



ADDENDUM #2

PROJECT: Kitchen Alterations & Related Work
at Several Locations
for Monroe Public Schools
#24101-24102-24103

The above plans and specifications are modified, corrected, augmented or supplemented as follows and this Addendum is hereby made a part of the contract documents. Contractor shall note on the Proposal Form that he has received this Addendum.

ITEM 1: PROJECT SPECIFICATIONS UPDATED (ISSUED HEREIN)

- A. Mechanical Specifications have been added to the Bidding Documents.
- B. Plumbing Specifications have been added to the Bidding Documents.
- C. Electrical Specifications have been added to the Bidding Documents.

ITEM 2: ALTERNATE #2 – ADDED MOTOR INFORMATION FOR SECOND OVERHEAD DOOR

- A. #23102 – Raisinville Elementary:
 - a. Refer to drawing E1.01 ELECTRICAL LEGEND, FIXTURE AND PANEL SCHEDULES & DETAILS (Re-issued Herein).
 - i. Revised panel schedule. Added circuit for second motor operated overhead serving door as part of Alternate #2 (E-1).
 - ii. Revised Load Summary to include second motor operator and controls and fire alarm tie-ins to both overhead serving doors.
 - b. Refer to drawing E3.01 ELECTRICAL POWER & SYSTEMS PLANS (Re-issued Herein).
 - i. Added motor and controls for second overhead serving door as part of Alternate E-1.
 - ii. Added door releasing mechanism and fire alarm addressable relay for second overhead serving door.
 - iii. Revised Alternate E-1 description to include motor operator and controls and fire alarm tie-ins to both overhead serving doors.

ITEM 3: TEMPORARY FIRE-RATED PARTITION TO BE REMOVED FROM SCOPE

- A. #21012 – Raisinville Elementary: Summer program for the building has changed and students will no longer have access to the building during construction. Temporary fire separation structures have been removed from all plans. Removal of these temporary protective features does not relieve the contractor of their obligation to provide temporary measures to contain dust/debris/damage as part of this work and as required elsewhere in the contract documents.
 - a. A1.00 (Re-issued Herein) – Plan updated to remove temporary barriers and notes from the Demolition Plan.
 - b. A2.00 (Re-issued Herein) – Plan updated to remove temporary barriers and notes from the Construction Plan.
 - c. A3.00 (Re-issued Herein) – Plan updated to remove temporary barriers and notes from the Reflected Ceiling Plan.

ITEM 4: COOLER / FREEZER SCOPE CLARIFICATION

- A. #21013 – Arborwood South Elementary:
 - a. A2.00 (Re-issued Herein) – Plan notes for the new Cooler / Freezer trim have been updated for coordination and clarification.
 - b. A3.00 (Re-issued Herein) – Plan noted for the new Cooler / Freezer trim have been updated for coordination and clarification. Demolition of existing ceiling has been removed from the scope.
 - c. A8.00 (Re-issued Herein) – Preliminary Walk-in Cooler Floor Plan provided by the manufacturer (as basis of design) has been updated.
 - d. A8.50 (Re-issued Herein) – Preliminary Walk-in Freezer Floor Plan provided by the manufacturer (as basis of design) has been updated.

ITEM 5: FLOOR DRAIN UPDATES

- A. #21013 – Arborwood South Elementary:
 - a. A1.00 (Re-issued Herein) – Plan note updated to clarify only area surrounding the drain to be saw-cut as required to complete the work.
 - b. Refer to drawing P1.01 Plumbing Specifications and Partial Plan (Re-issued Herein).
 - i. Revised Hub Drain HD-1 to Floor Drain FD-1.

-END-

Distribution: Monroe Public Schools
Kleinfelder

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SECTION 26 05 00 - GENERAL ELECTRICAL PROVISIONS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This Division of Work shall include all labor, materials, tools, equipment and services necessary for and/or reasonably incidental to the furnishing and installation of electrical work as shown on the contract documents and specified herein, for a complete and operable installation.
- B. The documents encompassed by these specifications and the attached drawings outline the work and/or materials required to furnish, install, alter, and/or expand the electrical system to provide a complete, finished and operational project. This shall include all associated cutting, patching, excavation, backfill, compaction, concrete bases, supports, auxiliary steel, inserts, anchors, chases, sleeves, etc., required to accomplish all portions of the this Work, without relying upon other trades, or the work described in other divisions of the specifications, unless it is specifically stated in Division 26 or on the Electrical Drawings, that an item will be provided by another trade. Wherever the word 'provide' is used, it shall be understood to mean: furnish and install complete and ready for proper use.
- C. This division of work includes, but is not limited to, the following major areas of electrical work:

Arborwood South:

- a. Disconnect and remove electrical connections, equipment, and associated conduit and wiring for items indicated for demolition on plan.
- b. Replace wiring and disconnects, rework associated conduits as necessary and add specified overcurrent protection devices for new walk-in cooler and new walk-in freezer and corresponding equipment and lighting as indicated on drawings. Provide branch circuits, disconnects, fuses and connections for equipment items included in the project. Provide branch circuits to supply power for the low voltage control, alarm and communication systems provided under other Divisions.
- c. Disconnect and remove one light fixture above existing walk-in freezer. Disconnect, relocate and reconnect one light fixture as indicated on plan.

Raisinville:

Base Bid

- a. Disconnect and remove electrical connections, equipment, and associated conduit and wiring for kitchen equipment indicated for demolition on plan.
- b. Install new or extend existing branch circuits to wiring devices for kitchen equipment.
- c. Furnish and install release device and associated equipment to accommodate overhead door as indicated on plan. Extend existing fire alarm system to connect to this device.
- d. Disconnect and remove electrical connections and control wiring to existing light fixtures to demolished as indicated on plans.
- e. Furnish and install lighting fixtures, re-work/extend existing branch circuits, and reconnect to existing lighting controls.

Alternate E-1

- a. Furnish and install motor, controls and fire alarm tie-ins for motor operated overhead door.

Custer II:

- a. Disconnect and remove existing electrical connections for item indicated for demolition on plan.
- b. Install electrical connections for kitchen equipment. Rework conduit as necessary.

D. Work by others:

1. All electric motors for building equipment, appliances, and utility systems, will be furnished under other divisions of these specifications
2. All electric work associated with equipment control and temperature control systems, devices, and panels, including the associated raceways and conductors, shall be provided under Division 23, unless specifically noted otherwise.
3. Field painting of electrical equipment, conduit, boxes, supports, etc., other than touch-up work to repair factory finishes, will be provided by others (as specified elsewhere in these specifications).

1.2 DRAWINGS

- A. The accompanying drawings are complementary to the specifications. Work indicated by either, shall be considered as being required by both. No apparent omission from the Drawings shall relieve the Contractor from providing equipment, materials, or services described by the electrical specifications or drawings.
- B. The Drawings may be superseded by later revised drawings or specification addenda and the Contractor shall conform to all reasonable changes without extra cost to the Owner. All items not specifically mentioned in the specifications or noted on the drawings but which are obviously necessary to make a complete working installation, shall be included.
- C. The electrical drawings are schematic in nature. The exact location of conduits, boxes, devices, fixtures, etc., (not referenced by dimension), shall be determined in the field considering interferences, structural conditions, appearance, and the work of other trades. Minor changes in the location of electrical items, from that shown on the drawings, shall not constitute a reason for additional compensation. This contractor shall field verify dimensions indicated by scaling the plans, since actual distances, locations and elevations will be governed by actual field conditions.

1.3 RELATED DOCUMENTS AND REFERENCES

- A. The Instructions to Bidders, General Conditions, Special Conditions, Addenda, Alternates, these Technical Specifications and the Drawings together with the Contract and Proposal Form comprise the Contract Documents for the Electrical Contract.
- B. Bidder shall refer to applicable portions of Division 1 – General, as many of the general requirements stated therein apply to or will affect the Electrical work and coordination between the trades is required.

- C. The term Associate as used herein refers to the design team on the project including the prime Architectural or Engineering design firm responsible for the drawings.

1.4 REFERENCED CODES AND STANDARDS

- A. Perform all work in accordance with the latest edition of the National Electrical Code as issued by the National Fire Protection Association International, National Electrical Safety Code, Life Safety Code, State of Ohio Building Codes, and any local codes or ordinances.
- B. All work, materials and apparatus shall conform to the rules and regulations of the National Board of Fire Underwriters, to the Codes and Standards of the various National Engineering Societies applicable to the work in question, and to the following:

ACIL	American Council of Independent Laboratories
ANSI	American National Standards Institute
ASTM	American Society for Testing & Materials
AWS	American Welding Society
FM	Factory Mutual
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
NEMA	National Electrical Manufacturers Association
OSHA	Occupational Safety & Health Administration
UL	Underwriters Laboratories, Inc.

- C. The above standards are minimum requirements. When plans and/or specifications call for higher standards, the plans and/or specifications shall govern.
- D. All materials shall be installed using tools, methods, means, supports, etc., as may be recommended by the material manufacturer, even if more stringent than the governing codes or regulations specified by the NEC and the State Building Code.

1.5 PERMITS AND FEES

- A. All plan approvals required by any of the foregoing will be secured and paid for by the Contractor and the proper copy distributed to the Associate.
- B. All Electrical Work shall be inspected by the Bureau of Construction Codes, Permit Division, P.O. Box 30255, Lansing, MI 48909 (Phone: 517-241-9313) or the local building inspection department, where certified as the Inspection Authority for this project and site.
- C. Upon completion of the work, this Contractor shall furnish to the Associate certification or evidence of final approval from said Authority before final payment on contract.
- D. All fees for inspection and permits shall be a part of the Contract, the cost of which shall be included in the Contractor's Bid.

1.6 QUALITY ASSURANCE

- A. All material manufacturers shall be firms regularly engaged in the manufacture of products for electrical work of the sizes, types and ratings as specified, and whose products have been in satisfactory use in similar service for not less than three (3) years.

- B. Contractors shall have at least ten (10) years of successful installation experience on electrical projects similar to that required for this work.

1.7 SUBMITTALS

A. Related requirements:

- 1. Section 260512 "Submittal Procedures" for information and requirements on approval drawings.

B. Record Drawings

- 1. Contractor shall keep in the field, and open to inspection, an accurate and current record of all deviations from Contract Drawings and Specifications. He shall neatly and correctly enter in colored marker any deviations on drawings affected. An extra set of drawings will be furnished for this purpose.
- 2. On completion of the work, the record drawings shall indicate actual routing of conduit (i.e. above ceiling, in slab), location of outlets, circuit numbering for all lighting, power and receptacle circuits. Underground feeders and duct-banks shall be located by dimension to assist in future excavations. Before final approval, contractor shall certify to the accuracy of each sheet by signature thereon and deliver same to Associate.
- 3. At completion of the project, the Record Drawings will be delivered to the Owner by the Contractor along with the final Instruction Manuals. Record drawings shall be delivered to the Associate within 30 days of project acceptance.
- 4. All final operating and instruction manuals, record drawings, etc., shall be completed and turned over to the Associate prior to request for final payment.

C. Instruction Manual: Bind the written operating instructions, shop drawings, equipment catalog cuts and manufacturer's maintenance instructions into a hard-backed binder, so that they can be accommodated into 8 1/2" X 11" size. Provide written instructions for each system requiring operator intervention under normal and design conditions. Submit one copy to the Associate for review. Upon approval, submit three (3) copies to the Associate for delivery to the Owner. Materials shall be assembled as follows:

- 1. Title Page--Title of Job, Owner, Address, Date of Submittal, Name of Contractor and Name of Associate.
- 2. Index of all sections
- 3. A section listing items requiring periodic service and for proper operation, and either state the service needed or refer to the manufacturer's data in the binder that describes the proper service.
- 4. A section of all project shop drawings, complete with a section index.
- 5. A section of all material manufacturer's operating instructions, complete with a section index.
- 6. A list of all material (other than basic materials) and material suppliers used on the job, Contractor's purchase order numbers, supplier's name and address, for future use by the owner's maintenance personnel.
- 7. List of a qualified service agency or contractor for each electrical system or major electrical component that may require service.

1.8 VISITING THE SITE

- A. Contractor shall examine the site and compare it with the drawings and specifications, and shall satisfy himself as to all conditions under which the work is to be performed. Failure to do so shall be deemed as acceptance of existing conditions. The contractor shall ascertain and check the location of any existing structures or equipment that may affect this work.
- B. It shall be the responsibility of this Contractor to refer to any discrepancies upon examination of site and drawings to the Associate before bid due date. No allowances shall be made on his behalf for any extra expense to which he may be put due to failure or neglect on his part to make such examination.

1.9 GUARANTEE

- A. This Contractor shall guarantee his workmanship and materials for a period of one year from the date of final acceptance and leave his work in perfect order at completion. Should defects develop within the guarantee period, this Contractor shall, upon notice of same, remedy the defects and have all damages to other work or furnishings caused by the defects or the work of correcting same repaired and/or replaced at his expense, to the condition before such damage. The date of final acceptance is defined as the date of signature of the Associate on the final payment of this Contract, unless otherwise defined in the General or Special Conditions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Unless specified otherwise, all materials shall be new and of the best quality and, if applicable, materials shall bear certification of quality. If requested, Contractor shall furnish satisfactory evidence as to the kind and quality of materials.
- B. Provide all basic electrical materials including conduit, raceways, fittings, conductors, cabling, trays, boxes, supports, devices, connections, cover plates, grounding, controls, labeling, etc., whether or not specifically shown, specified or noted, as may be required for a complete and operable installation,

2.2 STANDARDS & SUBSTITUTIONS

- A. Those articles, devices, materials, forms of construction, fixtures, etc., named in the specifications to denote the kind and quality required, whether or not the words "or equal" are used, shall be known as "Standards" and all proposals shall be based on same. Where two or more "Standards" are named together, the successful bidder may furnish any one of the "Standards" named, but Contractors shall make their selections known to Associate within 30 days following award of their contract.
- B. Note that "substitutions" are not permitted except under the strict guidelines of the General Conditions. In no case will a "substitution" affect determining of the lowest bid.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All work shall be done by technicians skilled in the particular trade involved and shall be of the best quality, shall be done in a neat, workmanlike manner, up to present standards and practices.
- B. Installation shall be so made that its several component parts will function together as a workable system. It shall be complete with all accessories necessary for its operation and shall be left with all equipment properly adjusted and in working order.
- C. Work shall be executed in conformity with best practice and so as to contribute to efficiency of operation, minimum maintenance, accessibility and sightliness.
- D. All installations shall provide for efficiency of operation, ease of maintenance, efficient utilization of space, and good construction practice, in concert with all other trades and contractors. Special care shall be exercised to insure that proper equipment maintenance and normal component replacements may be accomplished after final project completion without removal of excessive unrelated items of equipment, raceways, boxes, etc.
- E. The Contractor shall have in charge of the work at all times during construction a competent foreman or superintendent, experienced in the work to be installed under this division of the work and with previous experience as a foreman for the successful Contractor. Note that selection of the foreman shall be subject to the approval of the Associate and Owner.
- F. Immediately correct all work that is found unacceptable by the Associate. Work shall be unacceptable where it is not in conformance with the Drawings, Specifications or normal standards of good workmanship.

3.2 COORDINATION

- A. This Contractor shall review the drawings and specifications of others trades involved in the project, and shall examine the work of such, to which his work must connect, attach, align, or otherwise coordinate. This Contractor shall, in no case, connect to, attach to, cover up, or finish work adjacent to defective or improper work, but shall notify the appropriate other contractor and the Associate, upon such circumstance.
- B. The Contractor must be prepared to enter upon his work promptly and shall layout and conduct his work at all times so as not to interfere unnecessarily with the operations of the Owner or other contractors. He shall work in harmony with such other contractors and the Owner to the best interests of the job as a whole. Provide adequate and timely input to the contractor preparing "coordination drawings" where specified elsewhere. All conflicts shall be resolved in the best interest of the Owner and the successful completion of the project.
- C. Contractor shall layout his work and be responsible for correct locations, elevations, and dimensions of all work executed under this contract. He shall exercise proper precautions to verify figures shown on drawings before laying out the work and shall be held responsible for any error resulting from his failure to exercise such precaution.
- D. No pleas as to acts, orders, directions or supervision of the Associate or Owner shall be admitted as justification of any error or departure from the terms of the Contract, unless such order or directions are explicitly given in writing.

3.3 SCHEDULING

- A. Contractor shall take special note of the construction phasing and time constraints in other portions of these specifications. It is necessary that this Contractor cooperate closely with the Associate, Owner and General Contractor as to the areas of work and coordination of the various trades, etc. It shall be the responsibility of this Contractor to carefully plan his delivery and work schedule to coincide with operation and schedule of the other Contractors.
- B. This Contractor shall work closely with the General Contractor and submit a Construction Schedule to coordinate with the General Contractors Schedule prior to actual start of construction and shall outline specifically those items whose delivery or installation may cause schedule difficulties. See Division 1.
- C. Exposed raceways and boxes installed after the room has been painted, shall be painted to match the room finish, at the expense of this contractor.

3.4 CLEANING AND FINISHING

- A. After all tests have been completed and approved by the Associate and Owner, this Contractor shall clean all fixtures and equipment leaving everything in working order at completion of the work.
- B. All tags, stickers, markings, etc., shall be removed from fixtures, conduit and equipment. All operating instructions, connections diagrams, etc., furnished with equipment shall be turned over to the Associate as part of the Operating Instruction Brochure.
- C. Finally, all debris created by execution of electrical work shall be removed by this Contractor.

3.5 FIELD TESTING

- A. Contractor shall conduct such tests and adjustments of equipment as required by Associate or necessary to verify performance requirements. Submit data taken during such tests to Associate. Contractor shall pay all professional engineering fees involved in required testing of equipment. Tests shall include the operation of all lights and equipment, and grounding and insulation resistance measurements on not more than ten (10) representative circuits and any others for which a technical reason exists for such testing.
- B. This Contractor shall provide necessary electrical personnel and testing instruments as required or desired by the Associate to insure proper performance or load balance, etc.
- C. Load Balancing: This Contractor shall furnish personnel and equipment and insure that building power, lighting, motor and appliance loads are balanced between phases of service entrances, distribution feeders and/or transformers to within ten (10) per cent under maximum load conditions. Special care shall be taken during load balance to assure that reverse rotation of motors is not caused.
- D. Phasing/Rotation: All panels, switches, switchgear, motor control, etc., shall be checked and verified in the presence of the Associate for "ABC" - "CLOCKWISE" rotation in accordance with NEMA Standards and Recommendations. This includes all existing panels and switchgear being re-fed. Exercise caution that reconnections of panel feeders, etc., do not cause any motor phase rotation reversal.

- E. At the completion of the project, Contractor shall verify complete Ground/Neutral separation except at the main service bonding jumper and shall clear and correct all other grounded neutrals within his scope of work. (This generally requires a power outage coordinated with the utility company).

3.6 EQUIPMENT AND SYSTEM DEMONSTRATIONS

- A. All special purpose equipment, such as Standby Power Systems, Automatic Transfer Switches, Exterior Lighting Contactors and controls, etc., shall be demonstrated in the presence of the Owner and Associate, including operation of random devices, components and wiring, to verify proper operation of the finished installation.
- B. System demonstrations shall be scheduled ONLY after all devices, components, etc., have been fully tested and system is in final operating condition.

END OF SECTION 26 05 00

SECTION 26 05 05 - RELATED WORK

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Provide work associated with the electrical installation, which is closely associated therewith, and required for a complete and operational installation. Such work may be non-electrical in nature, but shall be provided by this contractor, in order to assure coordination and installation responsibility by this contractor. Such work shall include cutting and patching, excavation and backfilling, concrete work, and other items as may be described on the plans.
- B. Where final interior or exterior finishes of this related work, is to remain exposed, such finishes shall be provided via workers or subcontractors specifically trained in the work to be performed, all at the expense of this contractor.

