUCTS

2.1. FIRE STOPPING MATERIALS:

A. Fire stopping materials shall be intumescent safety barriers designed to block the spread of fire and smoke through penetrations created by electrical installations in fire rated walls and floors. Materials shall be flame, toxic fume and water resistant and shall have a minimum 3 hour fire rating. Fire rating shall be defined by tests conducted by ASTM, UL or other testing and inspection agencies acceptable to authorities having jurisdiction.

1. Acceptable Manufacturers:

Specified Technologies, Inc. (STI) Somerville, NJ
Tremco, Inc. Beachwood, OH
3M Inc., Minneapolis, MN

2. Materials:

a. Firestop Mortar:
STI SpecSeal Mortar
Tremco TREMstop-M
3M Fire Barrier Mortar

b. Intumescent Firestop Sealants and Caulks
SpecSeal SSP Putty
Tremco TREMstop-WBM
3M Fire Barrier CP-25 WB

c. Silicone Firestop Sealants Caulks
STI SpecSeal Pensil 100 & 300
Tremco Fyre Sil Sealant
3M Fire Barrier 2000 & 2003

d. Firestop Putty:
   STI SpecSeal Firestop Putty Bars & Pads
   Tremco TREMstop FP Flowable Putty
   3M Fire Barrier Firestop Putty

e. Firestop Collars:
   STI SpecSeal Firstop Collars
   Tremco TREMstop D Combustible Pipe Device
   3M Fire Barrier Pipe Device

f. Wrap Strip:
   STI Spec Seal Wrap Strip
   Tremco TREMstop-WS
   3M Fire Barrier WS-195 Wrap Strip

3.___EXECUTION

3.1. EXAMINATION:

A. Examine area and conditions under which basic electric materials are to be installed or methods are to be performed and notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

3.2. ROUGH-IN:

A. Verify with Architect prior to rough-in, exact location of items such as receptacles, etc., in finished areas.

B. Verify with respective equipment supplier prior to rough-in, exact location and method of connection to respective equipment for such items as mechanical equipment, etc.

3.3. ELECTRICAL INSTALLATIONS:

A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate electrical systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
4. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work.
5. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
6. Install systems, materials, and equipment to conform with approved submittal data to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
7. Install systems, materials, and equipment level and plumb, parallel, and perpendicular to other building systems and components.

8. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
9. Provide access panel or doors where units are concealed behind finished surfaces such as drywall and/or plaster construction, etc. Coordinate the access panel type with the Architect.
10. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope (such as for underground services, etc.).
11. All wiring other than within an item of equipment, to be in raceways unless shown otherwise on Drawings or covered otherwise in these Specifications.
12. Raceways, boxes, cables, conductors, etc., installed in plenum spaces and similar areas shall be supported from the building structure and shall be installed symmetrical with the axis of the space (do not cross room at an angle). Support wires for lay-in type grid ceilings shall not be used to support electrical equipment, raceways, cables, etc. Use J-hooks rated to support communication cables.
13. Wiring of Motors and/or Equipment:
    a. Provide necessary power wiring to motors and/or equipment where shown on Drawings.
        1.) Make final "line" connections to respective items of equipment as shown on Drawings.
        2.) Provide "Control" wiring, regardless of voltage, only when shown on Electrical Drawings.
        3.) In general, all 120, 208, 240, 277, or 480 volt wiring to be construed as power wiring; however, line voltage control wiring shall not be construed as power wiring unless shown on Electrical Drawings.
14. Wiring of Heating, Ventilating, and Air Conditioning Equipment:
    a. Provide power wiring as shown on Electrical Drawings. In general, this shall consist of power conductors and raceway up to and including connections to line terminals of respective items of equipment.
        1.) Where this Contractor furnishes motor starter and/or disconnect switch, this also shall include the power wiring between the load side of starter and/or disconnect switch and line terminals of respective item of equipment.
        2.) Where other Divisions furnish motor starter and/or disconnect switch (other than factory-mounted, prewired items), this Contractor shall provide power wiring as described in previous paragraph and shall mount respective starter and/or disconnect switch.
        3.) Where electric heating equipment is involved, wiring responsibilities to be as shown on Electrical Drawings.
        4.) Control wiring, regardless of voltage characteristics, is not to be construed as power wiring and is not the responsibility of this Contractor unless indicated as such on Electrical Drawings.

            In certain cases, such as between a thermostat and a cabinet heater or a unit heater, or between a switch and a small exhaust fan, wiring may be required by this Contractor only if shown on Electrical Drawings.

5.) It shall be the responsibility of this Contractor, prior to rough-in of conduits serving mechanical equipment, to verify with respective equipment supplier the required ampacity and quantity of conductors serving the equipment. In the event changes are required from those shown on the Drawings, this information shall be brought to the attention of the Engineer and authorization obtained from the Engineer in writing prior to proceeding with the necessary changes. Changes required shall be performed at the expense of the mechanical (HVAC or plumbing) contractor.

15. Temperature Control Wiring:

a. Temperature control wiring, regardless of voltage characteristics, is not the responsibility of this Contractor unless indicated as such on Electrical Drawings or herein described.

1.) In general, the furnishing and installing of all temperature control devices and respective wiring shall be the responsibility of other Divisions.

3.4. CUTTING AND PATCHING:

A. General: Perform cutting and patching in accordance with Division 01 Section "CUTTING AND PATCHING".

3.5. INSTALLATION OF FIRE-STOPPING MATERIAL:

A. General:

1. All fire and smoke rated walls and floors penetrated by electrical raceways, exposed conductors, etc. shall be properly sleeved and fire sealed. See Division 7 “Firestopping”. All firestop system types shall be by same manufacturer to fullest extent possible.
2. All fire stopping will be installed in accordance to the U.L. rated system designed for the application.
3. Insulation types specified in other sections shall not be installed in lieu of firestopping material specified herein.
4. Grout, Mortar, or Gypsum products shall not be installed in lieu of firestopping material specified here.

B. Penetrations - Provide Firestopping:

1. Where penetrations including conduit, cable, wire, or other elements which pass through one or both outer surfaces of a fire rated floor or wall.
2. Except for floor on grade, where a penetration occurs through a structural floor or roof and a space would otherwise remain open between the surfaces of the penetration and the edge of the adjoining structural floor or roof.
3. Where a penetration occurs through fire-rated walls, or partitions of hollow-type construction, provide fire stopping to completely fill spaces around the penetration, on each side of the wall or partition.
4. These requirements for penetrations shall apply whether or not sleeves have been provided, and whether or not penetrations are to be equipped with escutcheons or other trim. If penetrations are sleeved, fire stop annular space, if any, between sleeve and wall opening.