1.2 RELATED DOCUMENTS

- A. Refer to section 260500 for general requirements for the electrical work.
- B. Refer to the General Trades Specification Sections for other requirements for cutting and patching.
- C. Refer to the General Trades Specification Sections for requirements for field installed concrete.

PART 2 - PRODUCTS

2.1 NOT APPLICABLE

PART 3 - EXECUTION

3.1 SLEEVES, INSERTS AND OPENINGS

- A. Contractor shall lay out and install his work in advance of constructing floors and walls. He shall furnish and install all sleeves and openings through floors and walls required for passage of all conduits, pipes or ducts installed by him. Sleeves shall be heavy gauge galvanized sheet steel, supported and packed to prevent ingress of concrete. All necessary cutting and patching to correct improperly installed material shall be done at this Contractor's expense. No horizontal chases will be allowed. Provide all necessary inserts for support of electrical equipment.
- B. All conduits, sleeves, outlet boxes, fittings, etc., shall be properly closed with fireproof materials and patched where passing through walls, floors or ceilings in accordance with NEC 300.21 for prevention of fire spread. Sealant material shall be Dow Corning RTV Silicone Foam, UL Listed and tested for fire penetration sealing or equal by Nelson or Burndy.
- C. Where conduits, cable tray, ducts, etc., pass thru walls, floors or ceilings the opening around said penetration shall be sealed against moisture and fire penetration.

3.2 FIRE PROOFING

- A. Pipe or duct penetrations thru all floors, fire walls or rated ceilings shall be sealed by the E.C. to prevent spread of fire and smoke and ingress of moisture.
- B. Areas around conduits or sleeves shall be filled with a dielectric, non-hardening putty as manufactured by 3M Company or expanding caulk materials such as Silicone R.T.V. Foam or equal with appropriate fire ratings.
- C. Large openings in floors or masonry walls may be sealed using light weight, low density expanding mortar as made by 3M Company, or equal with appropriate fire ratings.
- D. Large openings around bus ducts or cable trays where passing thru fire rated wall shall be sealed using fire seal bags stuffed into the opening. Bags shall be coated intumescent materials, flexible and conformable and shall be easily removable and re-useable for retrofit applications. Bag seals shall be as manufactured by 3M Company or Spec Seal. or equal.
- E. All fire and smoke penetration seals shall be properly closed using U.L. Listed Products to match the penetration firestop system designation and all fire and smoke stop materials shall be free of asbestos, dangerous solvents, non-halogenated and shall not produce toxic fumes or smoke during exposure to fire. Fire stop shall be designed and installed to provide a minimum 2 hour rating. All fire stop materials shall be installed in strict accordance with the manufacturer's installation instructions.

3.3 CUTTING AND PATCHING

- A. Contractor shall work in advance of work of others wherever possible, eliminating all cutting and patching. Where such procedure is impossible, cutting and patching shall be done in a neat manner by various mechanics skilled in various trades involved, to the satisfaction of the Associate. No excessive cutting will be permitted, and no structural members shall be cut without consent of the Associate.
- B. Contractor shall do his own cutting and patching as required to properly complete his own work. All floors, walls, ceilings, etc., shall be left in an acceptable condition. Final finishes will be by General Contractor if final finishes have not already been applied. In case final finishes have already been applied before cutting and patching by this contractor, then final finishes shall be replaced or repaired by the General Contractor but at this contractor's expense.
- C. Holes of excessive size caused by this Contractor will be repaired at this Contractor's expense, as directed by the Associate and in accordance with other applicable portions of this specification.
- D. Where underfloor raceway is indicated in existing areas, this contractor shall cut existing concrete floor to proper depth to install the new metal raceway and shall patch the concrete at the new raceway. Final floor finish to be by General Contractor.
- E. Penetration of metal roof deck is not permitted for hangers, supports, clamps, fasteners, etc.

3.4 MOUNTING PADS

- A. All ground mounted electrical equipment shall be mounted on 6" high poured concrete pads.
- B. Pads shall be complete with chamfered or rounded corners and shall provide a smooth level surface for the equipment.

- C. All concrete pads shall be "sealed" before equipment is set in place.

END OF SECTION 26 05 05

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SECTION 26 05 12 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information that require Architect/Engineer's responsive action.
- B. Informational Submittals: Written and graphic information that do not require Architect/Engineer's responsive action. Submittals may be rejected for not complying with requirements.

1.3 ACTION SUBMITTALS

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

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect/Engineer's Digital Data Files: Electronic copies of digital data files of the Contract Drawings will be provided by Architect/Engineer for Contractor's use in preparing submittals. Do not base Submittals on reproductions of the Contract Documents or standard printed data.
 - 1. Architect/Engineer will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings.
 - a. Architect/Engineer makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
- 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. Architect/Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect/Engineer's receipt of submittal. No extension of

the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 14 days for review of each resubmittal.
- D. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Stamp shall include project name, location, specification section, 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.
- E. Paper Submittals: Place a permanent label or title block on each submittal item for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect/Engineer.
 3. Include the following information for processing and recording action taken:
 - a. Project name and Date.
 - b. Name of Architect/Engineer.
 - c. Name of Contractor.
 - d. Name of subcontractor.
 - e. Name of supplier.
 - f. Name of manufacturer.
 - g. Number and title of appropriate Specification Section.
 - h. Drawing number and detail references, as appropriate.
 - i. Location(s) where product is to be installed, as appropriate.
 - j. Other necessary identification.
 4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect/Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
 5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect/Engineer will return, without review, submittals received from sources other than Contractor.
- F. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect/Engineer.
 4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Architect/Engineer, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect/Engineer.
 - d. Name of Contractor.
 - e. Name of firm or entity that prepared submittal.
 - f. Names of subcontractor, manufacturer, and supplier.
 - g. Category and type of submittal.
 - h. Submittal purpose and description.
 - i. Specification Section number and title.
 - j. Specification paragraph number or drawing designation and generic name for each of multiple items.

- k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Related physical samples submitted directly.
 - n. Indication of full or partial submittal.
 - o. Other necessary identification.
 - p. Remarks.
- G. Options: Identify options requiring selection by Architect/Engineer.
- H. Deviations: Identify deviations from the Contract Documents on submittals.
- I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
- 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked with authorization notation from Architect/Engineer's action stamp.
 - 4. Resubmittal Limitation Requirements: The Architect/Engineer will provide time to review the original submittal and ONE resubmittal. If resubmittals are required pursuant to the first resubmittal, the Architect/Engineer's time for these services will be paid by the Contractor. The charges for this time will be back-charged from the Contractor as a change-order through this project's contract. These charges will be based upon the Architect/Engineering standard hourly rates (i.e. Engineer @ \$125.00/hr, etc.).
- J. 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.
- K. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with authorization notation from Architect/Engineer's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements:
- 1. Issue electronic submittals as PDF electronic files directly to Architect/Engineer's e-mail address.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment. Multiple submittals for a single type of equipment are not acceptable. Submittal for a single type of equipment shall be based on one manufacturer throughout project. Multiple components intended to function together, shall be coordinated and submitted together.
- 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Clearly mark, highlight, or encircle each copy of each submittal to indicate which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts and Manufacturer's product specifications.
 - b. Standard color charts.

- c. Statement of compliance with specified referenced standards.
 - d. Testing by recognized testing agency.
 - e. Application of testing agency labels and seals.
 - f. Notation of coordination requirements.
 - g. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Physical weight.
 - c. Dimensions.
 - d. Finish.
 - e. Electrical ratings: Voltage and amperage.
 - f. Construction details for installation.
 - g. Operating Characteristics.
 - h. Capacities: KVA, temperature rise, control devices, ballast or driver data.
 - i. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data in the PDF electronic file format.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 - h. Items furnished by others: The Contractor will be provided complete manufacturers detailed shop drawings, wiring and connection diagrams, for all equipment to which his work connects. It shall be this Contractor's responsibility to request such drawings in advance of the time they are needed. Work that must be altered because of the Contractor's failure to request and obtain such shop drawings, shall be corrected without additional cost to the owner.
 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 24 by 36 inches.
 3. Submit Shop Drawings in the PDF electronic file format.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Submit product schedule in PDF electronic file format.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- G. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- H. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

- I. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- J. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- K. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- L. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.
- M. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- N. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- O. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- P. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect/Engineer.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT/ENGINEER'S ACTION

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

- B. Action and Informational Submittals: Architect/Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect/Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
 - 1. Architect/Engineer's Review Status:
 - a. No Exceptions Taken
 - b. Exceptions Taken As Noted
 - c. Resubmit
 - d. Rejected
 - 2. Action Required of Contractor:
 - a. Process
 - b. Resubmit
- C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 23 05 12

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Copper building wire rated 600 V or less.
 - 2. Aluminum building wire rated 600 V or less.
 - 3. Metal-clad cable, Type MC, rated 600 V or less.
 - 4. Armored cable, Type AC, rated 600 V or less.
 - 5. Fire-alarm wire and cable.
 - 6. Connectors, splices, and terminations rated 600 V and less.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency and manufacturer's authorized service representative.
- B. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. **Okonite Company (The).**
2. **Southwire Company.**
3. **Superior Essex Inc.**

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 or ASTM B496 for stranded conductors.

E. Conductor Insulation:

1. Type NM: Comply with UL 83 and UL 719.
2. Type RHH and Type RHW-2: Comply with UL 44.
3. Type USE-2 and Type SE: Comply with UL 854.
4. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
5. Type THHN and Type THWN-2: Comply with UL 83.
6. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
7. Type UF: Comply with UL 83 and UL 493.
8. Type XHHW-2: Comply with UL 44.

2.2 ALUMINUM BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. **Okonite Company (The).**
2. **Southwire Company.**
3. **Superior Essex Inc.**

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Aluminum, complying with ASTM B800 and ASTM B801.

E. Conductor Insulation:

1. Type NM: Comply with UL 83 and UL 719.

2. Type RHH and Type RHW-2: Comply with UL 44.
3. Type USE-2 and Type SE: Comply with UL 854.
4. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
5. Type THHN and Type THWN-2: Comply with UL 83.
6. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
7. Type XHHW-2: Comply with UL 44.

2.3 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. **AFC Cable Systems; Atkore International.**
2. **Southwire Company, LLC.**
3. **WESCO.**
4. **Encore Wire Corporation**
5. **Alpha Wire; brand of Belden Inc.**
6. **Belden Inc.**

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. RoHS compliant.
4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
5. Where required, provide health care rated cable with redundant ground conductors in patient care areas as per NEC 517.13.

D. Circuits:

1. Single circuit and multi-circuit with color-coded conductors.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

F. Ground Conductor: Insulated.

G. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

H. Armor: Steel or Aluminum, interlocked.

- I. Jacket: PVC applied over armor.

2.4 ARMORED CABLE, TYPE AC

- A. Description: A factory assembly of insulated current-carrying conductors with or without an equipment grounding conductor in an overall metallic sheath.
- B. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1. **AFC Cable Systems; Atkore International.**
 - 2. **Southwire Company, LLC.**
 - 3. **WESCO.**
 - 4. **Encore Wire Corporation**
 - 5. **Alpha Wire; brand of Belden Inc.**
 - 6. **Belden Inc.**
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Comply with UL 4.
 - 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
 - 5. Where required, provide health care rated cable with redundant ground conductors in patient care areas as per NEC 517.13.
- D. Circuits:
 - 1. Single circuit and multi-circuit with color-coded conductors.
 - 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- F. Ground Conductor: Insulated.
- G. Conductor Insulation: Type THHN/THWN-2. Comply with UL 83.
- H. Armor: Steel or Aluminum, interlocked.

2.5 FIRE-ALARM WIRE AND CABLE

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1. **Cerro Wire LLC**
 - 2. **nVent Thermal**
 - 3. **Southwire Company, LLC.**
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

- C. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.
 - 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
 - 1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
 - 2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
 - 3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NRTL listed for fire-alarm and cable tray installation, plenum rated.

2.6 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1. **3M Electrical Products.**
 - 2. **Hubbell Incorporated, Power Systems.**
 - 3. **ABB, Electrification Products Division.**
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Copper.
 - 2. Type: One or Two hole with standard barrels.
 - 3. Termination: Compression or Crimp.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. All line voltage circuits shall be stranded, copper, 600 Volt insulated: (75 degrees C THHN/THWN for circuits #14 AWG thru #2 AWG; 90 degrees C XHHW-2 for circuits #1 AWG and larger). Conductors #3/0 AWG and larger may be stranded electrical grade standard or compact stranded aluminum conductors with 90 degrees C rated XHHW-2 insulation, properly upsized for the ampacity equivalent to the copper conductors shown; conduit shall also be upsized for aluminum conductors. Branch circuit wiring shall be #12 AWG minimum.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway, Type XHHW-2, single conductors in raceway or Type USE, single conductor in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to General Trades Specification Sections.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements:
 - 3. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
 - 4. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

- b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 5. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- D. Cables will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports to record the following:
1. The test report shall include the following:
 - a. Summary of project.
 - b. Description of equipment tested.
 - c. Description of tests;
 - d. Test data.
 - e. Analysis and recommendations.
 2. Test and inspection data records shall include the following minimum requirements:
 - a. Identification of the testing organization.
 - b. Equipment identification.
 - c. Humidity, temperature and other conditions that may affect the results of the tests/calibrations.
 - d. Date of inspections, tests, maintenance and/or calibrations.
 - e. Identification of the testing technician.
 - f. Indication of inspections, tests, maintenance and/or calibrations to be performed and recorded.
 - g. Indication of expected results when calibrations are to be performed.
 - h. Indication of "as-found" and "as-left" results, as applicable.
 - i. Sufficient spaces to allow all results and comments to be indicated.
 3. The testing organization shall furnish a copy or copies of the complete report as specified in the maintenance testing contract.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Ground rods.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in General Trades Specification Sections include the following:
 - a. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article:
 - 1) Ground rods.
 - b. Instructions for periodic testing and inspection of grounding features at ground rods and grounding connections based on NETA MTS or NFPA 70B.

- 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
- 2) Include recommended testing intervals.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

- A. **Manufacturers: Subject to compliance with requirements, provide products by the following:**
 1. **ABB, Electrification Products Division.**
 2. **B-Line; a division of Eaton, Electrical Sector.**
 3. **Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated.**
 4. **Hoffman; brand of nVent Electrical plc.**
 5. **allIG Fabrication (formerly ALT).**

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 1. Solid Conductors: ASTM B3.
 2. Stranded Conductors: ASTM B8.
 3. Tinned Conductors: ASTM B33.
 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression or exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Conduit Hubs: Mechanical type, terminal with threaded hub.
- G. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt or socket set screw.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- J. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- K. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- L. Straps: Solid copper, cast-bronze clamp or copper lugs. Rated for 600 A.
- M. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- N. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with zinc-plated or stainless-steel bolts.
 - a. Material: Die-cast zinc alloy.
 - b. Listed for direct burial.
 - 2. U-bolt type with malleable-iron clamp and copper ground connector or copper ground connector rated for direct burial.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Grounding Conductors: Green-colored insulation.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Pad-Mounted Transformers and Switches: Install grounding per utility company's standards.

3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.

3.5 FENCE GROUNDING

- A. Fence Grounding: Install at maximum intervals of 100 feet except as follows:
 - 1. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 25 feet.
 - a. Gates and Other Fence Openings: Ground fence on each side of opening.
 - 1) Bond metal gates to gate posts.
 - 2) Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.
- B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet on each side of crossing.

- C. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.
- D. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
- E. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

3.6 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. Use exothermic welds for all below-grade connections.
 - 3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

- F. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Steel slotted support systems.
2. Aluminum slotted support systems.
3. Nonmetallic slotted support systems.
4. Conduit and cable support devices.
5. Support for conductors in vertical conduit.
6. Structural steel for fabricated supports and restraints.
7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
8. Fabricated metal equipment support assemblies.

1.3 ACTION SUBMITTALS

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

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Sockets.
 - e. Eye nuts.
 - f. Fasteners.
 - g. Anchors.
 - h. Saddles.
 - i. Brackets.
2. Include rated capacities and furnished specialties and accessories.

- B. Shop Drawings For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.

4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Piping, fittings, and supports.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M and AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame Rating: Class 1.
 2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. **Allied Tube & Conduit; Atkore International.**
 - b. **B-Line; a division of Eaton, Electrical Sector.**
 - c. **CADDY; brand of nVent Electrical plc.**
 - d. **Flex-Strut Inc.**
 - e. **ABB, Electrification Products Division.**
 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 3. Material for Channel, Fittings, and Accessories:
 - a. Interior Locations: Painted or plain steel.
 - b. Exterior Locations: Galvanized steel, Stainless steel, Type 304 or Stainless steel, Type 316.
 4. Channel Width: Selected for applicable load criteria.
 5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Aluminum Slotted Support Systems: Extruded-aluminum channels and angles with minimum 13/32-inch- diameter holes at a maximum of 8 inches o.c. in at least one surface.
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. **ABB, Electrification Products Division.**
 - b. **Eaton**
 - c. **Unistrut; Atkore International.**
 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 3. Channel Material: 6063-T5 aluminum alloy.
 4. Fittings and Accessories Material: 5052-H32 aluminum alloy.
 5. Channel Width: Selected for applicable load criteria.
 6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with minimum 13/32-inch- diameter holes at a maximum of 8 inches o.c., in at least one surface.
1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. **Allied Tube & Conduit; Atkore International.**
 - b. **B-line; Eaton, Electrical Sector.**
 - c. **Fabco Plastics Wholesale Limited.**
 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 3. Channel Width: Selected for applicable load criteria.
 4. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.
 5. Fitting and Accessory Materials: Same as those for channels and angles, except metal items may be stainless steel.
 6. Rated Strength: Selected to suit applicable load criteria.
 7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in

riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

- F. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1) **Hilti, Inc.**
 - 2) **MKT Fastening, LLC.**
 - 3) **Simpson Strong-Tie Co., Inc.**
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, [zinc-coated] [stainless] steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - 1) **B-line; Eaton, Electrical Sector.**
 - 2) **Hilti, Inc.**
 - 3) **MKT Fastening, LLC.**
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
 - 6. Toggle Bolts: All Stainless-steel springhead type.
 - 7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
 2. NECA 101
 3. NECA 102.
 4. NECA 105.
 5. NECA 111.
- B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
1. Secure raceways and cables to these supports with either two-bolt conduit clamps, single-bolt conduit clamps or single-bolt conduit clamps using spring friction action for retention in support channel.
- E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC and RMC may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 6. To Light Steel: Sheet metal screws.

7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

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

3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in General Trades Specification Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Surface raceways.
 - 5. Boxes, enclosures, and cabinets.
 - 6. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. GRC: Comply with ANSI C80.1 and UL 6.
3. ARC: Comply with ANSI C80.5 and UL 6A.
4. IMC: Comply with ANSI C80.6 and UL 1242.
5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit or IMC.
 - a. Comply with NEMA RN 1.
 - b. Coating Thickness: 0.040 inch, minimum.
6. EMT: Comply with ANSI C80.3 and UL 797.
7. FMC: Comply with UL 1; zinc-coated steel or aluminum.
8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

1. Comply with NEMA FB 1 and UL 514B.
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fittings, General: Listed and labeled for type of conduit, location, and use.
4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
5. Fittings for EMT:
 - a. Material: Steel or die cast.
 - b. Type: Setscrew or compression.
6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

- C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

D. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. **Allied Tube & Conduit; Atkore International.**
- b. **Crouse-Hinds; brand of Eaton, Electrical Sector.**
- c. **Topaz Lighting & Electric.**
- d. **Wheatland Tube; Zekelman Industries.**
- e. **ABB, Electrification Business.**
- f. **Southwire Company, LLC.**

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

1. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Fiberglass:
 - a. Comply with NEMA TC 14.
 - b. Comply with UL 2515 for aboveground raceways.
 - c. Comply with UL 2420 for belowground raceways.
3. ENT: Comply with NEMA TC 13 and UL 1653.
4. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
5. LFNC: Comply with UL 1660.
6. Rigid HDPE: Comply with UL 651A.
7. Continuous HDPE: Comply with UL 651A.
8. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D3485.
9. RTRC: Comply with UL 2515A and NEMA TC 14.