C. Provide fire stopping to fill miscellaneous voids and blank openings in fire-rated construction where conduit, cable, wire or equipment has been removed.

3.6. SELECTIVE DEMOLITION AND ALTERATION OF EXISTING ELECTRICAL SYSTEMS:

A. Demolition Definitions:

1. Under demolition notes, several words and phrases are used. These shall be interpreted to mean as follows:
    a. Abandon: Disconnect designated equipment and remove respective conductors back to source, such as a panelboard, distribution panel, switchboard, switchgear, etc. Alter respective legend accordingly.
    b. Disconnect: Disconnect designated equipment and remove respective branch circuit wiring and affected exposed electrical equipment, such as boxes, raceways, control, etc.
        1.) Remove conductors back to source such as panelboard, etc. Alter respective legend accordingly.
        2.) Remove exposed raceway. When in unfinished areas such as mechanical equipment rooms, remove back to source. When in finished spaces, remove only that raceway which is exposed.
        3.) Where raceway is above an existing suspended, accessible ceiling and that ceiling grid is being reused or replaced, remove the exposed raceway in the affected area. Concealed homeruns are to remain and may be reused at Contractor's option.
    c. Disconnect and Reconnect: Disconnect designated items, remove and store same where necessary, and then reinstall item and reconnect to existing branch circuit and control.
    d. Remove Branch Circuit and/or Feeder: Remove conductor and respective raceway, fittings, boxes, etc.

B. Where existing building construction is to be altered to accommodate the planned renovations and/or an addition(s), alter existing electrical service and distribution system, communications systems, fire alarm system, etc., as shown on the drawings and as required for proper operation of the altered system.

C. Where existing accessible ceiling grid panels and grid support members are removed to permit the installation of new conduit, boxes, etc., it shall be the responsibility of this Contractor to reinstall the panels and grid support system to the satisfaction of the **Architect**. Damaged items shall be replaced at no cost to the Owner.

D. Remove all existing affected electrical equipment, devices, fixtures, boxes, etc. which are not incorporated into or are not necessary for the operation of new and/or existing electrical systems, making sure that no remaining fixtures, devices, or appliances are left without service.

E. Make sure that no remaining fixtures, devices, etc. within the renovated area or adjacent areas are left without service.

1. Services and/or power outages and cutovers to be coordinated Engineer and Owner and done at Owner's convenience.
2. Modify existing "systems" as required to accommodate added equipment.
3. Remove abandoned accessible surface-mounted boxes and raceway. Abandoned accessible surface raceway shall be removed complete back to source.
4. Where an abandoned raceway penetrates floor, slab, wall, etc. raceway shall be cut below the surface. Seal the opening and restore respective surface to match surrounding surface as directed.
5. Where an abandoned raceway is not accessible, the raceway shall remain. Any accessible portions penetrating out of wall, floor, slab, etc. shall be cut off below the surface. Seal the opening and restore the respective surface to match the surrounding surface as directed.
    a. Perform cutting and patching required for demolition in accordance with Division 01 and Division 02 for cutting and patching requirements.

6. Flush mounted outlet boxes which are abandoned or used for junction boxes and are not concealed by new construction shall have openings covered by a blank, stainless steel plate.
7. Where an existing distribution center is altered, provide a new, accurate, typed legend.
8. Where work cannot be executed during normal working hours, this Contractor shall include in the Base Bid all necessary overtime pay to execute this contractors contract.

F. All electrical equipment removed and not scheduled for reuse shall be turned over to the Owner at the construction site for salvage. All items deemed not salvageable by the Owner shall become the property of this Contractor and shall be removed from the site within 72 hours.

END OF SECTION 260500

SECTION 260519 - CONDUCTORS AND CABLES

1.GENERAL

1.1. RELATED DOCUMENTS

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

B. Division 26 Basic Electrical Requirements, Basic Electrical Materials and Methods, and Electrical Identification sections apply to work specified in this section.

1.2. SUMMARY:

A. Extent of electrical wire and cable work is indicated by drawings and schedules.

B. Types of electrical wire, cable, and connectors specified in this section include the following:

Copper conductors.

Fixture wires.

Tap type connectors.

Wirenut connectors.

C. Applications of electrical wire, cable, and connectors required for project are as follows:

For power distribution (600 volts and less)

For lighting circuits.

For appliance and equipment circuits.

For motor-branch circuits.

For communications, control and alarm circuits.

1.3. QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical wire and cable products of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience with projects utilizing electrical wiring and cabling work similar to that required for this project.

C. Codes and Standards:

1. NEC Compliance: Comply with NEC requirements as applicable to construction, installation and color coding of electrical wires and cables.
2. UL Compliance: Comply with requirements of all applicable UL standards.
3. UL Compliance: Provide wiring/cabling and connector products which are UL-listed and labeled.

1.4. DELIVERY, STORAGE, AND HANDLING

A. Deliver wire and cable properly packaged in factory-fabricated type containers, or wound on NEMA-specified type wire and cable reels.

B. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.

C. Handle wire and cable carefully to avoid abrading, puncturing and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

2. PRODUCTS

2.1. ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of wire, cable, and connector):

1. Wire and Cable:

Belden Wire & Cable Co.

Berk-Tek, Inc.

Cerro Wire & Cable – SlipWire

Carol Cable Co., Inc.

Southwire Co. - Simpull

West Penn Wire/CDT

2. Connectors:

Adalet, Inc.

Burndy Corp.

Hubbell, Inc., Wiring Devices Div.

Ilsco

Kearney.

3M Electrical Products Div.

Panduit Corp.

Thomas & Betts Corp.

2.2. WIRES, CABLES, AND CONNECTORS

A. General: Provide electrical wires, cables, and connectors of manufacturer's standard materials as indicated by published product information; designed and constructed as recommended by manufacturer, for a complete installation, and for application indicated. Unless noted otherwise on drawings or in these specifications, all conductors to be copper with conductivity not less than 98% at 2 deg F. 600 volt THHN to be manufactured using the co-extrusion process.

B. Building Wires: Provide factory-fabricated wires of sizes, ampacity ratings #12 AWG minimum size unless shown otherwise on Drawings. Where not indicated on Contract Documents, provide proper wire selection as determined by Installer to comply with project's installation requirements, NEC and NEMA standards. Select from the following UL types, those wires with construction features which fulfill project requirements:

1. Type THHN/THWN: For dry and wet locations; maximum operating temperature 75 deg C (167 deg F) for wet locations and 90 deg C (194 deg F) for dry locations.
2. Type THHN: For dry locations; max operating temperature 90 deg C (194 deg F).

C. Cables: Provide UL-type factory-fabricated cables of sizes, ampacity ratings, materials and jacketing/sheathing for services indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements, NEC and NEMA standards.