B. Nonmetallic Fittings:

1. Fittings, General: Listed and labeled for type of conduit, location, and use.
2. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
 - a. Fittings for LFNC: Comply with UL 514B.
3. Solvents and Adhesives: As recommended by conduit manufacturer.

C. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. **Allied Tube & Conduit; Atkore International.**
- b. **Crouse-Hinds; brand of Eaton, Electrical Sector.**
- c. **Topaz Lighting & Electric.**
- d. **Wheatland Tube; Zekelman Industries.**
- e. **ABB, Electrification Business.**
- f. **Southwire Company, LLC.**

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 3R unless otherwise indicated, and sized according to NFPA 70.
 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

- C. Wireway Covers: Hinged type, Screw-cover type or Flanged-and-gasketed type unless otherwise indicated.
- D. Finish: Manufacturer's standard enamel finish.
- E. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. **Allied Tube & Conduit; Atkore International.**
 - b. **Crouse-Hinds; brand of Eaton, Electrical Sector.**
 - c. **Topaz Lighting & Electric.**
 - d. **Wheatland Tube; Zekelman Industries.**
 - e. **ABB, Electrification Business.**
 - f. **Southwire Company, LLC.**

2.4 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect Prime coated, ready for field painting (verify with architect prior to ordering materials).
- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
- D. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. **Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.**
 - b. **Wiremold; Legrand North America, LLC.**

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- C. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- D. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- E. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 or Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Nonmetallic Enclosures: Plastic.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

F. Cabinets:

1. NEMA 250, Type 1 or Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

- a. **ABB, Electrification Business.**
- b. **Appleton; Emerson Electric Co., Automation Solutions.**
- c. **Arlington Industries, Inc.**
- d. **Crouse-Hinds; brand of Eaton, Electrical Sector.**
- e. **Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.**
- f. **Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.**

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Standard: Comply with SCTE 77.
2. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC" OR "LIGHTING" or as indicated for each service.
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes 12 Inches Wide by 12 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.
8. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.

9. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units SCTE 77, Tier 8 structural load rating.
10. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.

- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
- a. **Armorcast Products Company.**
 - b. **Carson Industries LLC.**
 - c. **CDR Systems Corporation.**
 - d. **New Basis.**
 - e. **Quazite.**
 - f. **Synertech.**

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC or IMC.
 2. Concealed Conduit, Aboveground: GRC or IMC.
 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried and GRC.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC or LFNC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
 6. Elbow: Use GRC for stub-ups from underground runs and for all underground elbows on runs exceeding two-hundred feet.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed 10 feet above finished floor, Not Subject to Physical Damage: EMT.
 2. Exposed 10 feet above finished floor, Not Subject to Severe Physical Damage: EMT.
 3. Exposed 10 feet below finished floor and Subject to Severe Physical Damage: GRC.
Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: GRC.
 7. Elbow: Use GRC for stub-ups from underground runs and for all underground elbows on runs exceeding two-hundred feet and for all panel feeders.
 8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 1/2-inch trade size.

- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - 3. EMT: Use setscrew or compression, steel or cast-metal fittings. Comply with NEMA FB 2.10.
 - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

- K. Support conduit within 12 inches of enclosures to which attached.
- L. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
- M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- N. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- O. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- Q. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- R. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- S. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- T. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- U. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- V. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

- W. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service raceway enters a building or structure.
 3. Conduit extending from interior to exterior of building.
 4. Conduit extending into pressurized duct and equipment.
 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 6. Where otherwise required by NFPA 70.
- X. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- Y. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Z. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.
- AA. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in General Trades Specification Sections for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in General Trades Specification Sections.
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in General Trades Specification Sections.
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- E. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- F. If conduits do not enter enclosure through open bottom, field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in General Trades Specification Sections.

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

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SECTION 26 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Round sleeves.
2. Rectangular sleeves.
3. Sleeve seal systems.
4. Grout.
5. Pourable sealants.
6. Foam sealants.

- B. Related Requirements:

1. General Trades Specification Sections for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

- A. Wall Sleeves, Steel:

1. Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

- B. Wall Sleeves, Cast Iron:

1. Description: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

- C. Pipe Sleeves, PVC:

1. Description: ASTM D1785, Schedule 40.

D. Molded Sleeves, PVC:

1. Description: With nailing flange for attaching to wooden forms.

E. Molded Sleeves, PE or PP:

1. Description: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sheet Metal Sleeves, Galvanized Steel, Round:

1. Description: Galvanized-steel sheet; thickness not less than 0.0239-inch; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.2 RECTANGULAR SLEEVES

A. Sheet Metal Sleeves, Galvanized Steel, Rectangular:

1. Description:

- a. Material: Galvanized sheet steel.
- b. Minimum Metal Thickness:

- 1) For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness must be 0.052 inch.
- 2) For sleeve cross-section rectangle perimeter not less than 50 inches or with one or more sides larger than 16 inches, thickness must be 0.138 inch.

2.3 SLEEVE SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.

1. Sealing Elements: EPDM or Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel, Fiber-reinforced plastic or Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 GROUT

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

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

2.5 POURABLE SEALANTS

- A. Description: Single-component, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2.6 FOAM SEALANTS

- A. Description: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in General Trades Specification Sections.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless sleeve seal system is to be installed.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- C. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for wall assemblies.
- D. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

- E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel or cast-iron pipe sleeves and mechanical sleeve seal systems. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- F. Underground, Exterior-Wall and Floor Penetrations:
 - 1. Install steel or cast-iron pipe sleeves with integral waterstops. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve seal system. Install sleeve during construction of floor or wall.
 - 2. Install steel pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve seal system. Grout sleeve into wall or floor opening.

3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

- A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.
- B. Install conduits and cable with no crossings within the sleeve.
- C. Fill opening around conduits and cables with expanding foam without leaving voids.
- D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.3 INSTALLATION OF SLEEVE SEAL SYSTEMS

- A. Install sleeve seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION 26 05 44

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Labels.
 - 2. Bands and tubes.
 - 3. Tapes and stencils.
 - 4. Tags.
 - 5. Signs.
 - 6. Cable ties.
 - 7. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with NFPA 70E requirements for arc-flash warning labels.

- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
 - 1. Color shall be factory applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 240-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - 4. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 5. Color for Neutral: White.
 - 6. Color for Equipment Grounds: Green.
 - 7. Colors for Isolated Grounds: Green with two or more yellow stripes.
- C. Raceways and Cables Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."
- D. Warning Label Colors:
 - 1. Identify system voltage with black letters on an orange background.
- E. Warning labels and signs shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

F. Equipment Identification Labels:

1. Black letters on a white field.
2. White letters on a red field for all Emergency and Standby power equipment.
3. Include item name, voltage and phase. All panelboard and switchboard labels shall indicate the source of supply per NEC 408.4

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- thick, polyester or vinyl flexible label with acrylic pressure-sensitive adhesive.
 1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
 2. Marker for Labels:
 - a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - b. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches for raceway and conductors.
 - b. 3-1/2 by 5 inches for equipment.
 - c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
- C. Tape and Stencil: 4-inch- wide black stripes on 10-inch centers placed diagonally over orange background and are 12 inches wide. Stop stripes at legends.
- D. Floor Marking Tape: 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with black and white or yellow and black stripes and clear vinyl overlay.
- E. Underground-Line Warning Tape:
 - 1. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 2. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
 - d. Tensile according to ASTM D882: 30 lbf (133.4 N) and 2500 psi (17.2 MPa).
- F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.6 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch 0.023 inch thick, color-coded for phase and voltage level, with factory screened or printed permanent designations; punched for use with self-locking cable tie fastener.

2.7 SIGNS

- A. Baked-Enamel Signs:

1. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 7 by 10 inches.

B. Metal-Backed Butyrate Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:
 - a. For signs up to 20 sq. in., minimum 1/16 inch thick.
 - b. For signs larger than 20 sq. in., 1/8 inch thick.
 - c. Engraved legend with black letters on white face.
 - d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
 - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- H. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "POWER."
- I. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.

2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- J. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- K. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- L. Self-Adhesive Labels:
1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
- M. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- N. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- O. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- P. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- Q. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- R. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- S. Underground Line Warning Tape:
1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
 2. Limit use of underground-line warning tape to direct-buried cables.
 3. Install underground-line warning tape for direct-buried cables and cables in raceways.
- T. Metal Tags:
1. Place in a location with high visibility and accessibility.
 2. Secure using plenum-rated cable ties.
- U. Nonmetallic Preprinted Tags:
1. Place in a location with high visibility and accessibility.
 2. Secure using plenum-rated cable ties.

V. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on minimum 1-1/2-inch- high sign; where two lines of text are required, use signs minimum 2 inches high.

W. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high sign; where two lines of text are required, use labels 2 inches high.

X. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high sign; where two lines of text are required, use labels 2 inches high.

Y. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels or vinyl tape applied in bands.
 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
 1. "POWER."
- E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use either vinyl wraparound labels, self-adhesive wraparound labels, snap-around labels, snap-around color-coding bands or self-adhesive vinyl tape to identify the phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes or self-adhesive labels with the conductor designation.
- H. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- I. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- J. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- K. Workspace Indication: Apply floor marking tape or tape and stencil to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- L. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- M. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
 1. Apply to exterior of door, cover, or other access.
 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
- N. Operating Instruction Signs: Self-adhesive labels, Baked-enamel warning signs, Metal-backed, butyrate warning signs or Laminated acrylic or melamine plastic signs.
- O. Equipment Identification Labels:
 1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
 2. Outdoor Equipment: Laminated acrylic or melamine sign.
 3. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of engraved laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchgear.
 - e. Switchboards.

- f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
- g. Emergency system boxes and enclosures.
- h. Motor-control centers.
- i. Enclosed switches.
- j. Enclosed circuit breakers.
- k. Enclosed controllers.
- l. Variable-speed controllers.
- m. Motor Starters
- n. Push-button stations.
- o. Power-transfer equipment.
- p. Contactors.
- q. Remote-controlled switches, dimmer modules, and control devices.
- r. Power-generating units.
- s. Monitoring and control equipment.
- t. Fire-alarm control panel and annunciators.

END OF SECTION 26 05 53

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SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Standard-grade receptacles, 125 V, 20 A.
 - 2. GFCI receptacles, 125 V, 20 A.
 - 3. Cord and plug sets.
 - 4. Toggle switches, 120/277 V, 20 A.
 - 5. Decorator-style devices, 20 A.
 - 6. Wall plates.

1.3 DEFINITIONS

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.
- G. SPD: Surge protective device.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Comply with NFPA 70.
- C. RoHS compliant.
- D. Comply with NEMA WD 1.
- E. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with requirements in this Section.
- F. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.
- G. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to Essential Electrical System: Red.
- H. Wall Plate Color: For plastic covers, match device color.
- I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

- A. Duplex Receptacles, 125 V, 20 A:
 - 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Hubbell
 - b. Eaton
 - c. Leviton
 - 2. Description: Two pole, three wire, and self-grounding.
 - 3. Configuration: NEMA WD 6, Configuration 5-20R.

4. Standards: Comply with UL 498 and FS W-C-596.

B. Weather-Resistant Duplex Receptacle, 125 V, 20 A:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Hubbell
 - b. Eaton
 - c. Leviton
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

C. Tamper-Resistant Duplex Receptacles, 125 V, 20 A :

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Hubbell
 - b. Eaton
 - c. Leviton
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.3 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Hubbell
 - b. Eaton
 - c. Leviton
2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:

1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Hubbell
 - b. Eaton
 - c. Leviton

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-15R.
4. Standards: Comply with UL 498 and UL 943 Class A.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.4 CORD AND PLUG SETS

- A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
- B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
- C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.5 TOGGLE SWITCHES, 120/277 V, 20 A

- A. Single-Pole Switches, 120/277 V, 20 A:
 1. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 - a. Hubbell
 - b. Eaton
 - c. Leviton
 2. Standards: Comply with UL 20 and FS W-S-896.

2.6 OCCUPANCY SENSORS: Refer to specification section 260923.

2.7 WALL PLATES

- A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
- B. Single and combination types shall match corresponding wiring devices. Refer to drawings for requirements.
- C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant thermoplastic with lockable cover.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

F. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

- A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
- D. Tests for Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- E. Wiring device will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 26 27 26

SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:
 - a. Control circuits.
 - b. Enclosed switches.
2. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 3. Current-limitation curves for fuses with current-limiting characteristics.
 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software and in PDF format.
 5. Coordination charts and tables and related data.
 6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in the General Trades Specification Sections include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in electronic format suitable for use in coordination software and in PDF format.
4. Coordination charts and tables and related data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 FIELD CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 1. **Bussmann; Eaton, Electrical Sector.**
 2. **Littelfuse, Inc.**
 3. **Mersen USA.**
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 1. Fuses shall be dual-element, time-delay, rejection style, Class RK-5 for fuses up to 600 amperes; Bussmann type "FRN" (250 volt) or type "FRS" (600 volt). Larger fuses shall be Class L, bolt-in style; Bussmann "Hi-Cap".
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.

- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

2.3 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Identification: "SPARE FUSES" in 1-1/2-inch- high letters on exterior of door.
 - 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by [Architect] [Construction Manager] [Owner].

3.3 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13

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SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and electronic format.
- B. Shop Drawings: For enclosed switches and circuit breakers.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Seismic Qualification Data: Certificates, for enclosed switches and circuit breakers, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in the General Trades Specification Sections, include the following:
 - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and electronic format.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Fuse Pullers: Two for each size and type.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.10 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

- A. **Manufacturers: Subject to compliance with requirements, provide products by one of the following:**
 1. **Square D; Schneider Electric USA.**
 2. **GE/ABB**
 3. **Eaton**
 4. **Siemens Industry, Inc., Energy Management Division.**
- B. Type HD, Heavy Duty:
 1. Safety switches shall be heavy duty, H.P. rated, 250 or 600 volts AC rated to match the circuit shown, with ground lug, rejection style fuse clips and NEMA 1 enclosure indoors or NEMA 3R enclosure outdoors.
- C. Accessories:
 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical or Compression type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.

2.3 NONFUSIBLE SWITCHES

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

1. **Square D; Schneider Electric USA.**

2. **GE/ABB**

3. **Eaton**

4. **Siemens Industry, Inc., Energy Management Division.**

B. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Three Pole, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Lugs: Mechanical or Compression type, suitable for number, size, and conductor material.
6. Service-Rated Switches: Labeled for use as service equipment.

2.4 RECEPTACLE SWITCHES

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

- 1. Square D; Schneider Electric USA.**
- 2. GE/ABB**
- 3. Eaton**
- 4. Siemens Industry, Inc., Energy Management Division.**

2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1) or gray baked enamel paint, electrodeposited on cleaned, phosphatized galvanized steel (NEMA 250 Types 3R, 12).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 1. Notify Architect and Owner no fewer than seven days in advance of proposed interruption of electric service.
 2. Indicate method of providing temporary electric service.
 3. Do not proceed with interruption of electric service without Architect's and Owner's written permission.
 4. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.

3.4 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NFPA 70 and NECA 1.

3.5 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Tests and Inspections for Switches:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.

- g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
 - i. Verify correct phase barrier installation.
 - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
 - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

E. Tests and Inspections for Molded Case Circuit Breakers:

- 1. Visual and Mechanical Inspection:
 - a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and clearances.
 - d. Verify that the unit is clean.
 - e. Operate the circuit breaker to ensure smooth operation.
 - f. Inspect bolted electrical connections for high resistance using one of the two following methods:

- 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - g. Inspect operating mechanism, contacts, and chutes in unsealed units.
 - h. Perform adjustments for final protective device settings in accordance with the coordination study.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
 - e. Determine the following by primary current injection:
 - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
 - f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.

- g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
 - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
 - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 4. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.
1. The test and inspection report shall include the following:
 - a. Summary of project.
 - b. Description of equipment tested.
 - c. Description of tests.
 - d. Test data.
 - e. Analysis and recommendations
 2. Test and inspection data records shall include the following minimum requirements:
 - a. Identification of the testing organization.
 - b. Equipment identification.
 - c. Humidity, temperature, and other conditions that may affect the results of the tests/calibrations.
 - d. Date of inspections, tests, maintenance, and/or calibrations.
 - e. Identification of the testing technician.
 - f. Indication of inspections, tests, maintenance, and/or calibrations to be performed and recorded.
 - g. Indication of the expected results when calibrations are to be performed.
 - h. Indication of "as-found" and "as-left" results, as applicable.
 - i. Sufficient spaces to allow all results and comments to be indicated.
 3. The testing organization shall furnish a copy or copies of the complete report as specified in the maintenance testing contract.

3.7 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

END OF SECTION 26 28 16

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SECTION 26 51 19 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. LED luminaires:
 - 1. Reference drawings and fixture schedule for types of LED luminaires and additional information.
- B. Related Requirements:
 - 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 - 6. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The

adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.

- a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which equipment and/or luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:
 - a. Other luminaires.
 - b. Air outlets and inlets.
7. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Product Certificates: For each type of luminaire.

D. Product Test Reports: For each type of luminaire, for tests performed a qualified testing agency.

E. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. LED boards/Strips/Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.
 - 4. LED drivers: Ten for every 100 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.
- C. Warrant lamps for 5 year period for all LED lamp applications. Upon lamp failure, before the end of the 5 year period, contractor shall replace lamp and provide labor during the warranty coverage.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Ambient Temperature: 41 to 104 deg F.
 - 1. Relative Humidity: Zero to 95 percent.
- B. Altitude: Sea level to 1000 feet.

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI.
- C. Recessed luminaires shall comply with NEMA LE 4.

2.3 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. **Lithonia**
- 2. **Cooper**
- 3. **Cree**
- 4. **Philips**

2.4 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Steel:
 - 1. ASTM A36/A36M for carbon structural steel.
 - 2. ASTM A568/A568M for sheet steel.
- C. Stainless Steel:
 - 1. 1. Manufacturer's standard grade.

2. 2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

2.5 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

A. Comply with NECA 1.

- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaires:
 - 1. Secured to outlet box.
 - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - 3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaires:
 - 1. Do not attach luminaires directly to gypsum board.
- G. Ceiling-Grid-Mounted Luminaires:
 - 1. Secure to any required outlet box.
 - 2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
 - 3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.
- H. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 26 51 19

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SECTION 284621.13
EXISTING FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Related Requirements:

1. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for cables and conductors for fire-alarm systems.

1.2 DEFINITIONS

- A. EMT: Electrical Metallic Tubing.
- B. FACP: Fire Alarm Control Panel.
- C. NICET: National Institute for Certification in Engineering Technologies.

1.3 ACTION SUBMITTALS

A. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified fire-alarm technician; **Level III** minimum.
 - c. Licensed or certified by authorities having jurisdiction.

B. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, and profiles and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

C. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery size calculations.
7. Include input/output matrix.

8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Include floor plans to indicate final outlet locations showing zone designation of each device. Show size and route of cable and conduits and point-to-point wiring diagrams.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
 1. In addition to items specified in General Specifications include the following and deliver copies to authorities having jurisdiction:
 - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide the "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 - c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
 - d. Riser diagram.
 - e. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
 - f. Record copy of site-specific software.
 - g. Provide the "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
 - h. Manufacturer's required maintenance related to system warranty requirements.
 - i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

2. Installation shall be by personnel certified by NICET as fire-alarm **Level III** minimum technician.

B. NFPA Certification:

1. Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).
2. Obtain certification according to NFPA 72 by a UL-listed alarm company.
3. Obtain certification according to NFPA 72 in the form of a placard by an FM Global-approved alarm company.