D. Connectors:

1. General: Provide UL-type factory-fabricated, metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Where not indicated, provide proper selection as determined by Installer to comply with project's installation requirements, NEC and NEMA standards.

3. EXECUTION

3.1. EXAMINATION

A. Examine areas and conditions under which products are to be installed, and substrate which will support wires and cables. Notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Engineer.

3.2. INSTALLATION OF WIRES AND CABLES

A. General: Install electrical cables, wires and wiring connectors in compliance with applicable requirements of NEC, NEMA, UL, and NECA's "Standard of Installation", and in accordance with recognized industry practices.

1. Coordinate wire/cable installation work including electrical raceway and equipment installation work, as necessary to properly interface installation of wires/cables and other work.
2. Pull conductors simultaneously where more than one is being installed in same raceway.
3. Use pulling means including, fish tape, cable, rope and basket weave wire/cable grips which will not damage cables or raceway.
4. Install exposed cable, parallel and perpendicular to surfaces, or exposed structural members, and follow surface contours, where possible.
5. Keep conductor splices to minimum and accessible.
6. Install splices and tapes which possess equivalent and/or better mechanical strength and insulation ratings than conductors being spliced.
7. Use splice and tap connectors which are compatible with conductor material.
8. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std 486A and B.
9. Conductors to be color-coded for phase identification, as follows:

208Y/120 Volts	Phase	480Y/277 Volts
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	White with Black Stripe
Green	Ground	Green

10. Nominal 20 amp branch circuit home runs to panelboards and/or control equipment longer than 100 feet to be not less than #10 AWG and sized to allow for voltage drop.
11. Conductors of #12 AWG size and larger to be stranded.
12. Conductors installed in locations subject to greater or less than normal ambient temperature to have insulation suitable and approved for such locations.
13. Number of conductors for various control, alarm, signal and communications circuits are intended to show general control scheme; actual number of conductors installed to be as required to accomplish specified results with provided equipment.
14. Before covers are finally installed on switchboards, switchgear, distribution panels, panelboards, etc., each feeder conductor shall be clearly and permanently identified as to conductor size and type of insulation. Use identification label or some other similar permanent form of identification as specified in Division 260553 - Electrical Identification.

15. Where home runs serving fluorescent fixtures are combined, the neutral shall be considered a current carrying conductor.

3.3. FIELD QUALITY CONTROL

A. Prior to energization of circuitry, check installed wires and cables with megohm meter to determine insulation resistance levels to ensure requirements are fulfilled.

B. Prior to energization, test wires and cables for electrical continuity and for short-circuits.

C. Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION 260519

SECTION 260526 - GROUNDING

1. GENERAL

1.1. RELATED DOCUMENTS:

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

B. Division 26 Basic Electrical Requirements and Basic Electrical Materials and Methods sections apply to work specified in this section.

C. Requirements of this section apply to electrical grounding and bonding work specified elsewhere in these specifications.

1.2. SUMMARY:

A. Provide grounding of entire electrical installation as shown on Drawings and specified herein, and in accordance with Article 250 of N.E.C.

B. Items to be grounded to include but not be limited to the following:

1. Metal raceways and enclosures.
2. Neutral or identified conductor of electrical distribution system.
3. Non-current carrying metal parts of fixed equipment such as motors.

C. Metal columns, posts and structural steel supports for mechanical and electrical equipment. Refer to other Division 26 sections for wires/cables, electrical raceways, boxes and fittings, and wiring devices which are required in conjunction with electrical grounding and bonding work; not work of this section.

1.3. QUALITY ASSURANCE:

A. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction, and NEC as applicable to electrical grounding and bonding, pertaining to systems, circuits and equipment.

2. PRODUCTS

2.1. MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide grounding and bonding products of one of the following (for each type of product):

Burndy Corporation

Cadweld Div; Erico, Inc.

OZ Gedney.

Thomas & Betts.

2.2. GROUNDING AND BONDING:

A. Materials and Components:

1. General: Except as otherwise indicated, provide electrical grounding and bonding systems; with assembly of materials, including, but not limited to, cables/wires, connectors, solderless lug terminals, grounding electrodes, and plate electrodes, bonding jumper braid, surge arresters, and additional accessories needed for a complete installation. Where more than one type component product meets indicated requirements, selection is Installer's option. Where materials or components are not indicated, provide products which comply with NEC requirements and with established industry standards.

B. Conductors: Unless otherwise indicated, provide electrical grounding conductors for grounding system connections that match power supply wiring materials and are sized according to NEC.

1. Bonding Jumper Braid: Copper braided tape, constructed of 30-gage bare copper wires and properly sized for indicated applications.

3.EXECUTION

3.1. EXAMINATION:

A. Examine areas and conditions under which electrical grounding and bonding connections are to be made and notify Engineer in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

3.2. INSTALLATION OF ELECTRICAL GROUNDING AND BONDING SYSTEMS:

A. General: Install electrical grounding and bonding systems in accordance with manufacturer's instructions and Article 250 of NEC, NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that products comply with requirements.

B. Coordinate with other electrical work as necessary to interface installation of electrical grounding and bonding system work with other work.

C. Manner of Grounding:

1. Sizes and types of ground conductors, ground clamps, bonding jumpers, conduit, fittings and methods of securing same to obtain effective electrical continuity, when not indicated on Drawings, to be in accordance with NEC Article 250.

2. All flexible metal raceway connections shall be bonded with a separate grounding conductor.

3. Raceways for all conductors shall include a separate grounding conductor sized in accordance with the NEC or as shown on Drawings.

4. Where raceways are equipped with wiring devices, such as surface raceway with receptacles, grounding conductor to be pulled in entire length of raceway and each wiring device connected to same.

D. Terminate feeder and branch circuit insulated equipment grounding conductors with grounding lug, bus, or bushing.

E. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.

F. Route grounding connections and conductors to ground and protective devices in shortest and straightest paths as possible to minimize transient voltage rises.

G. Apply corrosion-resistant finish to field-connections, buried metallic grounding and bonding products, and places where factory applied protective coatings have been destroyed, which are subjected to corrosive action.

3.3. FIELD QUALITY CONTROL:

A. Upon completion of installation of electrical grounding and bonding systems, test ground resistance with ground resistance tester. Where tests show resistance-to-ground is over 25 ohms, take appropriate action to reduce resistance to 25 ohms, or less, then retest to demonstrate compliance.

END OF SECTION 260526

SECTION 260529 - SUPPORTING DEVICES

1. GENERAL

1.1. RELATED DOCUMENTS:

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

B. Division 26 Basic Electrical Requirements and Basic Electrical Materials and Methods sections apply to work specified in this section.

1.2. SUMMARY:

A. Types of supports and anchors specified in this section include but are not limited to the following:

One-hole conduit straps.