1.7 PROJECT CONDITIONS

- A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.
- B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
 1. Notify Architect, Construction Manager and Owner no fewer than seven days in advance of proposed interruption of fire-alarm service.
 2. Do not proceed with interruption of fire-alarm service without Architect, Construction Manager and Owner written permission.
- C. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.8 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.
- B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with and operate as an extension of existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.
- B. Noncoded system dedicated to fire-alarm service only.
- C. All components provided shall be listed for use with the selected system.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Existing Fire Alarm System: Simplex, a Johnson Controls Brand.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Provide a complete and operable extension/completion to the existing fire alarm system, in accordance with the state building code and NFPA 72. Contractor shall field verify prior to bid, existing fire alarm system type, completion, capacity and expansion capability/limitation of adding new indicated devices. Contractor to provide upgrades as required to accommodate relocation of existing devices and addition of new devices compatible with existing fire alarm system and of similar type model as existing devices, candela and DB rating per NFPA 72. Any addition/extension/completion to the system shall be complete with individually similar type to existing initiating devices, manual stations at perimeter doors, audio-visual signals, photo-electric smoke detectors at selected locations and air handling equipment. All fire alarm wiring shall be provided per the manufacturers recommendations. All horizontal cabling shall be supported per NEC. Provide 3/4" conduit from junction box with pull string and insulated bushing stubbed above an accessible ceiling or joist space for each new device. Provide all cards, modules, relays, programming and start-up.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF EQUIPMENT

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
- B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
 - 1. Connect new equipment to the existing control panel in the existing part of the building.
 - 2. Connect new equipment to the existing monitoring equipment at the supervising station.
 - 3. Expand, modify, and supplement the existing control or monitoring equipment as necessary to extend the existing control or monitoring functions to the new points. New components shall be capable of merging with the existing configuration without degrading the performance of either system.
- C. Manual Fire-Alarm Boxes:
 - 1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
 - 2. Mount manual fire-alarm box on a background of a contrasting color.
 - 3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- D. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.
- E. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.
- F. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS

- A. Pathways above recessed ceilings and in accessible locations may be routed exposed.
 - 1. Exposed pathways located less than 96 inches above the floor shall be installed in EMT.
- B. Pathways shall be installed in EMT.
- C. Exposed EMT shall be painted red enamel.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.5 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.6 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Visual Inspection: Conduct the visual inspection prior to testing.
 - a. Inspection shall be based on completed record Drawings and system documentation that is required by NFPA 72 in Chapter 10 "Fundamentals," Section 10.18.21 "Completion Documents, Preparation."
 - b. Comply with NFPA 72, Chapter 14, "Inspection, Testing, and Maintenance," Section 14.3, "Inspection" and the "Visual Inspection Frequencies" Table; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with NFPA 72, Chapter 14, "Inspection, Testing, and Maintenance," Section 14.4 "Testing" and the "Test Methods" Table.
 - 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 - 4. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 - 5. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with the visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.7 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 3. Perform tests listed in the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel as well as others selected by Owner to adjust, operate, and maintain fire-alarm system.

END OF SECTION 28 46 21.13

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SECTION 23 05 11 - BASIC MECHANICAL SYSTEM REQUIREMENTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section and the other sections of Division 23.

1.2 SUMMARY

- A. This Section includes general administrative and procedural requirements for mechanical installation. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
 - 1. Maintenance manuals.
 - 2. Coordination drawings.
 - 3. Record (As-Built) documents.
 - 4. Contract documents.
 - 5. Vérification.
 - 6. Product Substitutions.
 - 8. Rough-in requirements.
 - 9. Mechanical installations.
 - 10. Cutting and patching.
 - 11. Removals

1.3 MAINTENANCE MANUALS

- A. Prepare operation and maintenance manual; include the following information for equipment items:
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 2. Manufacturer's operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 - 4. Servicing instructions and lubrication charts and schedules.

1.5 COORDINATION DRAWINGS

- A. Contractor shall prepare coordination drawings for refrigerant piping, equipment, routing of piping as required. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the work. Include the following:
 - 1. Planned piping layout, including valve and specialty locations and valve-stem movement.
 - 2. Clearances for installing and maintaining insulation.

3. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
4. Equipment and accessory service connections and support details.
5. Sizes and location of required concrete pads and bases.
6. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
7. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

1.6 RECORD (AS-BUILT) DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 01. In addition to the requirements specified in Division 01, indicate the following installed conditions:
 1. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Division 23 Section "Identification for Piping & Equipment." Indicate actual inverts and horizontal locations of underground piping.
 2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
 4. Contract Modifications, actual equipment and materials installed.

1.7 CONTRACT DRAWINGS

- A. In general, drawings are schematic in nature and are intended as a guide to the Contractor, but do not necessarily show all details, offsets, etc. All drawings are to be thoroughly inspected.
- B. The Contractor's work shall conform to the information contained in this Specification and/or as indicated in the latest revision of the drawings referred to therein. The Contractor shall consult with the Engineer regarding all questions on which he may be in doubt before proceeding with fabrication of parts affected. The Contractor shall prepare all additional detail or field installation drawings necessary at his own expense. The Contractor shall verify all dimensions and conditions indicated on the Engineer's layout drawings and determine if any changes are required in conduits, piping runs, drains, ducts, etc., to avoid interference. Major changes shall not be made without the approval of the Engineer.
- C. While the drawings are to be adhered to as closely as possible, the Contractor has the right to vary the run of conduits, piping and/or ducts during progress of the work as may be found necessary or desirable to avoid interferences. Major revisions shall be verified with the Engineer.

1.8 VERIFICATION

- A. Before running any conduits, ducts, piping, etc., within the building, this Contractor shall field verify all existing conditions and existing in place items. Contractor shall assure himself that they can be installed as contemplated without trapping or interfering with columns, beams, piping, fixtures, etc. Any necessary major deviation shall be referred to the Engineer for adjustment before lines are run, at no increase in contract price.
- B. Of necessity, openings, supporting steel, field-built curbs, electrical data, space requirements, etc., were designed around specific parameters. When the Contractor determines the make of equipment to be provided for the job, it shall be his responsibility to verify and coordinate unit

dimensions with all other sub-contractors on the job. It shall also become the Contractor's responsibility to change as necessary, through the Engineer, all required dimensions so that openings, supporting steel, curbs, electrical data, etc., will fit the equipment supplied. Any additional cost will be the sole responsibility of this Contractor.

- C. In addition, electrical power, interlock and control diagrams and piping arrangements were designed around one specific manufacturer. If additional wiring, piping controls, etc., are required for other equipment, this Contractor shall include the cost of same in his price.
- D. Dimensions, elevations and relative locations of existing equipment, sewers, pipes, ducts, conduits, etc., in place as shown on the drawings, are taken from asbuilt and record drawings and are deemed reliable only insofar as general layout is concerned. Such dimensions shall not be used for layout drawings nor detailing of components. The responsibility for checking in place items will be the Contractors. All measurements, the exact determination of relative elevations or locations, the ascertaining of accuracy of all given elevations and dimensions and the obtaining of all necessary additional information to insure the proper fit and coordination of all conduit equipment, ducts, and piping shall be the responsibility of the Contractor.\

1.9 PRODUCT SUBSTITUTIONS

- A. The manufacturers listed in the equipment schedules are included as a basis of design. Submission of alternate manufacturers of similar equipment is subject to engineer approval. Units of equipment, other than those listed as the basis of design, must be proven to be physically acceptable, in addition to meeting all performance and equipment specifications. Liability of non-conformance shall lie with the Contractor/Submitter. Bidders desiring consideration for the use of material, equipment, etc. not named in the Specifications may submit in writing, at least seven (7) days prior to bid opening, the change including the specifications and description to the Architect for review and if approved, the change will be issued in an addendum at least four (4) days prior to the opening of bids.

PART 2 – PRODUCTS

2.1 NOT APPLICABLE

PART 3 – EXECUTION

3.2 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

3.3 MECHANICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
 1. Coordinate mechanical systems, equipment, and materials installation with other building components. Verify all dimensions by field measurements.
 2. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
 3. Coordinate the installation of required supporting devices, sleeves and other structural components, as they are constructed.

4. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 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. 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 mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnection, with minimum of interference with other installations. Extend grease fittings to an accessible location. Install access panel or doors where units are concealed behind finished surfaces.
 8. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
 9. Electrical requirements for mechanical equipment shall conform to the schedules indicated on the mechanical plans. Where such information is not included, this contractor shall coordinate the electrical requirements (i.e. voltage, phase, starter requirements, etc.) with those shown on the electrical drawings. If motors or equipment furnished hereunder, require more or larger starters, more or larger branch circuits, additional disconnects, etc., from that indicated on the mechanical drawings or specified herein, this contractor shall reimburse the Electrical Contractor for the cost differential he incurs. It is the responsibility of each contractor furnishing motors, to advise the Electrical Contractor of the exact function of the supplied systems to assure proper operation.
- 3.4 CUTTING AND PATCHING: Perform cutting, fittings, and patching of mechanical equipment and materials required to install equipment and materials in existing structure. Cut, remove and legally dispose of components and materials made obsolete by the new work. Protect the structure, furnishings, finishes, and patching. Patch existing finished surfaces and building components using new materials (which match adjacent materials) and utilize experienced installers.
- 3.5 REMOVALS: Contractor to perform all removals indicated in contract documents. The owner has the option to retain all equipment and/ or materials removed. All other materials not claimed by the owner or reused shall be removed from the site by the mechanical contractor.

END OF SECTION 23 05 11

SECTION 23 05 12 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information that require Architect/Engineer's responsive action.
- B. Informational Submittals: Written and graphic information that do not require Architect/Engineer's responsive action. Submittals may be rejected for not complying with requirements.

1.3 ACTION SUBMITTALS

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

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect/Engineer's Digital Data Files: Electronic copies of digital data files of the Contract Drawings will be provided by Architect/Engineer for Contractor's use in preparing submittals.
 - 1. Architect/Engineer will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings.
 - a. Architect/Engineer makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
- 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. Architect/Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect/Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 14 days for review of each resubmittal.
- D. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Stamp shall include project name, location, specification section, 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.
- E. Paper Submittals: Place a permanent label or title block on each submittal item for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect/Engineer.
 3. Include the following information for processing and recording action taken:
 - a. Project name and Date.
 - b. Name of Architect/Engineer.
 - c. Name of Contractor.
 - d. Name of subcontractor.
 - e. Name of supplier.
 - f. Name of manufacturer.
 - g. Number and title of appropriate Specification Section.
 - h. Drawing number and detail references, as appropriate.
 - i. Location(s) where product is to be installed, as appropriate.
 - j. Other necessary identification.
 4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect/Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
 5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect/Engineer will return, without review, submittals received from sources other than Contractor.
- F. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect/Engineer.
 4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Architect/Engineer, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect/Engineer.
 - d. Name of Contractor.
 - e. Name of firm or entity that prepared submittal.
 - f. Names of subcontractor, manufacturer, and supplier.
 - g. Category and type of submittal.
 - h. Submittal purpose and description.
 - i. Specification Section number and title.
 - j. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.

- m. Related physical samples submitted directly.
 - n. Indication of full or partial submittal.
 - o. Other necessary identification.
 - p. Remarks.
- G. Options: Identify options requiring selection by Architect/Engineer.
- H. Deviations: Identify deviations from the Contract Documents on submittals.
- I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked with authorization notation from Architect/Engineer's action stamp.
 - 4. Resubmittal Limitation Requirements: The Architect/Engineer will provide time to review the original submittal and ONE resubmittal. If resubmittals are required pursuant to the first resubmittal, the Architect/Engineer's time for these services will be paid by the Contractor. The charges for this time will be back-charged from the Contractor as a change-order through this project's contract. These charges will be based upon the Architect/Engineering standard hourly rates (i.e. Engineer @ \$125.00/hr, etc.).
- J. 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.
- K. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with authorization notation from Architect/Engineer's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements:
 - 1. Issue electronic submittals as PDF electronic files directly to Architect/Engineer's e-mail address.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts and Manufacturer's product specifications.
 - b. Standard color charts.
 - c. Statement of compliance with specified referenced standards.
 - d. Testing by recognized testing agency.
 - e. Application of testing agency labels and seals.
 - f. Notation of coordination requirements.
 - g. Availability and delivery time information.
 - 4. For equipment, include the following in addition to the above, as applicable:

- a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data in the PDF electronic file format.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. 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 24 by 36 inches.
 3. Submit Shop Drawings in the PDF electronic file format.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Submit product schedule in PDF electronic file format.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- G. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- H. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- I. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- J. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- K. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- L. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

- M. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.
- N. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- O. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- P. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- Q. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect/Engineer.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT/ENGINEER'S ACTION

- A. General: Architect/Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action and Informational Submittals: Architect/Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect/Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
 - 1. Architect/Engineer's Review Status:
 - a. No Exceptions Taken
 - b. Exceptions Taken As Noted
 - c. Resubmit
 - d. Rejected
 - 2. Action Required of Contractor:
 - a. Process
 - b. Resubmit

- C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 23 05 12

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- C. Description: NEMA MG 1, Design B, medium induction motor.
- D. Efficiency: Premium efficient, as defined in NEMA MG 1.
- E. Service Factor: 1.15.

- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.3 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
 - 2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.4 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.

- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 05 13

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SECTION 23 05 17 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Sleeves.
- 2. Grout.
- 3. Silicone sealants.

- B. Related Requirements:

- 1. Section 07 84 13 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
- B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, anti-corrosion coated or zinc coated, with plain ends and integral welded waterstop collar.
- C. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- D. PVC Pipe Sleeves: ASTM D1785, Schedule 40.

- E. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 GROUT

- A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.3 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, use NT.
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 07 84 13 "Penetration Firestopping."

3.2 FIELD QUALITY CONTROL

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

END OF SECTION 23 0517

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SECTION 23 05_18 - ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.

1.3 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Insulated Piping: One-piece stainless steel with polished stainless-steel finish.

3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 23 05 18

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment stands.
8. Equipment supports.

- B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 23 31 13 "Metal Ducts" for duct hangers and supports.

1.3 ACTION SUBMITTALS

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

- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

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

2.2 TRAPEZE PIPE HANGERS

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

2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. B-line, an Eaton business.
 - b. G-Strut.
 - c. Thomas & Betts Corporation; A Member of the ABB Group.
 - d. Unistrut; Part of Atkore International.
 - 2. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
 - 3. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 4. Channels: Continuous slotted carbon-steel channel with inturred lips.
 - 5. Channel Width: Selected for applicable load criteria.

6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel.
8. Metallic Coating: Pregalvanized G90.
9. Paint Coating: Green epoxy, acrylic, or urethane.
10. Plastic Coating: PVC.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Carpenter & Paterson, Inc.
 2. Pipe Shields Inc.
 3. Rilco Manufacturing Co., Inc.
 4. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psi ASTM C552, Type II cellular glass with 100-psi minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - c. MKT Fastening, LLC.
 - d. Simpson Strong-Tie Co., Inc.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. B-line, an Eaton business.
 - b. Empire Tool and Manufacturing Co., Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - e. MKT Fastening, LLC.
2. Indoor Applications: Zinc-coated or stainless steel.
 3. Outdoor Applications: Stainless steel.

2.6 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIRO Industries.
 - b. PHP Systems/Design.
 - c. RectorSeal HVAC; a CSW Industrials Company.
 - d. Rooftop Support Systems, a division of Eberl Iron Works, Inc.
 2. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
 3. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
 4. Hardware: Galvanized steel or polycarbonate.
 5. Accessories: Protection pads.
- C. Low-Profile, Single Base, Single-Pipe Stand:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIRO Industries.
 - b. PHP Systems/Design.
 - c. Rooftop Support Systems, a division of Eberl Iron Works, Inc.
 2. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
 3. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
 4. Vertical Members: Two, stainless-steel, continuous-thread 1/2-inch rods.
 5. Horizontal Member: Adjustable horizontal, stainless-steel pipe support channels.
 6. Pipe Supports: Roller.
 7. Hardware: Stainless steel.
 8. Accessories: Protection pads.
- D. High-Profile, Single Base, Single-Pipe Stand:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIRO Industries.

- b. PHP Systems/Design.
 - c. Rooftop Support Systems, a division of Eberl Iron Works, Inc.
 2. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 3. Base: Single vulcanized rubber or molded polypropylene.
 4. Vertical Members: Two, stainless-steel, continuous-thread 1/2-inch rods.
 5. Horizontal Member: One, adjustable height, stainless-steel pipe support slotted channel or plate.
 6. Pipe Supports: Roller.
 7. Hardware: Stainless steel.
- E. High-Profile, Multiple-Pipe Stand:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIRO Industries.
 - b. PHP Systems/Design.
 - c. RectorSeal HVAC; a CSW Industrials Company.
 - d. Rooftop Support Systems, a division of Eberl Iron Works, Inc.
 2. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 3. Bases: Two or more; molded polypropylene.
 4. Vertical Members: Two or more, galvanized-steel channels.
 5. Horizontal Members: One or more, adjustable height, galvanized-steel pipe support.
 6. Pipe Supports: Clevis hanger.
 7. Hardware: Galvanized steel.
 8. Accessories: Protection pads, 1/2-inch continuous-thread rod.
 9. Height: 36 inches above roof.

2.7 EQUIPMENT SUPPORTS

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

2.8 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.

- F. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in **Section 07-8413** "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.
- E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- F. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See **Section 07-7200** "Roof Accessories" for curbs.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- O. Insulated Piping:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

- b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

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

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

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

- B. Touchup: Comply with requirements in **Section 09-9113** "Exterior Painting" **Section 09-9123** "Interior Painting" and Section **09-9600** "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use stainless steel pipe hangers and fiberglass pipe hangers and fiberglass strut systems and stainless steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

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

7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 23 05 29

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Pipe labels.
 - 3. Duct labels.
 - 4. Stencils.
 - 5. Valve tags.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Red.
 - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for

- greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- 6. Fasteners: Stainless-steel rivets or self-tapping screws.
- 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

- 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- 2. Letter Color: White.
- 3. Background Color: Red White.
- 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- 7. Fasteners: Stainless-steel rivets or self-tapping screws.
- 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.3 STENCILS

A. Stencils for Piping:

- 1. Lettering Size: Size letters according to ASME A13.1 for piping.
- 2. Stencil Material: Aluminum.
- 3. Stencil Paint: Exterior, gloss, acrylic enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
- 4. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

B. Stencils for Ducts:

- 1. Lettering Size: Minimum letter height of 1-1/4 inches for viewing distances up to 15 feet and proportionately larger lettering for greater viewing distances.

2. Stencil Material: Aluminum.
 3. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
 4. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.
- C. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:
1. Lettering Size: Minimum letter height of 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
 2. Stencil Material: Aluminum.
 3. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
 4. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.
 5. .

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 GENERAL INSTALLATION REQUIREMENTS

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

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

- A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
 1. Identification Paint: Use for contrasting background.
 2. Stencil Paint: Use for pipe marking.
- B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:

1. Chilled-Water Piping: White letters on a safety-green background.
2. Heating Water Piping: White letters on a safety-green background Black letters on a safety-orange background.
3. Refrigerant Piping: White letters on a safety-purple background.

DUCT END OF SECTION 23 05 53

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SECTION 23 06 00 – COMMISSIONING & CLOSE-OUT

GENERAL

1.1 SUMMARY

- A. Section includes commissioning process requirements for all HVAC systems, assemblies, and equipment.

1.2 DEFINITIONS

- A. Commissioning & Close-out Plan: A document, prepared by this mechanical contractor, which outlines the organization, schedule, allocation of resources, and documentation requirements of the contractor's commissioning & close-out process.
- B. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.
- C. Certify: Attest authoritatively and present formal documentation that the contractor has witnessed said item and said item has met the criteria indicated in the contract documents. Contractor's company letter head insignia and signature shall be evident on all certifications.

1.3 INFORMATIONAL SUBMITTALS

- A. Certificates of completion of installation, prestart, and startup activities.

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning & close-out procedures as noted herein.
- B. Attend construction phase controls coordination meeting as required.
- C. Organize pre-construction testing, adjusting, and balancing review and coordination meeting.
- D. Organize testing, adjusting, and balancing review and coordination meeting.
- E. Organize heating hot water systems, assemblies, equipment, and component maintenance orientation and inspections.
- F. Provide information and prepare the final commissioning documentation.
- G. Provide measuring instruments and logging devices to record test data and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.5 COMMISSIONING & CLOSE-OUT DOCUMENTATION

- A. Provide the following information in the commissioning and close-out plan:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
 - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.

3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for heating hot water systems, assemblies, equipment, and components to be verified and closed-out.
4. Certificate of readiness, signed by the Contractor, certifying that heating hot water systems, assemblies, equipment, components, and associated controls are ready for close-out.
5. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
6. Certificate of readiness certifying that heating hot water systems, subsystems, equipment, and associated controls are ready for close-out.
7. Test and inspection reports and certificates.
8. Corrective action documents.
9. Verification of testing, adjusting, and balancing reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

- A. Contractor shall Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- B. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- C. Inspect and verify the position of each device and interlock identified on the contractor's checklists.
- D. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

3.2 TESTING AND BALANCING VERIFICATION

- A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the Architect/Engineer.
- B. Notify the Architect/Engineer at least 10 days in advance of testing and balancing Work. A contractor's representative is required to be in attendance to witness testing and balancing Work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of heating hot water systems.
 1. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 2. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report.
 3. Remedy the deficiency and notify the architect so verification of failed portions can be performed.

3.3 GENERAL CLOSE-OUT REQUIREMENTS

- A. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- B. The Contractor, along with his Subcontractors, testing and balancing Subcontractor, and Instrumentation and Control Subcontractor shall prepare testing plans, procedures, and checklists for heating hot water systems, subsystems, and equipment.
- C. Tests will be performed using design conditions whenever possible.
- D. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Set simulated conditions and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- E. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- F. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

END OF SECTION 23 06 00

SECTION 23 0719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulation for HVAC piping systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.
 - 1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
 - 2. Sheet Form Insulation Materials: 12 inches square.
 - 3. Jacket Materials for Pipe: 12 inches long by NPS 2.
 - 4. Sheet Jacket Materials: 12 inches square.
 - 5. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. 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 and test methods employed.

- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in **Section 23-0529** "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
 - 1. Preformed Pipe Insulation: Type II, Class 1, without jacket.
 - 2. Preformed Pipe Insulation: Type II, Class 2, with factory-applied ASJ jacket.
 - 3. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
 - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials, Type II for sheet materials.
- H. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.
 - 1. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ.
 - 2. 850 deg F.
 - 3. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
 - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Mineral-Fiber, Pipe and Tank: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C1393.
 - 1. Semirigid board material with factory-applied ASJ jacket.
 - 2. Nominal density is 2.5 lb/cu. ft. or more.
 - 3. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less.
 - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Adhesive: As recommended by jacket material manufacturer.
 2. Color: White.
 3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.3 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Width: 3 inches.
 2. Thickness: 11.5 mils.
 3. Adhesion: 90 ounces force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch in width.
 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
1. Width: 3 inches.
 2. Thickness: 6.5 mils.
 3. Adhesion: 90 ounces force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch in width.
 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.4 SECUREMENTS

- A. Bands:
1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch 3/4 inch wide with wing seal or closed seal.
 2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch 3/4 inch wide with wing seal or closed seal.
 3. Springs: Twin spring set constructed of stainless steel, with ends flat and slotted to accept metal bands. Spring size is determined by manufacturer for application.
- B. Staples: Outward-clinching insulation staples, nominal 3/4 inch wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy 0.062-inch soft-annealed, stainless steel 0.062-inch soft-annealed, galvanized steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install 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. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
 - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install 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 2 inches 4 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in **Section 07-8413 "Penetration Firestopping"** for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in **Section 07-8413 "Penetration Firestopping."**

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges, mechanical couplings, and unions using a section of oversized preformed pipe insulation to fit. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least two (2) times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in **Section 09-9113** "Exterior Painting" and **Section 09-9123** "Interior Painting."
 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

3.7 FIELD QUALITY CONTROL

- A. All insulation applications will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

3.8 PIPING INSULATION SCHEDULE, GENERAL

- A. Insulation conductivity and thickness per pipe size shall comply with Pipe material Construction & Insulation Schedule located on the contract documents or with requirements of authorities having jurisdiction, whichever is more stringent.

- B. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

- C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Underground piping.
 - 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

END OF SECTION 23 0719

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SECTION 23 08 00 – TEMPERATURE CONTROL SYSTEM (TCS)

PART 1 – GENERAL

1.1 SUMMARY

- A. Furnish all labor, materials, equipment, and service necessary for a complete and operating Temperature Control System (TCS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only.
- B. All labor, material, equipment and software not specifically referred to herein or on the plans, that are required to meet the functional intent of this specification, shall be provided without additional cost to the Owner.

1.2 SYSTEM DESCRIPTION

- A. The entire Temperature Control System (TCS) shall be comprised of a network of OPEN PROTOCOL, interoperable, stand-alone digital controllers via LonMark/LonTalk communication protocol to a Universal Network Controller (UNC).
- B. Drawings of temperature control systems are diagrammatic only and any apparatus not shown, such as relays, accessories, etc., but required to make the system operative to the complete satisfaction of the Architect shall be furnished and installed without additional cost.

1.3 MANUFACTURERS

- A. Automated Logic Installed by CSO (419) 887-1611
- B. Engineer Approved Equal

1.4 INSTALLER REQUIREMENTS

- A. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the temperature control system manufacturer or its exclusive factory authorized installing contracting field office (representative).
- B. The installing office shall have a minimum of five years of installation experience with the manufacturer and shall provide documentation in submittal package verifying longevity of the installing company's relationship with the manufacturer. Supervision, calibration and checkout of the system shall be by the employees of the local exclusive factory authorized temperature control contracting field office (branch or representative). Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.

1.5 SUBMITTALS

- A. Refer to Section 230512 "Submittal Procedures for requirements.
- B. Shop drawing submittals shall consist of a complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions. Shop drawings shall also contain complete wiring and schematic diagrams, software descriptions, calculations, and any

other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings. A complete written Sequence of Operation shall also be included with the submittal package.

- C. Submittal shall also include a complete point list of all connected points to the DDC system in the format as indicated in the temperature control system diagrams located on the drawings.
- D. Upon completion of the work, provide a complete set of 'as-built' drawings and application software on magnetic floppy disk media or compact disk. Three (3) copies of the 'as-built' drawings and block-style software programming sheets shall be provided in addition to the documents on compact disk.

1.5 RELATED WORK SPECIFIED ELSEWHERE

- A. Refer to Section 230600 "Commissioning & Close-out" for requirements associated with project close-out.
- B. Division 26 Electrical:
 - 1. Providing motor starters and disconnect switches (unless otherwise noted).
 - 2. Provision, installation and wiring of smoke detectors (unless otherwise noted).

1.7 AGENCY AND CODE APPROVALS

- A. All products of the FMCS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided with the submittal package. Systems or products not currently offering the following approvals are not acceptable.
 - 1. UL-916; Energy Management Systems
 - 2. FCC, Part 15, Subpart J, Class A computing Devices

1.8 SOFTWARE LICENSE AGREEMENT

- A. The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets within such software.

1.9 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. Store equipment and materials inside and protected from weather.

1.10 JOB CONDITIONS

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to insure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers, and structural and architectural features.

1.11 QUALITY ASSURANCE

- A. The manufacturer of the TCC digital controllers shall provide documentation supporting compliance with ISO-9001 (Model for Quality Assurance in Design/Development, Production, Installation and Servicing). Product literature provided by the TCSC digital controller manufacturer shall contain the ISO-9001 Certification Mark from the applicable registrar.

1.12 SPECIFICATION NOMENCLATURE

- A. Acronyms used in this specification are as follows:

FMCS	Facility Management and Control System
TCS	Temperature Control System
UNC	Universal Network Controller
IDC	Interoperable Digital Controller
IBC	Interoperable BACnet Controller
GUI	Graphical User Interface
WBI	Web Browser Interface
POT	Portable Operator's Terminal
PMI	Power Measurement Interface
DDC	Direct Digital Controls
LAN	Local Area Network
WAN	Wide Area Network
OOT	Object Oriented Technology
PICS	Product Interoperability Compliance Statement

PART 2 – MATERIALS

2.1 GENERAL

- A. The temperature Control System (TCS) shall be comprised of a network of OPEN PROTOCOL, interoperable, stand-alone digital controllers and other devices as specified herein.

2.2 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate both the ANSI/ASHRAE Standard 135-1995 BACnet and LonWorks technology communication protocols.
- B. Controller and System HVAC Applications if documented by the specified sequence of operations.
 1. Load Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, occupied/unoccupied setback/setup, DDC with PID and trend logging.
 2. Boiler Control Programs: Boiler plant optimization with hot water reset, boiler and pump equipment selection and sequencing.
 3. Programming Application Features: Trend point, alarm reporting, alarm lockout, weekly scheduling, staggered start, sequencing, anti-short cycling and calculated point.

2.3 INTEROPERABLE DIGITAL CONTROLLER (IDC)

- A. Controls shall be microprocessor based Interoperable LonMark™ or LonWorks Controllers (IDC). Where possible, all Interoperable Digital Controllers shall bear the applicable LonMark™

interoperability logo on each product delivered. Temperature controllers must be capable of custom programming; configuration only controllers are not acceptable.

- B. Custom Application Control Units: Modular, comprising processor board with programmable, nonvolatile, RAM/EEPROM memory for custom control applications. CAC's shall be provided for Air-Handling Units, boiler Plant, Chiller Plant and other applications as shown on drawings and shall have published LonWorks™ application source code, device resource files and external interface definitions.
1. Units monitor or control each input/output point: process information; and least 50 expressions for customized HVAC control including mathematical equations, Boolean logic, PID control loops with anti-windup, sequencers, timers, interlocks, thermostats, enthalpy calculation, counters, interlocks, ramps, drivers, schedules, calendars, OSS, compare, limit, curve fit, and alarms.
 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Peer to peer primary network level communications supporting at least 200 LonMark™ Standard Network Variables (SNVTs) per CAC utilizing at least 100 different SNCT types as documented by the LonMark™ devices. The 200 LonMark™ SNVTs, minimum, must be configurable in any combination – all inputs or all outputs or any combination of input/outputs in any combination of the 100 different, minimum, SNVT types. The XIF SNVT order shall be definable, rather than random, to provide logical and effective LonMark™ network management. With the submittal package, contractor shall provide CAC performance data that specifies the exact maximum number of SNVTs available in any combination and a list of all available SNVT types including the LonMark™ Interoperability Association SNVT number.
 - b. Automatic communications loss detection to maintain normal control functionally regardless of available network communications.
 - c. Discrete/digital, analog and pulse input/outputs.
 - d. Monitoring, controlling, or addressing data points.
 - e. Local energy management control strategies.
 3. Incorporate internal customizable safeties and limits to prevent third party LonMark™ tools from providing improper and unrealistic inputs to CAC's. Local operator interface port provides for download from and connection to portable workstation.
 4. Communication: The Custom Application Controller shall communicate via the Primary Controller Network between BMS Controllers and other LonWorks™ devices. CAC's shall communicate with the Building Controller and ASC's at a baud rate of not less than 78.8K baud using LonTalk™ communications protocol (EIA 790.1).
- C. HVAC control shall be accomplished using LonMark™ based devices where the application has a LonMark profile defined. Where LonMark devices are not available for a particular application, devices based on LonWorks shall be acceptable.
- D. All IDCs shall be fully application programmable and shall at all times maintain their LonMark certification, if so certified. Controllers offering application selection only (non-programmable) are NOT acceptable. All control sequences within or programmed into the IDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.
- E. The contractor supplying the IDC's shall provide documentation for each device, with the following information at a minimum:
1. Network Variable Inputs (nvi's); name and type
 2. Network Variable Outputs (nvo's); name and type

3. Network configuration parameters (nci, nco); name and type

- F. It is the responsibility of the Division 15395 contractor to ensure that the proper Network Variable Inputs and Outputs (nvi and nvo) are provided in each IDC, as required by the point charts.
- G. The TCS contractor shall supply one copy of the software used for control system access and programming to the owner. The contractor shall install the software on a laptop computer supplied by the owner. Any required cables for connection between the laptop computer and the IDCs shall be supplied by the contractor. The contractor shall provide a means of viewing all points, overriding or commanding inputs and outputs, changing set points, and changing schedules for all systems using the laptop computer. Graphics are not required for each system, but at a minimum, a points list shall be programmed in an organized manner for each system. Point names matching the submittal point names shall be used in the points list.

2.4 OTHER CONTROL SYSTEM HARDWARE

- A. Local Control Panels: Unitized NEMA 1 cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels.
 - 1. Fabricate panels of 0.06-inch thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.
 - 2. Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL Listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection, on all input/output name abbreviations shall be individually identified using a labeler, per control drawings, documents and the system interface. These labels shall be affixed to the cable at the control panel terminations as well as the field device termination.
 - 3. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper-positioning switches, thermometers, and gages.
 - 4. Provided ON/OFF power switch with over-current protection for control power sources to each local panel.
- B. Sensors:
 - 1. Electronic Temperature Sensors: Vibration and corrosion resistant; for wall, immersion, or pipe mounting as required.
 - 2. Resistance Temperature Detectors: Platinum, thermistor, or balco.
 - a. Accuracy: Plus or minus 0.2 percent at calibration point; thermistors shall have a maximum 5 year drift of no more than 0.225°F maximum error of no more than 0.36°F.
 - b. Wire: Twisted, shielded-pair cable.
 - c. Insertion Elements in Ducts: Single point, 6 inches long; use where not affected by temperature stratification or where ducts are smaller than 4 sq. ft.
 - d. Averaging Elements in Ducts: 60 inches, long, flexible for use where prone to temperature stratification or where ducts are larger than 4 sq. ft.; 264 inches long, flexible for use, where prone temperature stratification or where ducts are larger than 16 sq. ft.; length as required.
 - e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2½ inches.
 - f. Outside-Air Sensors: Watertight inlet fitting, shielding from direct sunlight.

- g. Room Security Sensors: Stainless steel cover plate with insulated back and security screws.
 - 3. Pressure Transmitters: Direct acting for liquid service; range suitable for system; proportional output 4 to 20 mA.
- C. Equipment operation sensors as follows:
 - 1. Status Inputs for Pumps: Differential-pressure switch piped across pump with adjustable pressure-differential range of 8 to 60 psig.
 - 2. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable trip point, split core with an integral LED for trip indication and set to 175 percent of rated motor current.
- D. Electronic Valve Position Indication: Visual scale indicating percent of travel and 2 to 10-V dc, feedback signal.
- E. Water-Flow Switches: Pressure-flow switches of bellows actuated mercury or snap-acting type, with appropriate scale range and differential adjustment, with stainless steel or bronze paddle. For chilled water applications, provide vapor proof type.
- F. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater.
- G. Line-Voltage, ON-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual on-off-auto selector switch.
 - 1. Equip thermostats, which control electric heating loads directly, with off position on dial wired to break underground conductors.
 - 2. Dead Band: Maximum 2°F.
- H. Remote-Bulb Thermostats: On-Off or modulating type, liquid filled to compensate for changes in ambient temperature, with copper capillary and bulb, unless otherwise indicated.
 - 1. Bulbs in water lines with separate wells of same material as bulb.
 - 2. Bulbs in air ducts with flanges and shields.
 - 3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit, adequately supported.
 - 4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
 - 5. On-Off Thermostat: With precision snap switches, with electrical ratings required by application.
 - 6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- I. Room Thermostat Cover Construction:
 - 1. Set-Point Adjustment: Concealed or exposed
 - 2. Set-Point Indication: Concealed or exposed
 - 3. Thermometer: Optional
 - 4. Color: Neutral
 - 5. Orientation: Vertical or horizontal
- J. Room thermostat accessories include the following:
 - 1. Insulating Bases: For thermostats located on exterior walls.
 - 2. Thermostat Guards: As specified in tamper prone areas.
 - 3. Adjusting Key: As required for calibration and cover screws.

4. Set-Point adjustment: 1/2 –inch diameter, adjustment knob.

2.5 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth, modulating action or two-position action under all environmental conditions (temperature, low power voltage fluctuations, tight seal damper design, maximum air and water flow forces).
 1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 2. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2": Size for running torque of 150 in x lbf and breakaway torque of 300 in. x lbf.
 3. Spring-Return Motors for Valves Larger Than NPS 2-1/2": Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Valve Actuators: Direct-coupled type non-hydraulic designed for minimum 100,000 full-stroke cycles at rated torque. The actuator shall have rating of not less than twice the thrust needed for actual operation of the damper or valve.
 1. Coupling: V-bolt and V-shaped, toothed cradle.
 2. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 3. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release non-spring-return actuators.
 4. Actuators shall have the ability to be tandem mounted.
 5. All spring-return actuators shall have a manual override. Complete manual override shall take no more than 10 turns.
 6. Power Requirements (Two-Position Spring Return): 24V ac or dc, Maximum 10VA.
 7. Power Requirements (Modulating): Maximum 15 VA at 24V ac.
 8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
 9. Temperature Rating: -22°F to 140°F.
 10. Run Time: 220 seconds open, 40 seconds closed.
 11. All actuators shall have a 5 year warranty.
 12. Valves:
 - a. Size for torque required for valve close-off at maximum pump differential pressure (regardless of water loop system pressures).
 - b. Valve and Actuators shall come from the factory fully assembled.
 - c. Spring Return Manual Override shall come with a 10 Degree Valve Preload to assure tight close off.

2.6 CONTROL VALVES

- A. General: Control valves shall be 2-way or 3-way pattern as shown constructed for tight shutoff and shall operate satisfactorily against system pressures and differentials. Two-position valves shall be 'line' size. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings). Valves with sizes up to and including 2 inches shall be "screwed" configuration and 2-1/2 inch and larger valves shall be "flanged" configuration. Electrically controlled valves shall include spring return type actuators sized for tight shut-off against system pressures and furnished with integral switches for indication of valve position (open-closed).

2.7 POWER MONITORING INTERFACE

- A. General: The Power Measurement Interface (PMI) device shall include the appropriate current and potential (voltage) transformers. The PMI shall be certified under UL-3111. The PMI shall perform continuous true RMS measurement based on 32 samples-per-cycle sampling on all voltage and current signals. The PMI shall provide outputs to the FMCS based on the measurement and calculation of the following parameters: (a) current for each phase and average of all three phases, (b) kW for each phase and total of all three phases, (c) power factor for each phase and all three phases, (d) percent voltage unbalance and (e) percent current unbalance. These output values shall be hard-wired inputs to the FMCS or shall be communicated to the FMCS over the open-protocol LAN.

PART 3 – EXECUTION

3.1 GENERAL

- A. Install equipment level and plumb.
- B. Install software in control units and operation workstation. Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- C. Connect and configure equipment and software to achieve sequence of operation specified.
- D. Verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate all 48 inches above the floor in accordance with ADA requirements. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- E. Install guards or tamper proof enclosures on thermostats in the following locations:
 - 1. Entrances.
 - 2. Public areas.
 - 3. Where indicated.
- F. Install labels and nameplates to identify control components according to Section 15053 "Identification for Piping & Equipment". The names on the labels shall match the point names given on the computer graphics display and also shown on the as-built drawings.
- G. Install hydronic instrument wells, valves, and other accessories according to Sections 15513 "Hydronic Piping" and 15516 "Hydronic Piping Specialties."
- H. Install electronic and fiber-optic cables according to Division 16.