Two-hole conduit straps.

Lead expansion anchors.

Toggle bolts.

U-channel strut system.

Conduit cable supports.

B. Supports and anchors furnished as part of factory-fabricated equipment, are specified as part of that equipment assembly in other Division 26 sections.

C. General:

1. Raceway and boxes to be supported from building structure. Support from piping, ducts and equipment installed by Other Trades is prohibited unless prior approval is obtained from Architect.
2. Raceways racked together and supported from building structure to be supported by U-shaped channel strut system.
3. Spacing of supports and size of suspension rods to be in accordance with recommendations of respective system manufacturer.

1.3. QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in manufacture of supporting devices, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience with projects utilizing electrical supporting device work similar to that required for this project.

C. Codes and Standards:

1. NEC Compliance: Comply with NEC requirements as applicable to construction and installation of electrical supporting devices.
2. NECA Compliance: Comply with National Electrical Contractors Association's "Standard of Installation" pertaining to anchors, fasteners, hangers, supports, and equipment mounting.
3. UL Compliance: Provide supporting devices which are UL-listed and labeled.

2. PRODUCTS

2.1. MANUFACTURED SUPPORTING DEVICES:

A. General: Provide supporting devices which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete

installation; and as herein specified. Where more than one type of supporting device meets indicated requirements, selection is Installer's option.

B. Supports: Provide supporting devices of types, sizes and materials indicated below:

1. Manufacturers: Subject to compliance with requirements, provide one of the following:

Appleton Electric Co.

Erico, Inc.

OZ/Gedney.

Thomas & Betts.

2. One and two hole metal conduit straps to be stamped, heavy duty steel or malleable iron.

3. Powder activated fasteners to be used on walls or floors in exposed areas, in shear stress only.

a. Use and location subject to prior approval of Architect.

4. Steel hardware used on exterior of building to have approved corrosion resistant finish.

5. Steel raceway supports in metal stud walls and when fastened to steel bar joists to be steel and as manufactured by Erico, Inc. (Caddy Series) or equivalent.

6. Box supports in steel stud walls and when fastened to steel bar joists to be steel and as manufactured by Erico, Inc. (Caddy Series) or equivalent.

C. Anchors: Provide lead expansion anchors, toggle bolts, etc., as required by the specific application.

D. U-Channel Strut Systems: Provide U-channel strut system for supporting electrical equipment, 12-gage hot-dip galvanized steel, of types and sizes indicated; construct with 9/16" dia. holes, 8" O.C. on top surface, with standard finish, and with all necessary matching fittings.

1. Manufacturers: Subject to compliance with requirements, provide channel systems of one of the following:

Allied Tube and Conduit Corp.

B-Line Systems, Inc.

OZ/Gedney.

Thomas & Betts.

E. Conduit Cable Supports: Provide cable supports with insulating wedging plug for non-armored type electrical cables in risers; construct for feeder conduit, wire quantity and type required; construct body of malleable iron casting with hot-dip galvanized finish.

3. EXECUTION

3.1. EXAMINATION:

A. Examine areas and conditions under which supporting devices are to be installed. Notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Engineer.

3.2. INSTALLATION OF SUPPORTING DEVICES:

A. Install hangers and anchors in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirement. Comply with requirements of NECA and NEC for installation of supporting devices.

B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

C. Install hangers, supports, clamps and attachments to support raceways properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on

trapeze type hangers where possible. Install supports with spacings in compliance with NEC requirements.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES

1. GENERAL

1.1. RELATED DOCUMENTS:

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

B. Division 26 Basic Electrical Requirements and Basic Electrical Materials and Methods sections apply to work specified in this section.

1.2. SUMMARY:

A. Extent of raceway work is indicated by drawings and schedules.

1. All wiring to be in raceway unless noted otherwise on Drawings or in these Specifications.
2. As shown on drawings, feeder and conduit routing, in general, are diagrammatic. Make revisions as required by field conditions during installation.

B. Raceways include the following:

1. Rigid metal conduit. (GRC)
2. Electrical metallic tubing (EMT).
3. Flexible metal conduit.
4. Liquidtight flexible conduit.

C. Boxes, enclosures, and cabinets include the following:

1. Device boxes.
2. Junction boxes.
3. Pull boxes.

1.3. QUALITY ASSURANCE:

A. Manufacturers: Firms regularly engaged in manufacture of electrical products, of types, sizes and capacities required, that have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects utilizing electrical products similar to those required for this project.

C. Codes and Standards:

1. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical products specified in this section.
2. UL Compliance: Comply with all applicable UL requirements pertaining to electrical products specified in this section. Provide only electrical products which are UL-listed and labeled.
3. NEMA Compliance: Comply with all applicable NEMA requirements pertaining to electrical products specified in this section.

2. PRODUCTS

2.1. METAL CONDUIT AND TUBING:

A. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) required for each service. Where types and grades are not indicated, provide proper selection determined by Installer to fulfill wiring requirements, and comply with applicable portions of NEC for raceways. Generic names for some types of raceways are shown in parentheses and are used interchangeably in these specifications and on drawings.

B. Manufacturers: Subject to compliance with requirements, provide metal conduit and tubing of one of the following:

1. Metal Conduit and Tubing:

AFC Cable Systems. (flexible steel, liquidtight)

Allied Tube and Conduit. (GRC, EMT, steel)

Anamet Electrical, Inc. (flexible steel, liquidtight)

Electriflex Co. (flexible steel, liquidtight)

Republic Conduit Company. (GRC, IMC, EMT, steel)

Wheatland Tube Co. (GRC, EMT, steel)

C. Electrical Metallic Tubing (EMT): Hot galvanized steel outside with an organic corrosion resistant inside coating and be produced in accordance with UL Standard #797 and ANSI C80.3. Domestic Manufacturer only.

D. Rigid Steel Conduit (GRC): Hot dipped, galvanized, threaded type steel conduit produced in accordance with UL Standard #6 and ANSI C80.3. Factory threads shall be hot galvanized after cutting. Field cut threads shall be cold galvanized after cutting. Domestic Manufacturer only.

E. Flexible Metal Conduit ("Flexsteel" or "Greenfield"): Provide conduit formed from a continuous length of spirally wound, interlocked galvanized strip steel.

F. Liquidtight Flexible Metal Conduit ("Sealtight"): Provide conduit having an outer liquidtight, nonmetallic (PVC), sunlight-resistant jacket over an inner flexible metal core constructed from a continuous, interlocked, double wrapped, galvanized (in or out) strip of steel.

2.2. METALLIC CONDUIT BODIES AND FITTINGS:

A. Conduit Bodies: Provide metal conduit bodies of types, shapes and sizes as required to fulfill job requirements and NEC requirements. Construct conduit bodies with threaded, conduit-entrance ends, removable covers and corrosion-resistant screws.