3.2 BOILER MEMORY MAPPING

- A. The boiler system integration controller shall be provided with input points. These points shall be integrated by the TCS contractor via ModBus. Refer to the drawings for requirements.
- B. Install material and components necessary to map the points illustrated on the drawings.
- C. Configuration Bits: The boiler shall provide an address which allows configuration bits to be received. The TCS contractor shall send bits from the BAS to the boiler. The bits are intended to tell the boiler to use its on-board inputs.

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 26.
- B. Install building wire and cable according to Division 26.
- C. Install signal and communication cable according to Division 26.
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Install exposed cable in raceway.
 - 3. Install concealed cable in raceway.
 - 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 - 5. Fasten flexible conductor, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlocks and controls when switch is in hand position (i.e. safeties and other Life safety shutdown functions shall NOT be overridden by the "hand" position. Life safety shutdown functions shall also operate in the full speed "Bypass" mode where such is provided for VFD's).

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Install piping adjacent to machine to allow service and maintenance.
- B. Ground equipment. 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.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing. Calibration and test electric/electronic thermostats by disconnecting input sensors and stimulating operation with compatible signal generator.
- B. Replace damaged or malfunctioning controls and equipment.
 - 1. Start, test and adjust control systems.
 - 2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
 - 3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.
- C. Verify DDC as follows:
 - 1. Verify software including automatic restart, control sequences, scheduling, reset controls, and occupied/unoccupied cycles.
 - 2. Verify operation of operator workstation.

3. Verify local control units including self-diagnostics.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.
 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing and maintaining equipment and schedules.
 2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs. Include a minimum of 40 hours dedicated instructor time on-site.
 3. Review data in maintenance manuals.
 4. Schedule training with Owner, through Architect, with at least seven day's advance notice.

3.6 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested by Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

3.7 TRAINING

- A. Provide a minimum of 24 hours of on-site or classroom training throughout the contract period for personnel designated by the Owner. Each session shall be a minimum of four hours in length and must be coordinated with the building Owner. Train the designated staff of Owners Representative and Owner to enable them to:
 1. Proficiently operate the system.
 2. Understand control system architecture and configuration.
 3. Understand DC system components.
 4. Understand system operation, including DDC system control and optimizing routines (algorithms).
 5. Operate the workstation and peripherals.
 6. Log on and off the system.
 7. Access graphics, point reports, and logs.
 8. Adjust and change system set points, time schedules, and holiday schedules.
 9. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.
 10. Understand system drawings, and Operation and Maintenance manual.
 11. Understand the job layout and location of control components.
 12. Access data from DDC controllers.
 13. Operate portable operators terminals.

3.8 WARRANTY

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.
- B. Within this period, upon notice by the Owner, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by the contractor at no expense to the Owner.

3.9 WARRANTY ACCESS

- A. The Owner shall grant to the Division 15395 contractor, reasonable access to the TCS during the warranty period.

3.10 ACCEPTANCE TESTING

- A. The contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications. The contractors shall coordinate the checkout of the system such that each Division has a representative present during system checkout.
- B. The contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.
- C. Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.
- D. System Acceptance: Satisfactory completion is when the Temperature Control sub-contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System shall be contingent upon completion and review of all corrected deficiencies.

END OF SECTION 23 08 00

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SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-407C:
 - 1. Suction Lines for Air-Conditioning Applications: 230 psig.
 - 2. Suction Lines for Heat-Pump Applications: 380 psig.

1.4 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
 - 1. Thermostatic expansion valves.
 - 2. Solenoid valves.
 - 3. Hot-gas bypass valves.
 - 4. Filter dryers.
 - 5. Strainers.
 - 6. Pressure-regulating valves.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Shop Drawing Scale: 1/4 inch equals 1 foot.
 - 2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- C. Welding certificates.
- D. Field quality-control test reports.

- E. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.6 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.7 COORDINATION

- A. Coordinate size and location of equipment supports..

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-134a:
 - 1. Suction Lines for Air-Conditioning Applications: 115 psig.
 - 2. Suction Lines for Heat-Pump Applications: 225 psig.
- B. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
 - 2. Suction Lines for Heat-Pump Applications: 535 psig.
 - 3. Liquid Lines: 535 psig.

2.2 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.

F. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.3 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; Type, Grade, and wall thickness as selected in Part 3 piping applications articles.
- B. Wrought-Steel Fittings: ASTM A 234/A 234M, for welded joints.
- C. Steel Flanges and Flanged Fittings: ASME B16.5, steel, including bolts, nuts, and gaskets, bevel-welded end connection, and raised face.
- D. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. Flanged Unions:

1. Body: Forged-steel flanges for NPS 1 to NPS 1-1/2 and ductile iron for NPS 2 to NPS 3. Apply rust-resistant finish at factory.
2. Gasket: Fiber asbestos free.
3. Fasteners: Four plated-steel bolts, with silicon bronze nuts. Apply rust-resistant finish at factory.
4. End Connections: Brass tailpiece adapters for solder-end connections to copper tubing.
5. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
6. Pressure Rating: Factory test at minimum 400 psig.
7. Maximum Operating Temperature: 330 deg F.

F. Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, stainless-steel-wire-reinforced protective jacket
2. End Connections:
 - a. NPS 2 and Smaller: With threaded-end connections.
 - b. NPS 2-1/2 and Larger: With flanged-end connections.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.4 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
 3. Operator: Rising stem and hand wheel.
 4. Seat: Nylon.
 5. End Connections: Socket, union, or flanged.
 6. Working Pressure Rating: 500 psig.
 7. Maximum Operating Temperature: 275 deg F.
- B. Packed-Angle Valves:
1. Body and Bonnet: Forged brass or cast bronze.
 2. Packing: Molded stem, back seating, and replaceable under pressure.
 3. Operator: Rising stem.
 4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
 5. Seal Cap: Forged-brass or valox hex cap.
 6. End Connections: Socket, union, threaded, or flanged.
 7. Working Pressure Rating: 500 psig.
 8. Maximum Operating Temperature: 275 deg F.
- C. Check Valves:
1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
 2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
 3. Piston: Removable polytetrafluoroethylene seat.
 4. Closing Spring: Stainless steel.
 5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
 6. End Connections: Socket, union, threaded, or flanged.
 7. Maximum Opening Pressure: 0.50 psig.
 8. Working Pressure Rating: 500 psig.
 9. Maximum Operating Temperature: 275 deg F.
- D. Service Valves:
1. Body: Forged brass with brass cap including key end to remove core.
 2. Core: Removable ball-type check valve with stainless-steel spring.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Copper spring.
 5. Working Pressure Rating: 500 psig.
- E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
1. Body and Bonnet: Plated steel.
 2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and ac coil.
 6. Working Pressure Rating: 400 psig .
 7. Maximum Operating Temperature: 240 deg F.
 8. Manual operator.
- F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
 2. Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Seat Disc: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Working Pressure Rating: 400 psig.
 6. Maximum Operating Temperature: 240 deg F.
- G. Thermostatic Expansion Valves: Comply with ARI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 5. Suction Temperature: 40 deg F.
 6. Superheat: Adjustable
 7. Reverse-flow option (for heat-pump applications).
 8. End Connections: Socket, flare, or threaded union.
- H. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
 2. Screen: 100-mesh stainless steel.
 3. End Connections: Socket or flare.
 4. Working Pressure Rating: 500 psig.
 5. Maximum Operating Temperature: 275 deg F.
- I. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
 2. Drain Plug: Brass hex plug.
 3. Screen: 100-mesh monel.
 4. End Connections: Socket or flare.
 5. Working Pressure Rating: 500 psig.
 6. Maximum Operating Temperature: 275 deg F.
- J. Moisture/Liquid Indicators:
1. Body: Forged brass.
 2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
 3. Indicator: Color coded to show moisture content in ppm.
 4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
 5. End Connections: Socket or flare.
 6. Working Pressure Rating: 500 psig.
 7. Maximum Operating Temperature: 240 deg F.
- K. Replaceable-Core Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
 2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 3. End Connections: Socket.
 4. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
 5. Maximum Pressure Loss: 2 psig.

6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

L. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Designed for reverse flow (for heat-pump applications).
4. End Connections: Socket.
5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
6. Maximum Pressure Loss: 2 psig.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

M. Mufflers:

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or flare.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

N. Receivers: Comply with ARI 495.

1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
2. Comply with UL 207; listed and labeled by an NRTL.
3. Body: Welded steel with corrosion-resistant coating.
4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
5. End Connections: Socket or threaded.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

O. Liquid Accumulators: Comply with ARI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

2.5 REFRIGERANTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

C. ASHRAE 34, R-134a: Tetrafluoroethane.

- D. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-134a

- A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
- B. Suction Lines NPS 2 to NPS 4 for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.
- C. Hot-Gas, Liquid Lines and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
- D. Safety-Relief-Valve Discharge Piping: Copper, Type ACR drawn-temper tubing and wrought-copper fittings with soldered joints.

3.2 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines NPS 1-1/2 and Smaller] for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
- B. Suction Lines NPS 2 to NPS 3-1/2 for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.
- C. Suction Lines NPS 4 for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.
- D. Hot-Gas and Liquid Lines[, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.
- E. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed soldered joints.

3.3 VALVE AND SPECIALTY APPLICATIONS

- A. Install diaphragm packless valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- E. Install a full-sized, three-valve bypass around filter dryers.

- F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Hot-gas bypass valves.
 - 4. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve.
- L. Install receivers sized to accommodate pump-down charge.
- M. Install flexible connectors at compressors.

3.4 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.

- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operation" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- Q. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:
 - 1. Shot blast the interior of piping.
 - 2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
 - 3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
 - 4. 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.
 - 5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
 - 6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.
- R. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- S. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
- T. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

- U. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- V. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.
- W. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

3.5 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
- F. Threaded Joints: Thread steel pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.
- H. Welded Joints: Construct joints according to AWS D10.12/D10.12M.
- I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.

3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2 : Maximum span, 60 inches minimum rod size, 1/4 inches.
2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.

D. Support multifloor vertical runs at least at each floor.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.8 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.9 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 - 1. Open shutoff valves in condenser water circuit.
 - 2. Verify that compressor oil level is correct.
 - 3. Open compressor suction and discharge valves.
 - 4. Open refrigerant valves except bypass valves that are used for other purposes.
 - 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 23 23 00

DIVISIONS 22: PLUMBING SYSTEM SPECIFICATION INDEX

SECTION	TITLE	PAGES
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22 13 19.13	SANITARY DRAINS	2

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SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
 - 2. Hubless, cast-iron soil pipe and fittings.
 - 3. Stainless steel drainage pipe and fittings.
 - 4. PVC pipe and fittings.
 - 5. Specialty pipe fittings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and elevations, or Building Information Model (BIM) drawn to scale, showing items described in this Section and coordinated with all building trades.
- B. Field quality-control reports.

1.4 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:
 - 1. Notify Architect, Construction Manager and Owner no fewer than seven days in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without Architect's, Construction Manager's or Owner's written permission.

1.5 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10 ft. head of water.

2.2 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings:
 - 1. Marked with CISPI collective trademark.
 - 2. ASTM A74, service cast iron.
- B. Gaskets: ASTM C564, rubber.
- C. Caulking Materials: ASTM B29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings:
 - 1. Marked with CISPI collective trademark.
 - 2. ASTM A888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
 - 1. Standards: ASTM C1277 and CISPI 310.
 - 2. Description: Stainless steel corrugated shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

2.5 STAINLESS STEEL DRAINAGE PIPE AND FITTINGS

- A. Description: Comply with requirements of ASME A112.3.1 drainage pattern.
- B. Material: Type 316L stainless steel.
- C. Pipe Construction: Seamless.
- D. Internal Sealing Rings: EPDM or NBR.

- E. Joints: Single or double, socket and spigot ends.

2.6 PVC PIPE AND FITTINGS

- A. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.
- B. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.
- C. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- D. Adhesive Primer: ASTM F656.
- E. Solvent Cement: ASTM D2564.

2.7 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
 - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 - 3. Shielded, Nonpressure Transition Couplings:
 - a. Standard: ASTM C1460.
 - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. End Connections: Same size as and compatible with pipes to be joined.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.

2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
 - B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
 - C. Install piping at indicated slopes.
 - D. Install piping free of sags and bends.
 - E. Install fittings for changes in direction and branch connections.
 - F. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
 3. Do not change direction of flow more than 90 degrees.
 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
 - G. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
 1. Sanitary Waste Piping: Two percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - H. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - I. Install stainless steel piping in accordance with ASME A112.3.1 and applicable plumbing code.
 - J. Install underground PVC piping in accordance with ASTM D2321.
 - K. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- 3.3 JOINT CONSTRUCTION
- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
 - B. Hubless, Cast-Iron Soil Piping Coupled Joints:
 1. Join hubless, cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
 - C. Join stainless steel pipe and fittings with gaskets in accordance with ASME A112.3.1.

- D. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.

3.4 INSTALLATION OF SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in ODs.
 - 2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.6 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than 10 ft. head of water.
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
 - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1 inch wg.
 - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - d. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.7 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.8 PIPING SCHEDULE

- A. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller are to be one of the following:
 1. Service cast-iron soil piping; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 3. Stainless steel pipe and fittings, gaskets, and gasketed joints.
 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 221316

SECTION 22 13 19.13 - SANITARY DRAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Floor drains.
 - 2. Floor sinks.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 FLOOR DRAINS AND FLOOR SINKS

- A. Floor drains and stainless-Steel Floor Sinks:
 - 1. Refer to contractor documents for specification.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jay R. Smith Mfg Co; a division of Morris Group International.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Wade; a subsidiary of McWane Inc.
 - d. Zurn Industries, LLC.
 - e. Josam Company.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install floor drain and/or floor sink and set grate flush with finished floor, unless otherwise indicated.
 - 1. Position floor drain and/or floor sink for easy access and maintenance.

2. Install flashing collar or flange, so no leakage occurs between floor sink and adjoining flooring.
 - a. Maintain integrity of waterproof membranes where penetrated.
3. Install individual traps for floor drains and/or floor sinks connected to sanitary building drain, unless otherwise indicated.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 PROTECTION

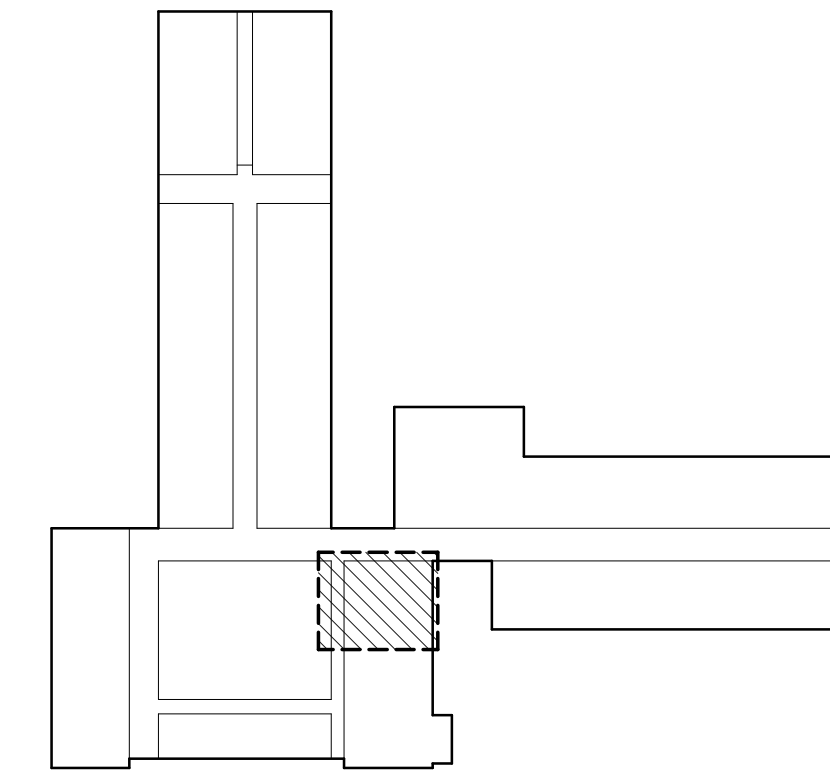
- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319.13



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MAKE
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KEY PLAN
SCALE: 1" = 80'-0"

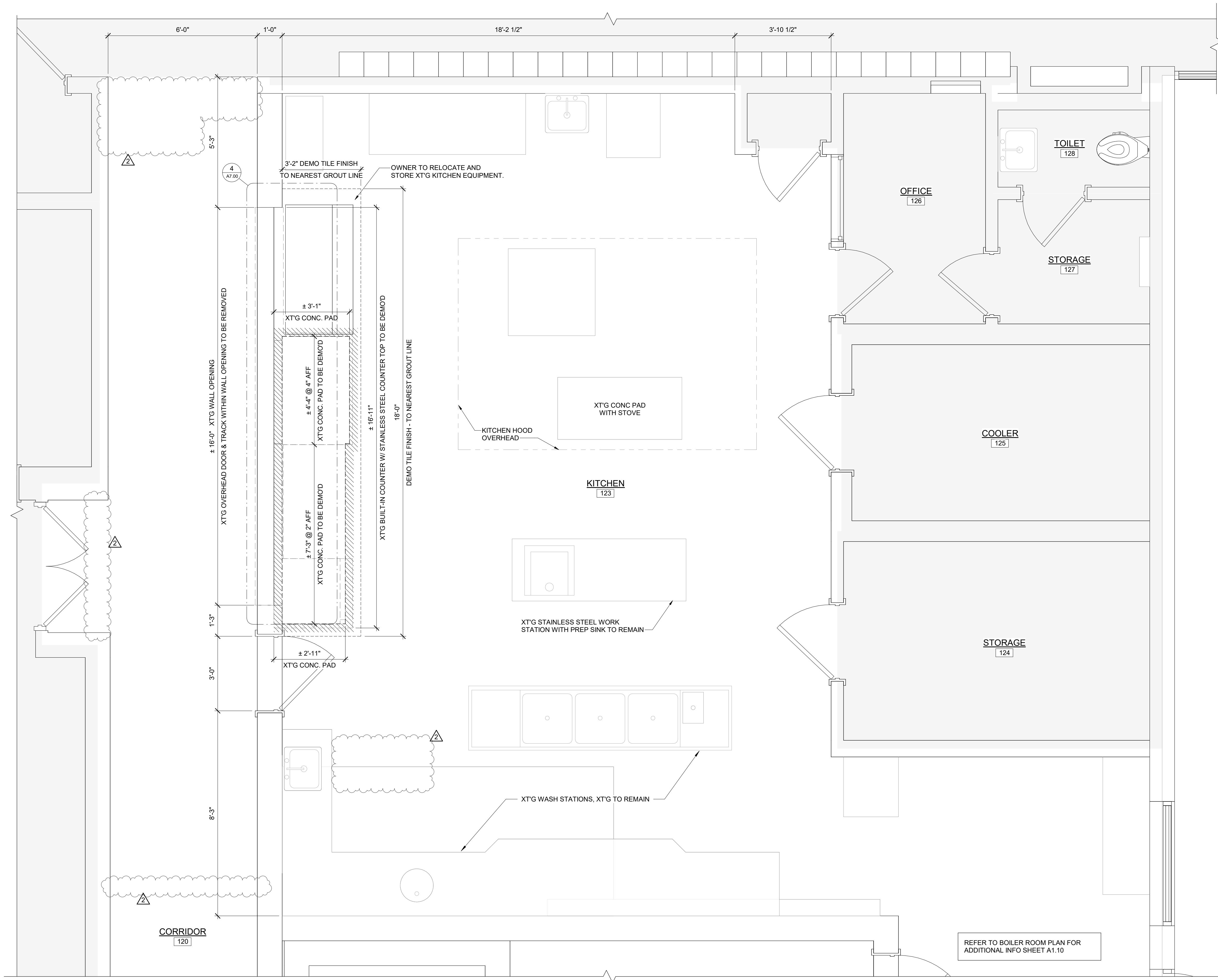
GENERAL DEMOLITION NOTES:

- COORDINATE ALL DEMOLITION WITH THE OWNER'S HAZARDOUS MATERIAL ABATEMENT DOCUMENTS AND SCOPE.
- DEMOLITION CONTRACTOR TO PROTECT ALL AREAS ADJACENT TO CONSTRUCTION AND COMMON POINTS OF TRAVEL TO AND FROM CONSTRUCTION AREAS. PROTECTION IN THESE AREAS TO INCLUDE AIR QUALITY, WALK SURFACES, EQUIPMENT, FURNISHINGS, BUILDING OCCUPANTS, ETC. FROM DUST / DEBRIS, EXCESSIVE NOISE, WEAR, OR DAMAGE OF ANY KIND. PRIOR TO ANY PHYSICAL WORK, THE CONTRACTOR MUST HAVE A WRITTEN PLAN FOR PROTECTION APPROVED BY THE ARCHITECT.