B. Manufacturers: Subject to compliance with requirements, provide metallic conduit bodies and fittings to mate and match conduit used of one of the following:

Adalet, Inc.

Arlington Industries, Inc.

Hubbell, Inc.

O-Z/Gedney

Steel City/Thomas & Betts.

C. Rigid Metal Conduit Fittings: To be cast malleable iron, galvanized or cadmium plated.

D. Flexible Metal Conduit Fittings: Provide conduit fittings for use with flexible steel conduit of threadless hinged clamp type.

1. Straight Terminal Connectors: One piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.

2. 45 Degree or 90 Degree Terminal Angle Connectors: Two-piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut.

E. Liquid-Tight Flexible Metal Conduit Fittings: Provide cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated, or noninsulated throat.

F. EMT Fittings: To be seamless steel tubing, steel set screw or compression type. Die cast, pot metal couplings and connectors shall not be used.

2.3. BOXES, ENCLOSURES, AND CABINETS:

A. Manufacturers: Subject to compliance with requirements, provide boxes, enclosures and cabinets of one of the following:

Adalet, Inc.

Erickson Electrical Equipment Co.

Hammond Manufacturing Co.

Hoffman Engineering, Co.

Hubbell Inc.

O-Z/Gedney.

Raco, Inc.

Steel City/Thomas & Betts.

B. Device Boxes:

1. Switch and Receptacle Boxes - Concealed:

a. Interior of Building, Dry Locations: Galvanized, stamped steel, 4" (min.) square box. Where installed in finished masonry walls, use masonry gangable type boxes (boxes with plaster rings not approved). Where 4" square box must be used with extension ring, use square cut tile wall type ring or an approved equal.

b. Interior of Building, Wet Locations: Galvanized, stamped steel, 4" square box. Provide cast-metal face plates with spring-hinged watertight cover suitably configured for each application, including face plate gaskets and corrosion-resistant plugs and fasteners. The integrity of the weatherproof enclosure shall be maintained even when receptacle is in use per NEC Article 410-57.

c. Exterior of Building: Galvanized, stamped steel, 4" square box. Provide cast-metal face plates with spring-hinged watertight cover suitably configured for each application, including face plate gaskets and corrosion-resistant plugs and fasteners. The integrity of the weatherproof enclosure shall be maintained even when receptacle is in use per NEC Article 410-57.

2. Switch and Receptacle Boxes - Exposed:

a. Interior of Building, Dry Locations: Galvanized, stamped steel, 4" square or as shown on Drawings.

b. Interior of Building, Wet Locations: Provide corrosion-resistant cast-metal Type "FS" or "FD" device boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening electrical conduit, cast-metal face plates with spring-hinged watertight cover suitably configured for each application, including face plate gaskets and corrosion-resistant plugs and fasteners. The integrity of the weatherproof enclosure shall be maintained even when receptacle is in use per NEC Article 410-57.

c. Exterior of Building: Provide corrosion-resistant cast-metal Type "FS" or "FD" device boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening electrical conduit, cast-metal face plates with spring-hinged watertight cover suitably configured for each application, including face plate gaskets and corrosion-resistant plugs and fasteners. The integrity of the weatherproof enclosure shall be maintained even when receptacle is in use per NEC Article 410-57.

3. Device Box Accessories: Provide device box accessories as required for each installation, including mounting brackets, device box extensions, switch box supports, plaster ears, and plaster board expandable grip fasteners, which are compatible with device boxes being utilized to fulfill installation requirements for individual wiring situations. Choice of accessories is installer's code-compliance option.
4. Device Box Support: Recessed device boxes shall be properly supported to not allow box to be pushed into wall cavity upon installation of drywall or other wall construction material. Use Caddy or equivalent metal stud clip and for side box support to eliminate box movement in wall.
5. Shallow Applications: Galvanized, stamped steel, 4" square or octagon, 1-1/2" deep. For use walls with 1-1/2" min. furring. Provide plaster ring of depth required.

C. Junction Boxes:

1. Dry Location: Galvanized, stamped steel, 4" square or octagon, with flat metal screw-on cover.
2. Wet Location: Cast metal, 4" square or octagon with threaded conduit holes and flat cast metal screw-on cover sealed with a neoprene gasket.

D. Pull and Splice Boxes (Low Voltage):

1. Pull Boxes: Provide boxes fabricated of heavy gauge steel and flanged on all sides to increase strength and rigidity. Furnish with screw mounted cover. When box is utilized in a wet or exterior location it shall be watertight, painted and the cover sealed with a neoprene gasket. Boxes shall be manufactured to the size indicated on drawings or when not indicated in compliance with the NEC.
2. Bushings, Knockout Closures and Locknuts: Provide corrosion-resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

3. EXECUTION

3.1. EXAMINATION:

A. Examine areas and conditions under which products are to be installed, and substrate which will support raceways. Notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Engineer.

3.2. INSTALLATION OF RACEWAYS:

A. General: Install raceways in accordance with manufacturer's written installation instructions, and in compliance with NEC, and NECA's "Standards of Installation". Install units plumb and level, and maintain manufacturer's recommended clearances.

B. Coordinate with other work including wires/cables, boxes, and panel work, as necessary to interface installation of electrical raceways and components with other work.

C. Use boxes as supplied by raceway manufacturer wherever junction, pull or devices boxes are required.

D. Installation of all raceways, in general, shall conform to the requirements listed in installation of conduits below.

3.3. INSTALLATION OF CONDUITS:

A. General: Install conduits concealed in new and existing construction work, either in walls, under slabs, or above hung ceilings. Where conduits cannot be concealed in finished areas, use surface metal raceways, but only with prior approval of Engineer.

1. Mechanically fasten together metal conduits, enclosures, and raceways for conductors to form continuous electrical conductor. Connect to electrical boxes, fittings and cabinets to provide electrical continuity and firm mechanical assembly.
2. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.
3. Install miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs that have been specifically designed and manufactured for their particular application. Install expansion fittings in conduit every 200' linear run or wherever structural expansion joints are crossed.
4. Use roughing-in dimensions of electrified units furnished by respective supplier. Rough-in conduit and boxes for connection to units only after receiving review of dimensions and after checking location with other trades.
5. Test conduits required to be installed, but left empty. Test with ball mandrel. Clear any conduit which rejects ball mandrel. Pay costs involved for restoration of conduit and surrounding surfaces to original condition.
6. In unfinished areas such as boiler rooms and mechanical equipment rooms, electrical rooms, storage rooms, etc. conduit may be exposed. Verify with Engineer prior to installation.
7. Cut conduits straight, properly ream, and cut threads for heavy wall conduit deep and clean.
8. Field-bend conduit with benders designed for purpose so as not to distort nor vary internal diameter.
9. Size conduits to meet NEC. No conduit smaller than 3/4 inch shall be used on project.
10. Fasten GRC conduit terminations in sheet metal enclosures by 2 locknuts, and terminate with bushing. Install locknuts inside and outside enclosure.
11. Conduits are not to cross pipe shafts, or ventilating duct openings.
12. Keep conduits a minimum distance of 6" from parallel runs of flues, hot water pipes or other sources of heat. Wherever possible, install horizontal raceways runs above water and steam piping.
13. Use of running threads at conduit joints and terminations is prohibited. Where required, use 3-piece union or split coupling.
14. Complete installation of conduit before starting installation of cables/wires within conduit.
15. Install conduits as not to damage or run through structural members. Avoid horizontal or cross runs in building partitions or side walls.
16. Exposed Conduits:
    a. Install exposed conduits and extensions from concealed conduit systems neatly, parallel with, or at right angles to walls of building.
    b. Install exposed conduit work as not to interfere with ceiling inserts, lights or ventilation ducts or outlets
    c. Support exposed conduits by use of hangers, clamps, or clips. Support conduits on each side of bends and on spacing not to exceed following: up to 1": 6'-0"; 1-1/4" and over: 8'-0".
    d. Run conduits for outlets on waterproof walls exposed. Set anchors for supporting conduit on waterproof wall in waterproof cement.
    e. Above requirements for exposed conduits also apply to conduits installed in space above hung ceilings, and in crawl spaces.

17. Install expansion fittings in all conduits wherever structural expansion joints are crossed.
18. Properly support and anchor conduits for their entire length by structural materials. Conduits are not to span any space unsupported.
19. Standard electrical "handy" boxes, etc., shall not be permitted for use with surface conduit installations.
20. Pipe curbs or boots shall be used for conduits penetrating roof. Where possible serve roof mounted equipment through respective equipment roof opening.
    a. Where roof must be penetrated, transpose to GRC prior to leaving building and seal per NEC.
21. Conduits to be sealed with NEC approved fittings when entering and/or leaving the following areas:
    a. Changes from inside to outside of building, if above grade.
22. Conduits to be supported from building structure.
    a. Conduits shall not be supported from ductwork, mechanical equipment, lay-in grid ceiling support system, etc.
    b. Conduits not serving items on a piece of mechanical equipment shall not use that mechanical equipment as a supporting structure.
    c. Conduits serving vibrating equipment, such as air handling units, motors, etc., shall be flexsteel or sealtite when transposing from the building structure conduit to the respective item of equipment.
    d. Where conduit is mounted on mechanical equipment or ducts do not penetrate side of equipment or ducts for fasteners without prior permission and coordination of mechanical contractor.
23. Provide nylon pull wire in all empty conduits longer than 10 feet.

B. Type of conduit to be used in various locations is as follows, unless noted otherwise on Drawings:
1. Exposed Conduit When Subject to Possible Physical Damage: GRC.
2. Exposed Conduit Where Not Subject to Possible Physical Damage: EMT.
3. Between outlet boxes and/or pullboxes located above hung or furred ceilings: EMT
4. Between outlet box or pullbox to individual lighting fixture: Flexible metal.
5. Between Junction Box and Temperature Control Devices Located on Equipment in Mechanical Equipment Rooms: Flexible metal.
6. Motor Connections:
    a. Outside: Liquid tight flexible metal.
    b. Inside Within 24" of Floor: Liquid tight flexible metal.
    c. Inside, on Equipment Higher than 24 Inches above Finished Floor Dry Location: Flexible metal.
    d. Inside, on Equipment Higher than 24 Inches above Finished Floor Wet Location: Liquid tight.
7. Connections to vibrating equipment, such as air handling units, compressors, etc:
    a. Dry Location: Flexible metal.
    b. Wet Location: Liquid tight.

3.4. INSTALLATION OF ELECTRICAL BOXES AND FITTINGS:

A. General: Install electrical boxes and fittings, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.

C. Provide weathertight outlets for interior and exterior locations exposed to weather or moisture.

D. Provide knockout closures to cap unused knockout holes where blanks have been removed.

E. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.

F. Do not install boxes back-to-back in walls. Provide not less than 6" (150 mm) separation in non-fire rated walls and 24” (600 mm) in fire rated walls.

G. Position recessed outlet boxes accurately to allow for surface finish thickness. Outlet box support shall not permit movement of box during drywall installation.

H. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.

I. Box support shall be independent of conduit. Boxes shall be supported from building structure.

J. Subsequent to installation of boxes, protect boxes from construction debris and damage.

3.5. GROUNDING:

A. Upon completion of installation work, properly ground raceways and electrical boxes and demonstrate compliance with requirements.

3.6. PROTECTION:

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, to ensure that coatings, finishes, and cabinets are without damage or deterioration at Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

3.7. CLEANING:

A. Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION 260533

SECTION 260553 - ELECTRICAL IDENTIFICATION

1. GENERAL

1.1 RELATED DOCUMENTS

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

B. Division 26 Basic Electrical Requirements and Basic Electrical Materials and Methods sections apply to work specified in this section.

1.2 DESCRIPTION OF WORK

A. Extent of electrical identification work is indicated on drawings and schedules.

B. Types of electrical identification work specified in this section include the following:

Electrical power, control and communication conductors.

Operational instructions and warnings.

C. Refer to Division 01 general requirements section, "Identification Systems", for equipment and system nameplates, and performance data; not work of this section.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical identification products of types required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards:

1. NEC Compliance: Comply with NEC as applicable to installation of identifying labels and markers for wiring and equipment.
2. UL Compliance: Comply with applicable requirements of UL Std 969, "Marking and Labeling Systems", pertaining to electrical identification systems.

2. PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide electrical identification products of one of the following (for each type marker):

Brady, USA, Inc., Industrial Products Division.

Ideal Industries, Inc.

Panduit Corp.

Plymouth/Bishop Insulating Products.

Thomas and Betts Corp.

3M Electrical Products Division.

2.2 ELECTRICAL IDENTIFICATION MATERIALS

A. General: Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

B. Color-Coded Plastic Tape:

1. General: Provide manufacturer's standard self-adhesive vinyl tape not less than 3 mils thick by 1-1/2" wide.

2. Colors: Unless otherwise indicated or required, provide tape colors to match those specified in Section 16120 "Wires and Cables".

C. Cable/Conductor Identification Bands:

1. General: Provide manufacturer's standard vinyl-cloth self-adhesive cable/conductor markers of wrap-around type, either pre-numbered plastic coated type, or write-on type with clear plastic self-adhesive cover flap; numbered to show circuit identification. Apply at each end of cable/conductor.