AREA OF HIGH REPLACEMENT VALUE OR MORE LIKELY FOR DAMAGE ARE TO HAVE ADDED PROTECTION (I.E. GYM FLOORS, ROOFING, ETC.)
- ANY WORK UNDER THE CONTRACT THAT WILL INTERRUPT THE OWNER'S ACTIVITIES SHALL BE COORDINATED WITH THE OWNER'S REPRESENTATIVE.
- ALL DEMOLITION WORK REQUIRED IS NOT LIMITED TO THAT INDICATED ON PLAN. THE INTENT IS TO REMOVE ALL MECHANICAL, ELECTRICAL, AND ARCHITECTURAL ITEMS AS NECESSARY TO FACILITATE NEW CONSTRUCTION.
- PRIOR TO COMMENCEMENT OF DEMOLITION WORK, CONTRACTOR IS TO INSPECT ALL AREAS IN WHICH WORK WILL BE PERFORMED. DOCUMENT EXISTING CONDITIONS OF STRUCTURE, SURFACES, EQUIPMENT OR SURROUNDING AREAS WHICH COULD BE MISCONSTRUED AS DAMAGE RESULTING FROM DEMOLITION WORK AND FILE WITH CONSTRUCTION MANAGER OR ARCHITECT.
- NOTIFY ARCHITECT IF ANY EXISTING ITEM THAT CONFLICTS WITH THE INTENDED FINAL PRODUCT IS NOT SPECIFICALLY CALLED OUT. DEMOLITION CONTRACTOR TO NOTIFY ARCHITECT OF ANY DISCREPANCIES IN THE DOCUMENTS & FIELD CONDITIONS BEFORE PROCEEDING WITH DEMOLITION AND / OR CONSTRUCTION.
- ALL DEMOLITION WORK, UNLESS OTHERWISE NOTED IN THE PROJECT MANUAL, DRAWINGS OR DIRECTED BY OWNER SHALL BECOME THE PROPERTY OF THE CONTRACTOR AND SHALL BE REMOVED FROM THE SITE. ALL DEBRIS CAUSED BY DEMOLITION AND CONSTRUCTION SHALL BE CLEARED AND REMOVED FROM THE SITE. DEBRIS STORAGE SHALL NOT INFRINGE ON CLEAR PATH OF EGRESS.
- PROVIDE TEMPORARY BARRICADES AND OTHER FORMS OF PROTECTION AS REQUIRED TO PROTECT OWNER'S PERSONNEL AND GENERAL PUBLIC FROM INJURY DUE TO DEMOLITION WORK.
- PROTECT EXISTING STRUCTURES, FINISHES, UTILITIES AND OTHER ITEMS SCHEDULED TO REMAIN. AREAS THAT ARE DAMAGED BY SELECTIVE DEMOLITION SHALL BE PATCHED AND REPAIRED AND FINISHED OR REPLACED TO MATCH EXISTING ADJACENT SURFACES.
- CONTRACTOR TO COORDINATE A WALK THROUGH WITH THE CONSTRUCTION MANAGER AND OWNER PRIOR TO EACH PHASE OF DEMOLITION TO IDENTIFY ALL REMAINING / ITEMS TO BE SALVAGED.
- FOR ANY ITEMS TO BE SALVAGED BY CONTRACTOR, PROVIDE A DETAILED INVENTORY LIST OF ALL SALVAGED ITEMS AND THEIR STORED LOCATIONS ON SITE.
- SHOULD HIDDEN FIELD CONDITIONS REQUIRE MODIFICATIONS TO THE LAYOUT, THE CONTRACTOR SHALL COORDINATE WITH THE CONSTRUCTION MANAGER OR ARCHITECT.
- STRIP EXIST. FLOORS THAT ARE TO RECEIVE FLOOR FINISHES. FOLLOW MANUFACTURERS RECOMMENDATIONS FOR INSTALLATION OF FINISH MATERIALS ON EXIST. SUBSTRATES.
- AFTER DEMOLITION IS COMPLETE PATCH AND REPAIR EXIST. SURFACES TO REMAIN, AS REQUIRED FOR NEW FINISHES.

DEMOLITION SCOPE:

- REMOVE XTG BUILT-IN EQUIPMENT AND STAINLESS STEEL COUNTERS.
- REMOVE XTG QUARRY TILE IN ENTIRE SERVING AREA.
- REMOVE XTG CONCRETE CURBS LOCATED BELOW EQUIPMENT. GRIND DOWN TO BE FLUSH WITH SURROUNDING SUBFLOOR.
- REMOVE XTG OVERHEAD COUNTER DOOR AND CEILINGS AND WALLS FOR NEW OVERHEAD DOORS.
- DEMO XTG KNEE WALL LOCATED BEHIND EQUIPMENT / COUNTER.
- DEMO XTG COOLER COMPRESSOR IN THE BOILER ROOM, REFER TO ELEC. DWGS.



COLOR LEGEND
 □ AREA OF WORK
 □ N.I.C.

KITCHEN FLOOR PLAN - DEMO
SCALE: 1/2" = 1'-0"

REFER TO BOILER ROOM PLAN FOR ADDITIONAL INFO SHEET A1.10

KITCHEN SERVING COUNTER ALTERATIONS & RELATED WORK

RAISINVILLE ELEMENTARY SCHOOL
2300 NORTH RAINVILLE ROAD, MONROE, MICHIGAN 48162
MONROE PUBLIC SCHOOLS
1275 NORTH MACOMB STREET, MONROE, MICHIGAN 48162

JOB # **24102**

KITCHEN DEMOLITION FLOOR PLAN

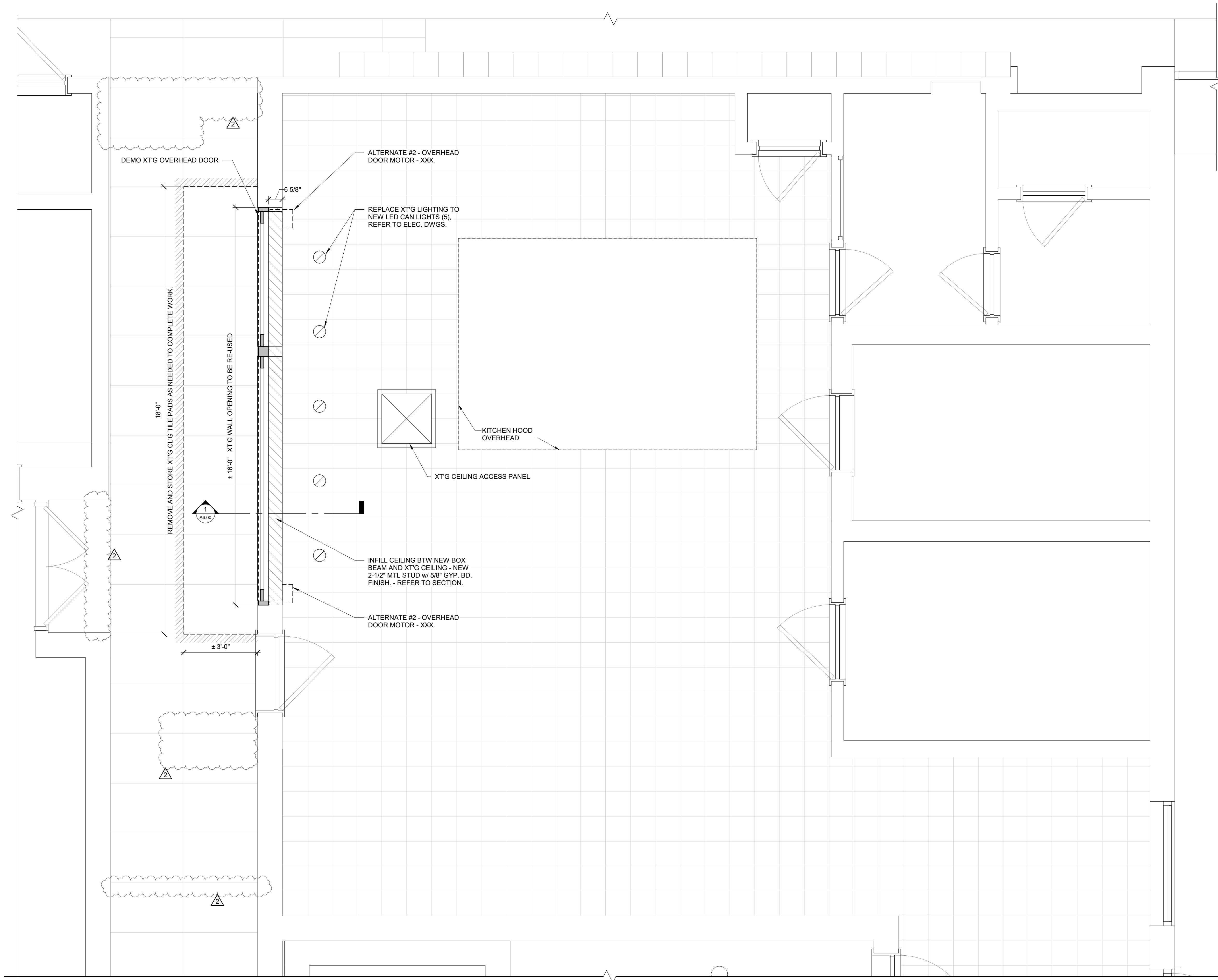
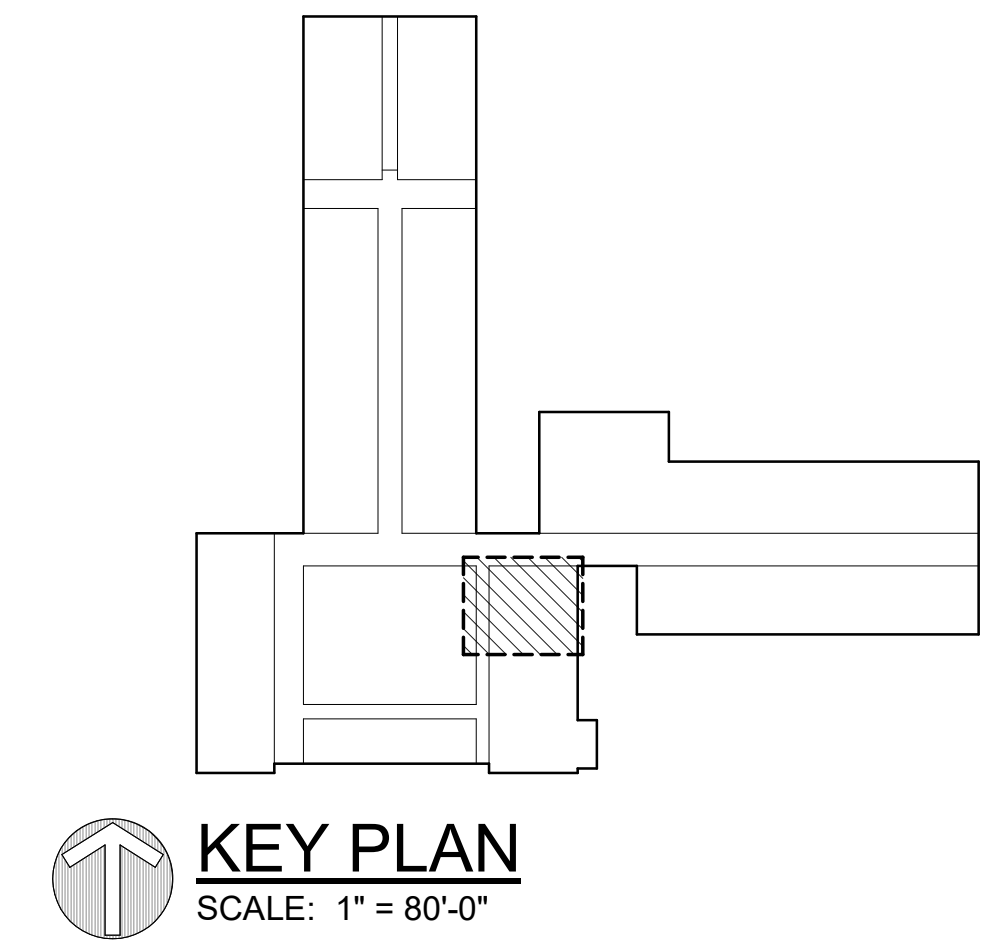
A1.00

4/11/2024 8:51:08 PM Autodesk Docs (MPS) - Raisinville - 24102 - Kitchen Counter Alterations (A1.00-2) RSN Kitchen Update-2024.rvt



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DATE	DESCRIPTION
03.18.2024	BIDDING & STATE REVIEW
4.10.2024	ADDENDUM #2

KITCHEN SERVING COUNTER ALTERATIONS & RELATED WORK

AT **RAISINVILLE ELEMENTARY SCHOOL**
2300 NORTH RAISINVILLE ROAD, MONROE, MICHIGAN 48162
FOR **MONROE PUBLIC SCHOOLS**
1275 NORTH MACOMB STREET, MONROE, MICHIGAN 48162

- CEILING SCOPE:**
- XT'G CEILING FINISHES TO REMAIN.
 - REMOVE XT'G LIGHT FIXTURES ABOVE THE SERVING COUNTER.
 - INSTALL NEW CAN LIGHTING IN-PLACE OF REMOVED LIGHT FIXTURES. REFER TO ELEC. DWGS.
 - DEMO XT'G 16" OVERHEAD DOOR.
 - INSTALL NEW BOX BEAMS, BOX COLUMN, & END FRAMING PRIOR TO INSTALLING NEW OVERHEAD FIRE RATED DOORS.
 - INFILL CEILING BETWEEN NEW BOX-BEAMS AND XT'G CEILING.

JOB # **24102**

KITCHEN REFLECTED CEILING PLAN

A3.00

KITCHEN FIRST FLOOR - RCP
SCALE: 1/2" = 1'-0"

4/11/2024 1:51:09 PM Autodesk Docs (MPS) - Raisinville - 24102 - Kitchen Counter Alterations/04/10/24/RSN Kitchen Update-2024.rvt

ELECTRICAL LEGEND

ABBREVIATIONS	<p>CCT ELECTRICAL (SUB) CONTRACTOR</p> <p>E.C. EXISTING</p> <p>F.B.O. FURNISHED BY OTHERS, INSTALLED AND/OR WIRED BY ELECTRICAL CONTRACTOR</p> <p>G.C. GENERAL (SUB) CONTRACTOR</p> <p>HP HORSEPOWER</p> <p>L.D. LOCATE AS DIRECTED</p> <p>MAX. MAXIMUM</p> <p>M.C. MECHANICAL (HVAC, PLBG, FP, OR TC) (SUB) CONTRACTOR</p> <p>MH MOUNTING HEIGHT TO BOTTOM OF DEVICE, BOX, OR FIXTURE, UNO</p> <p>MIN. MINIMUM</p> <p>OREQ OR EQUAL</p> <p>REV. REMOVE</p> <p>R/M RELOCATE/RELOCATED</p> <p>R/L UNLESS NOTED OTHERWISE</p> <p>UNO COMPLETE WITH</p> <p>W/ WITH WIRE GUARD</p> <p>WP WEATHERPROOF DEVICE, ENCLOSURE OR COVER PLATE.</p>	WIRE TICKS INDICATE BRANCH CIRCUIT PHASE, NEUTRAL, & GROUND WIRES, RESPECTIVELY
	CONDUIT--CONCEALED IN CEILING, WALL OR FLOOR OF NEW CONSTRUCTION. CONCEALED WHEREVER POSSIBLE IN EXISTING CONSTRUCTION (1/2" DIA. MIN.)	
	HOMERUN TO PANEL OR LOCATION NOTED	
	INDICATES CONCEALED CONDUIT UNDERGROUND/UNDERFLOOR - 3/4" MIN.	
	SURFACE MOUNTED RACEWAY--W/MATCHING FITTINGS, BOXES, ACCESSORIES, ETC. WIREMOLD #700 SERIES, HUBBELL #HBL75010W SERIES OREQ	
	INDICATES LOW VOLT CABLING ROUTED THRU PLENUM OR CEILING SPACE.	
	DISCONNECT SWITCH--HP RATED--TOGGLE TYPE--20 AMP--1 TO 3 POLES AS REQUIRED FOR EQPT--600 VOLT--NEMA 1 ENCLOSURE U.N.O.--LOCATE ADJACENT TO EQUIPMENT SERVED. (WP=WEATHERPROOF ENCLOSURE) SQUARE D CLASS 2510 SERIES OREQ	
	MOTOR--FRACTIONAL H.P.--120 VOLT (EF=EXH. FAN; UH=UNIT HEATER; MD=MOTORIZED DAMPER)	
	PUSHBUTTON CONTROL STATION PROVIDED WITH EQUIPMENT AND INSTALLED BY E.C. PER SUPPLIERS WIRING DIAGRAMS.	
	SERVING DOOR FIRE ALARM RELEASE DEVICE, 24V, FOR DOORS TO CLOSE DUE TO FIRE ALARM ACTIVATION-- PROVIDED BY DOOR MANUFACTURER; FSC24V FOR MOTORIZED DOOR/F58X24V FOR NON--MOTORIZED DOOR WITH REMOTE TEST STATION--M.H. 44"	
	FIRE ALARM INDIVIDUALLY ADDRESSABLE RELAY/SIGNAL MODULE--SURFACE MOUNTED ADJACENT TO FIRE ALARM RELEASE DEVICE.	
	EXISTING FIRE ALARM SYSTEM CONTROL PANEL (FACP)	
	EXISTING ITEMS ARE TO REMAIN--UNO	
	ALL EXISTING ITEMS "DASHED" ARE TO BE REMOVED--UNO	
	INDICATES EXISTING ITEM SHALL BE REMOVED INCLUDING ASSOCIATED CONDUIT AND WIRING NO LONGER IN SERVICE	
	DISCONNECT EXISTING MOTOR OR MOTORIZED EQUIPMENT OR APPLIANCE, FOR REMOVAL BY OTHERS.	