D. Engraved Plastic-Laminate Signs:

1. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated. Engrave with engraver's standard letter style of sizes and wording indicated. Punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

2. Thickness: 1/16", for units up to 20 sq. in. or 8" length; 1/8" for larger units.

3. Fasteners: Self-tapping stainless steel screws, except contact- type permanent adhesive where screws cannot or should not penetrate substrate.

2.3 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as recommended by manufacturer or as required for proper identification and operation/maintenance of electrical systems and equipment. Use 5/32 inch lettering.

3. EXECUTION

3.1 EXAMINATION

A. Examine area and conditions under which electrical connections for equipment are to be installed and notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

3.2 APPLICATION AND INSTALLATION

A. General Installation Requirements:

1. Install electrical identification products in accordance with manufacturer's written instructions, and requirements of NEC.

B. Coordination: Where identification is to be applied to surfaces which require finish, install identification after completion of painting.

C. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

D. Cable/Conductor Identification:

1. General: Apply cable/conductor identification, including voltage, phase and feeder number, on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present, except where another form of identification (such as color-coded conductors) is provided. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project's electrical work.

E. Operational Instructions and Warning Signs:

1. General: Install operational instruction and warning signs as required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved,

plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation.

F. Danger Signs:

1. General: In addition to installation of danger signs required by governing regulations and authorities, install appropriate danger signs at locations subsequently identified by Installer of electrical work as constituting similar dangers for persons in or about project.
2. Critical Switches/Controls: Install danger signs on switches and similar controls, regardless of whether concealed or locked where untimely or inadvertent operation (by anyone) could result in significant danger to persons, or damage to or loss of property. Signs should contain emergency instructions where applicable.
3.

G. Install signs and labeling at locations for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with self-tapping stainless steel screws, except use adhesive where screws should not or cannot penetrate substrate.

END OF SECTION 260553

SECTION 262726 - WIRING DEVICES

1. GENERAL

1.1. RELATED DOCUMENTS:

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

B. Division 26 Basic Electrical Requirements and Basic Electrical Materials and Methods sections apply to work specified in this section.

1.2. SUMMARY:

A. This section includes the following:

Ground-fault Circuit Interrupter Receptacles (GFCI)

Wall Plates

1.3. SUBMITTALS:

A. Product data for each type of product specified.

B. Samples of those products indicated for sample submission in Architect's comments on product data submittal. Include color and finish samples of device plates and other items per Architect's request.

1.4. QUALITY ASSURANCE:

A. Regulatory Requirements: Comply with provisions of the following codes.

1. NFPA 70 "National Electrical Code".
2. UL and NEMA Compliance: Provide wiring devices which are listed and labeled by UL and comply with applicable UL and NEMA standards.

1.5. SEQUENCE AND SCHEDULING:

A. Schedule installation of finish plates after the surface upon which they are installed has received final finish.

2. PRODUCTS

2.1. MANUFACTURERS:

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

Cooper Wiring Devices – (receptacles)

Hubbell Inc. - (receptacles)

Pass and Seymour Inc. - (receptacles)

2.2. WIRING DEVICES:

A. General: Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications shown on Drawings which are UL listed and which comply with all applicable UL and NEMA standards. Color and/or finish of wiring devices to be ivory unless otherwise noted or directed by Architect.

B. General Purpose Receptacles: Provide 20 amp, 125 volt, grounding type, heavy duty, specification grade, duplex receptacles with the following features:

1. One-piece brass integral ground strap.
2. Ground retention clips.
3. Bypass contact.
4. Square head, 10-thread brass center rivet.

5. I.D. marking.
6. Barbed assembly arms.
7. Back wired ground terminal.
8. External bundling terminals.
9. Deep nylon body design.
10. Reinforced thermoplastic back.
11. Meets or exceeds UL 498 NEMA WD-1 and Federal Specifications WC-596.

C. Hospital Grade Receptacles: Provide 20 amp, 125 volt, grounding type, heavy duty, hospital grade, duplex receptacles with the following features:

1. One-piece brass integral ground strap.
2. Ground retention clips.
3. Bypass contact.
4. Square head, 10-thread brass center rivet.
5. I.D. marking.
6. Barbed assembly arms.
7. Secondary ground contacts.
8. Back wired ground terminal.
9. External bundling terminals.
10. Deep nylon body design.
11. Reinforced thermoplastic back.
12. Meets or exceeds UL 498 (Hospital Grade) and UL 544.

D. Ground-Fault Interrupter (GFI) Receptacles: Provide “feed-thru” type ground-fault circuit interrupter, with integral heavy-duty NEMA 5-20R duplex receptacles arranged to protect connected downstream receptacles on same circuit. GFI receptacle features shall be identical to those specified for general purpose receptacles above. Provide unit designed for installation in a 2-1/8" deep outlet box without adapter.

2.3. WIRING DEVICE ACCESSORIES:

A. Wall Plates: Single and combination, of types, sizes, and with ganging and cutouts as required by diagrammatic layout shown on drawings or as required by Architect. Provide plates which mate and match with wiring devices to which attached. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates. Provide wall plates color to match wiring devices except as otherwise indicated or required by code. Provide wall plates with engraved legend where indicated below. Conform to requirements of Section "Electrical Identification". Provide plates possessing the following additional construction features:

1. Material and Finish: Match Existing.

3. EXECUTION

3.1. EXAMINATION:

A. Examine areas and conditions under which wiring devices are to be installed. Notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Engineer.

3.2. INSTALLATION OF WIRING DEVICES AND ACCESSORIES:

A. Install wiring devices and accessories in accordance with manufacturer's written instructions, applicable requirements of NEC, and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other work.

C. Install wiring devices only in electrical boxes which are clean; free from excess building materials, dirt, and debris.

D. Install wiring devices after wiring work is completed.

E. Install wallplates after painting work is completed.

F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A. Use properly scaled torque indicating hand tool.

G. Grounding type receptacles shall be installed with the grounding prong opening in the up position. Horizontally mounted grounding type receptacles shall be installed with the neutral prong opening in the up position.

H. When making connections to wiring devices with #10 or smaller stranded wire, the frayed end shall be taped or enclosed by a piece of the conductor insulation.

3.3. PROTECTION:

A. Protect installed components from damage. Replace damaged items prior to final acceptance.

3.4. FIELD QUALITY CONTROL:

A. Testing: Prior to energizing circuitry, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six times.

B. Test ground fault interrupter operation with both local and remote fault simulations in accordance with manufacturer recommendations.

3.5. CLEANING:

A. General: Clean devices, device outlet boxes, and enclosures. Replace stained or painted wall plates or devices.

END OF SECTION 262726

SECTION 262813 – FUSES

1. GENERAL

1.1 RELATED DOCUMENTS

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

B. Division 26 Basic Electrical Requirements and Basic Electrical Materials and Methods sections apply to work specified in this section.

1.2 SUMMARY

A. Extent of fuse work required by this section is indicated on drawings, and by requirements of this section.

B. Refer to other Division 26 sections for the following items; not work of this section.
Motor disconnects

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fuses of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards:

1. UL Compliance and Labeling: Comply with applicable provisions of UL 198D, "High-Interrupting-Capacity Class K Fuses". Provide overcurrent protective devices which are UL-listed and labeled.

2. NEC Compliance: Comply with NEC as applicable to construction and installation of fusible devices.

2. PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide fuses of one of the following:
Bussmann Div; Cooper Industries.
Littelfuse, Inc.
Mersen
Reliance Fuse

2.2 FUSES:

A. All low voltage equipment requiring fuses to be complete with same and fuses to be as follows unless shown otherwise on Drawings:

1. 1-600 Amps, 250 and 600 volts:

a. Non-renewable, current limiting type.

b. Where used to protect a motor, size same to protect motor as recommended by motor or equipment manufacturer.

B. Where current limiting fuses are required and indicated, provide Owner with spare set of three (3) fuses for each different size indicated on the Drawings.

1. Provide separate wall-mounted box with door, hinges and hasp for storage of same and mark door "Spare Fuses". Mount box in vicinity of main distribution panel.

C. UL classes of low voltage fuses to be used are as follows:

1. Class RK5 Dual Element, Time Delay, Current Limiting Fuses: Provide UL listed Class RK5 dual element, time delay, current limiting fuses rated 250V or 600V, 60 Hz, 600A maximum, with 200,000A RMS symmetrical interrupting rating. Fuses have both short circuit and overload protection for motors, welders, transformers, and capacitor banks.

3. EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which fuses are to be installed, and notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until satisfactory conditions have been corrected in manner acceptable to Engineer.

3.2 INSTALLATION OF FUSES

A. Install fuses in accordance with manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC, and NEMA standards for installation of fuses.

B. Coordinate with other work, including electrical wiring, as necessary, to interface installation of fuses with other work.

C. All fuses in a given device to be of same manufacturer.

3.3 FIELD QUALITY CONTROL

A. Prior to energization of fusible devices, test devices for continuity of circuitry and for short-circuits. Replace malfunctioning units with new units, and then demonstrate compliance with requirements.

END OF SECTION 262813

SECTION 262816 - DISCONNECT SWITCHES

1. GENERAL

1.1 RELATED DOCUMENTS

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

B. Division 26 Basic Electrical Requirements and Basic Electrical Materials and Methods sections apply to work specified in this section.

1.2 SUMMARY

A. This Section includes circuit and motor disconnects.

1.3 SUBMITTALS

A. Product data for each type of product specified. This information to include ampacity, voltage, number of poles, horsepower rating, short circuit rating and NEMA rating.

B. Maintenance data for circuit and motor disconnects, for inclusion in Operation and Maintenance Manual specified in Division 01 and Division 26 Section "Basic Electrical Requirements."

1.4 QUALITY ASSURANCE

A. Electrical Component Standards: Provide components complying with NFPA 70 "National Electrical Code" and which are listed and labeled by UL. Comply with all UL and NEMA standards pertaining to circuit and motor disconnects.

2. PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following (all disconnects to be of same manufacturer):

Eaton Corporation
General Electric Co.
Siemens Industries
Square D/Schneider Electric

2.2 CIRCUIT AND MOTOR DISCONNECT SWITCHES

A. General: Provide circuit and motor disconnect switches in types, sizes, duties, features, ratings, and enclosures required. Provide NEMA 1 enclosure. For motor and motor starter disconnects, provide units with horsepower ratings suitable to the loads.

1. All switches to be of same manufacturer.

B. Heavy Duty Fusible Switches: Heavy duty switches, with fuses of classes and current ratings indicated. See Section "FUSES" for specifications. Where current limiting fuses are indicated, provide switches and non-interchangeable feature suitable only for current limiting type fuses.

1. Switch Interior:

a. All switches shall have switch blades which are visible when the switch is OFF and the cover is open. Type 1.

b. Lugs shall be front removable and UL listed for 75 deg C aluminum or copper conductors Type 1.

c. 30 through 100 ampere switches shall be equipped with field installed fuse pullers, Type 1.

d. All current carrying parts shall be plated to resist corrosion.

e. Switches shall have removable arc suppressors to facilitate easy access to line side lugs.

f. Switches shall have provisions for a field installable electrical interlock.

2. Switch Mechanism:

a. Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.

b. The operating handle shall be an integral part of the box, not the cover, Type 1.

c. Provisions for padlocking the switch in the OFF position with at least three padlocks shall be provided.

d. The handle position shall travel at least 90 degrees between OFF and ON positions to clearly distinguish and indicate handle position, Type 1.

e. All switches Type 1 shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

3. Switch Enclosures:

a. The enclosure shall be finished with gray baked enamel paint which is electrodeposited on cleaned, phosphate pretreated steel Type 1.

b. Switch covers shall be attached with welded pin-type hinges Type 1.

c. The enclosure shall have On and OFF markings stamped into the cover Type 1.

d. The operating handle shall be provided with a dual colored, red/black position indication, Type 1.

e. All switches shall have provisions to accept up to three 3/8" hasp padlocks to lock the operating handle in the OFF position.

f. Concentric knockouts shall be provided to facilitate ease of conduit entry Type 1 for switches rated 30-200A.

4. Switch Ratings:

   a. Switches shall be horsepower rated for ac and/or dc.

   b. The UL listed short circuit current rating of the switches shall be:

      - 200,000 rms symmetrical amperes when used with or protected by Class R fuses 30-600 ampere switches employing appropriate fuse rejection schemes.

3.__ EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which circuit and motor disconnects are to be installed. Notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Engineer.

3.2 INSTALLATION OF CIRCUIT AND MOTOR DISCONNECTS

A. General: Provide circuit and motor disconnect switches as shown on Drawings and/or as required by the National Electrical Code. Comply with switch manufacturers' printed installation instructions.

3.3 FIELD QUALITY CONTROL

A. Testing: Subsequent to completion of installation of electrical disconnect switches, energize circuits and demonstrate capability and compliance with requirements. Except as otherwise indicated, do not test switches by operating them under load. However, demonstrate switch operation through six opening/closing cycles with circuit unloaded. Open each switch enclosure for inspection of interior, mechanical and electrical connections, fuse installation, and for verification of type and rating of fuses installed. Correct deficiencies then retest to demonstrate compliance. Remove and replace defective units with new units and retest.

END OF SECTION 262816