(EXISTING CIRCUITING)

PANELBOARD SCHEDULE (3)

PANEL: EXTG. L-5
 MAINS: 100A M.L.O.
 VOLTS: 120/208V-3ø-4W-SN
 MOUNTING: RECESSED

NOTES:
 GFCI BREAKER
 30 MILLIAMP EQUIPMENT GROUND FAULT TRIP
 SHUNT TRIP
 ARC FAULT
 SWITCHED NEUTRAL
 MOTOR OPERATED
 RELAY CONTROLLED
 --- KAIC RATING
 NON--CONSEQUENT LOAD

LOAD DESCRIPTION	NOTES	VOLT AMPS	C.B. AMP/P	A	B	C	C.B. P AMP	VOLT AMPS	NOTES	LOAD DESCRIPTION		
1 KITCHEN LTS		1000 20	1 1500				1 20	500		RECEPT&FANS--N,S WALL		
3 TIL. REFR. STOR. RM-REC. M/LG		1000 20	2	1500			1 20	500		UNKNOWN		
5 CANOPY -- OFFICE LTS		1000 20	2			1000	1 20	0		SPECIAL REFRIG. RECEPT		
7 COUNTER LTS		1000 20	1 1500				1 20	500		SINK RECEPT		
9 SINK RECEPT		500 20	1	1000			3 20	500		OFFICE & RCVG. RECEPT		
11 ICE CREAM MACHINE		1000 20	2			2200	3 20	1200		BAKERY RECEPT--MICRO		
13 MILK MACH. & REFRIG.		1000 20	2 1500				3 20	500		N WALL KITCHEN RECEPT		
15 STOR. RM EXH. FAN		500 20	1	1500			1 20	1000		DISHWASHER EXH. FAN		
17 REFRIG BLOWERS--WALKIN		1000 20	1			2000	1 20	1000		BLODGETT OVEN		
19 CANOPY EXH. FAN		500 15	3 1000				1 20	500		UNKNOWN		
21 --		500 15	3	1000			1 20	500		UNKNOWN		
23 --		500 15	3			1500	1 30	1000		STEAM TABLE		
25 UNKNOWN		500 20	2 1000				3 15	500		GARBAGE DISPOSAL		
27 --		500 20	2	1000			3 15	500		--		
29 UNKNOWN		500 20	1			1000	3 15	500		--		
31 SPARE		0 20	1 0				1 20	0		SPARE		
33 SPARE		0 20	1 0				1 20	0		SPARE		
35 SPARE		0 20	1 0				1 20	0		SPARE		
37 SPARE		0 20	1 0				1 20	0		SPARE		
39 SPARE		0 20	1 0				1 20	0		SPARE		
41 SPARE		0 20	1 0				1 20	0		SPACE		
				6500	6000	7700						
				BALANCE								
				97%	89%	114%						
TOTAL LOAD:				20200				TOTAL AMPS:		56.1		

"EXISTING 1200AMP SERVICE" LOAD SUMMARY

LOAD TYPE	CONNECTED VA	DEMAND FACTOR	DEMAND VA
EXISTING **	NEC 220.87	85298	125% 106623
REMOVED LOAD		-2940	100% -2940
LIGHTING LOAD	NEC 220.42	125	100% 125
GENERAL RECEPTACLE	NEC 220.141	180	100% 180
DEDICATED LOAD	NEC 220.14A	4252	100% 4252
TOTAL LOAD IN VA		86915	108240
TOTAL AMPS @ 208VOLT-3PHASE		241	301

** EXISTING LOAD CONSIST OF HIGHEST ELECTRICAL DEMAND RECORDED IN DECEMBER, 2022.

FIXTURE SCHEDULE

MARK	LAMP CATEGORY	LAMP QTY/TYP	VOLTS	DESCRIPTION	MFR. AND CATALOG SERIES	VA
DA	INCAND		120	DISCONNECT AND REMOVE EXISTING SUSPENDED 6" CYLINDER FIXTURE. EXISTING BRANCH CIRCUIT SHALL REMAIN.		60
A	LED	21 WATT 2,000 LUMENS 4000K CCT	120	6" DIA. RETROFIT RECESSED DOWNLIGHT, SELF-FLANGED, WHITE REFLECTOR AND PRISM LENS, WHITE TRIM, ELECTRONIC LED DRIVER, SELECTABLE LUMENS, E.C. TO SET AT 2000 LUMENS.	COOPER PR6R-FS24-D010-REV OR APPROVED EQUAL BY LITHONIA, CREE, ETC.	25

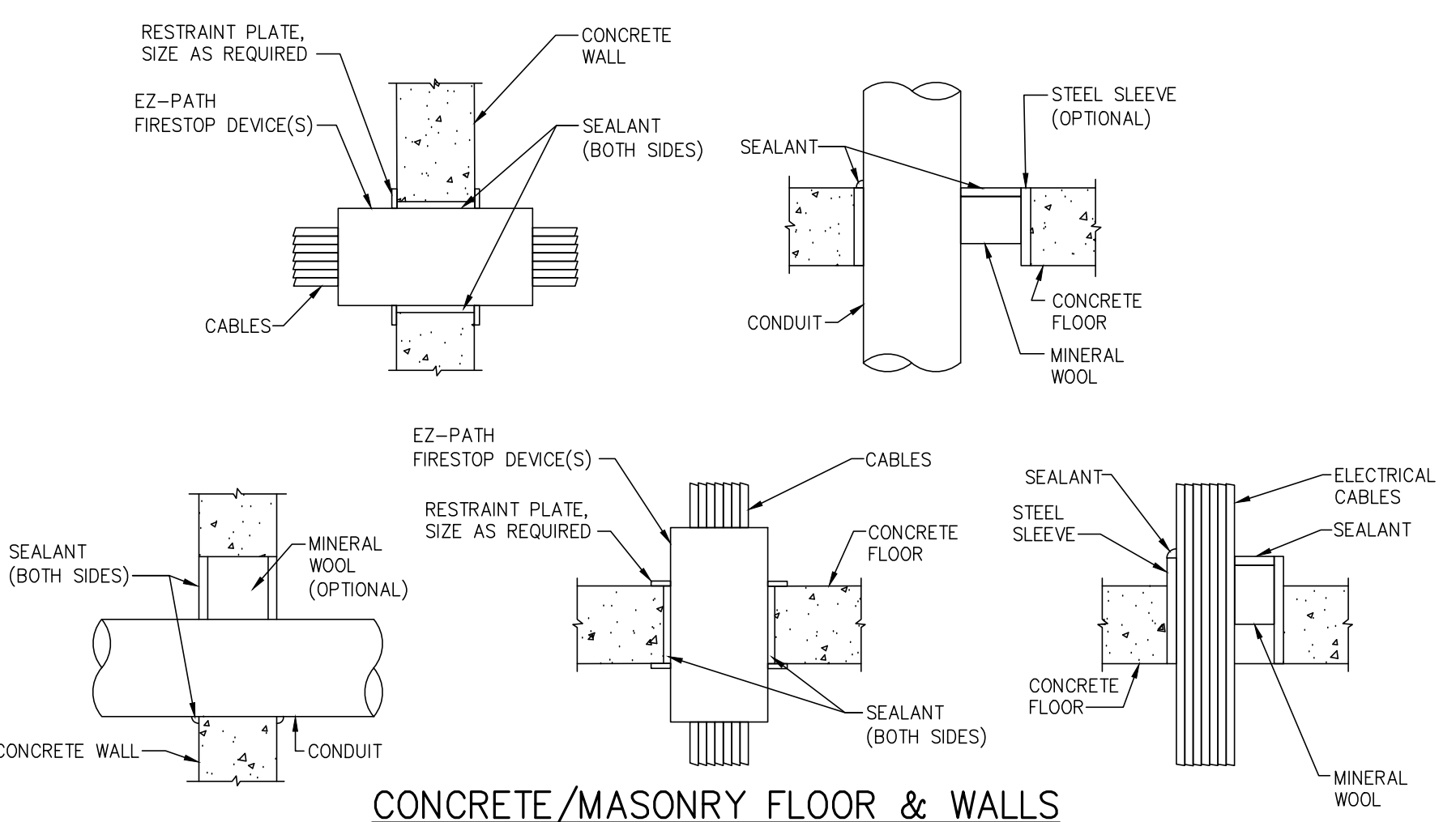
(NEW CIRCUITING)

PANELBOARD SCHEDULE (3)

PANEL: EXTG. L-5
 MAINS: 100A M.L.O.
 VOLTS: 120/208V-3ø-4W-SN
 MOUNTING: RECESSED

NOTES:
 GFCI BREAKER
 30 MILLIAMP EQUIPMENT GROUND FAULT TRIP
 SHUNT TRIP
 ARC FAULT
 SWITCHED NEUTRAL
 MOTOR OPERATED
 RELAY CONTROLLED
 --- KAIC RATING
 NON--CONSEQUENT LOAD

LOAD DESCRIPTION	NOTES	VOLT AMPS	C.B. AMP/P	A	B	C	C.B. P AMP	VOLT AMPS	NOTES	LOAD DESCRIPTION		
1 KITCHEN LTS		1000 20	1 1500				1 20	500		RECEPT&FANS--N,S WALL		
3 TIL. REFR. STOR. RM-REC. M/LG		1000 20	2	1500			1 20	500		UNKNOWN		
5 CANOPY -- OFFICE LTS		1000 20	2			1000	1 20	0		FUTURE EQUIP. RECEPT		
7 COUNTER LTS		1000 20	1 1500				1 20	500		SINK RECEPT		
9 SINK RECEPT		500 20	1	1000			3 20	500		OFFICE & RCVG. RECEPT		
11 COUNTER RECEPT		180 20	1			1380	3 20	1200		BAKERY RECEPT--MICRO		
13 COOLER		900 15	1 1400				3 20	500		N WALL KITCHEN RECEPT		
15 STOR. RM EXH. FAN		500 20	1	1500			1 20	1000		DISHWASHER EXH. FAN		
17 REFRIG BLOWERS--WALKIN		1000 20	1			2000	1 20	1000		BLODGETT OVEN		
19 CANOPY EXH. FAN		500 15	3 1000				1 20	500		UNKNOWN		
21 --		500 15	3	1000			1 20	500		UNKNOWN		
23 --		500 15	3			1500	1 30	1000		STEAM TABLE		
25 UNKNOWN		500 20	2 1000				3 15	500		GARBAGE DISPOSAL		
27 --		500 20	2	1000			3 15	500		--		
29 UNKNOWN		500 20	1			1000	3 15	500		--		
31 O/H DOOR OPERATOR		1176 20	1 2176				1 20	1000		STEAM TABLE		
33 O/H DOOR OPERATOR		1176 20	1 1176				1 20	0		SPARE		
37 SPARE		0 20	1 0				1 20	0		SPARE		
39 SPARE		0 20	1 0				1 20	0		SPARE		
41 SPARE		0 20	1 0				1 20	0		SPACE		
				8576	7176	6880						
				BALANCE								
				114%	95%	91%						
TOTAL LOAD:				22632				TOTAL AMPS:		62.9		



CONCRETE/MASONRY FLOOR & WALLS CONDUIT/CABLE PENETRATIONS THROUGH RATED ASSEMBLIES

N.T.S.

- GENERAL NOTES--**
- CABLE AND CONDUIT PENETRATION DETAILS ARE BASED ON A U.L. LISTED FIRE RATED ASSEMBLY (MINIMUM) UTILIZING STI FIRE STOP PRODUCTS. MANUFACTURE'S SHALL BE STI, HILTI, 3M OR APPROVED EQUAL. REFER TO MANUFACTURE'S SPECIFICATIONS AND INSTALLATION DETAILS FOR EXACT INSTALLATION METHODS.
 - PACKING AND SEALANT DEPTHS SHALL BE PER MANUFACTURE'S SPECIFICATIONS FOR U.L. ASSEMBLY RATING COMPLIANCE.
 - ALL FIRE STOP LOCATIONS SHALL BE LABELED AT POINT OF PENETRATION LABEL SHALL IDENTIFY FIRE STOPPING MATERIAL, U.L. LISTING NUMBER AND HOUR RATING OF WALL/FLOOR.

- PANEL NOTES**
- REMOVE EXISTING ITEMS INCLUDING ASSOCIATED WIRING NO LONGER IN SERVICE. TURN OVER SPARE TO OWNER.
 - PROVIDE CIRCUIT BREAKER TO MATCH EXISTING IN AVAILABLE SPACE. NEW BREAKER TO MATCH EXISTING IN TYPE, STYLE, MANUFACTURER AND AIC RATING.
 - PANEL DIRECTORIES REFLECT INFORMATION OBSERVED FROM FIELD PICTURES. EXISTING BRANCH CIRCUIT LOADS ARE ESTIMATED. FIELD VERIFY CIRCUIT DESIGNATIONS ASSOCIATED WITH RENOVATIONS AND FIELD VERIFY LOAD FOR ANY CIRCUIT MODIFIED OR EXTENDED AS PART OF THIS PROJECT. MAINTAIN BRANCH CIRCUIT WIRING CONTINUITY TO EXISTING DEVICES REMAINING.
 - UPDATE PANEL DIRECTORY AT COMPLETION OF PROJECT.

BRANCH CIRCUIT CONDUCTOR SIZING CHART

MAX. CIRCUIT LENGTH TO FARTHEST OUTLET	CIRCUIT VOLTAGE	MINIMUM BRANCH CIRCUIT SIZE.
100 FEET	120	#12 AWG
165 FEET	120	#10 AWG
265 FEET	120	#8 AWG
400 FEET	120	#6 AWG
250 FEET	277	#12 AWG
400 FEET	277	#10 AWG
550 FEET	277	#8 AWG
750 FEET	277	#6 AWG

ELECTRICAL DRAWING LIST

DWG NO.	TITLE	FILE NO.
E1.01	ELECTRICAL LEGEND, FIXTURE AND PANEL SCHEDULES & DETAILS	2400361E1.01.dwg
E3.01	ELECTRICAL POWER & SYSTEMS PLANS	2400361E3.01.dwg

ALTERNATES

ALTERNATE E-1: STATE THE AMOUNT TO BE ADDED TO THE BASE BID TO FURNISH ALL MATERIAL, LABOR AND EQUIPMENT NECESSARY FOR THE CORRECT INSTALLATION OF THE FOLLOWING:

- FURNISH MOTORS, CONTROLS, AND FIRE ALARM TIE-INS FOR MOTOR OPERATED OVERHEAD DOORS.

THIS ITEM HAS BEEN ELECTRONICALLY SIGNED AND SEALED BY ROBERT TIMOTHY BRANNAN, PE. USING A DIGITAL SIGNATURE AND DATE. PRINTED COPIES OF THIS DOCUMENT ARE NOT CONSIDERED SIGNED AND SEALED. AND THE SIGNATURE MUST BE VERIFIED ON ANY ELECTRONIC COPIES.

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Mechanical, Electrical, Plumbing, Fire Protection
 415 Conant St. - Muskegon, OH 43551 - 419.891.0022

03/11/2024

DATE	DESCRIPTION
03.18.2024	BIDDING & STATE REVIEW
04.10.2024	ADDENDUM #2

KITCHEN SERVING COUNTER ALTERATIONS & RELATED WORK
RAISINVILLE ELEMENTARY SCHOOL
 2300 NORTH RAISINVILLE ROAD, MONROE, MI 48162
MONROE PUBLIC SCHOOLS
 1275 N. MACOMB STREET, MONROE, MI 48162

JOB # **24102**

ELECTRICAL LEGEND,
 FIXTURE AND PANEL
 SCHEDULES & DETAILS
E1.01

S:\2A\Projects\24003611.001A - MPS Raisinville Kitchen Reno.Dwg\24003611E1.01.dwg 04/08/24 8:26:43 Nkamm



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ARCHITECTURE

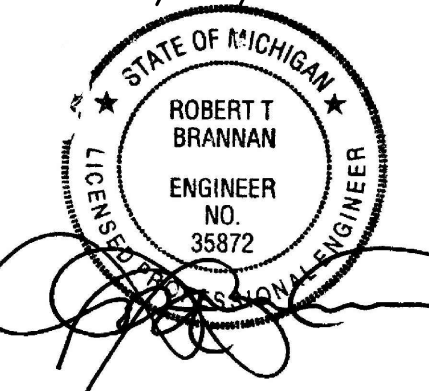
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MAKE
MAKE



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415 Conant St. - Muskegon, MI 49551 - 419.891.0022

03/11/2024



DATE	DESCRIPTION
03.18.2024	BIDDING & STATE REVIEW
04.10.2024	ADDENDUM #2

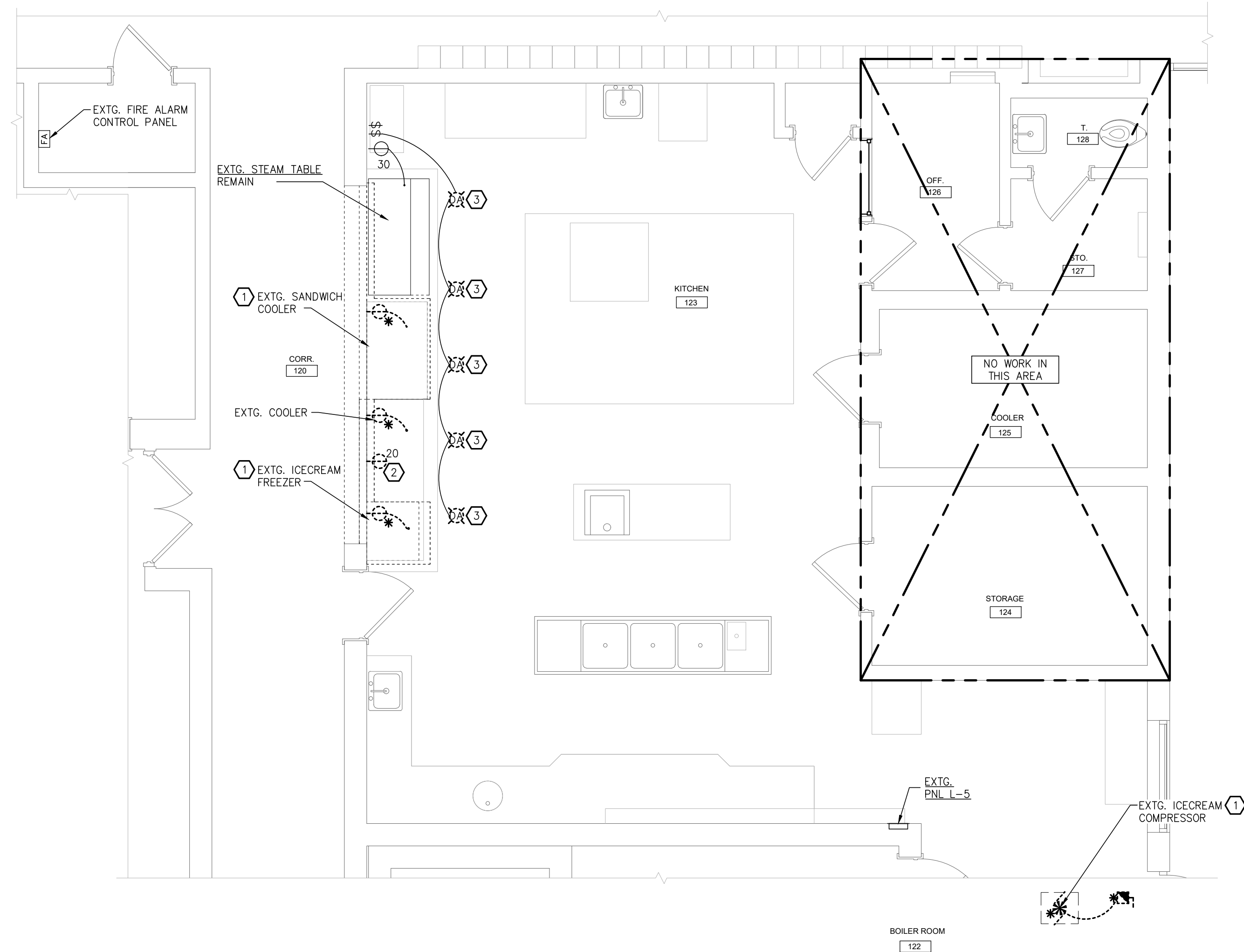
KITCHEN SERVING COUNTER ALTERATIONS & RELATED WORK

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MONROE PUBLIC SCHOOLS
1275 N. MACOMB STREET, MONROE, MI 48162

JOB # 24102

ELECTRICAL
POWER & SYSTEMS
PLANS

E3.01

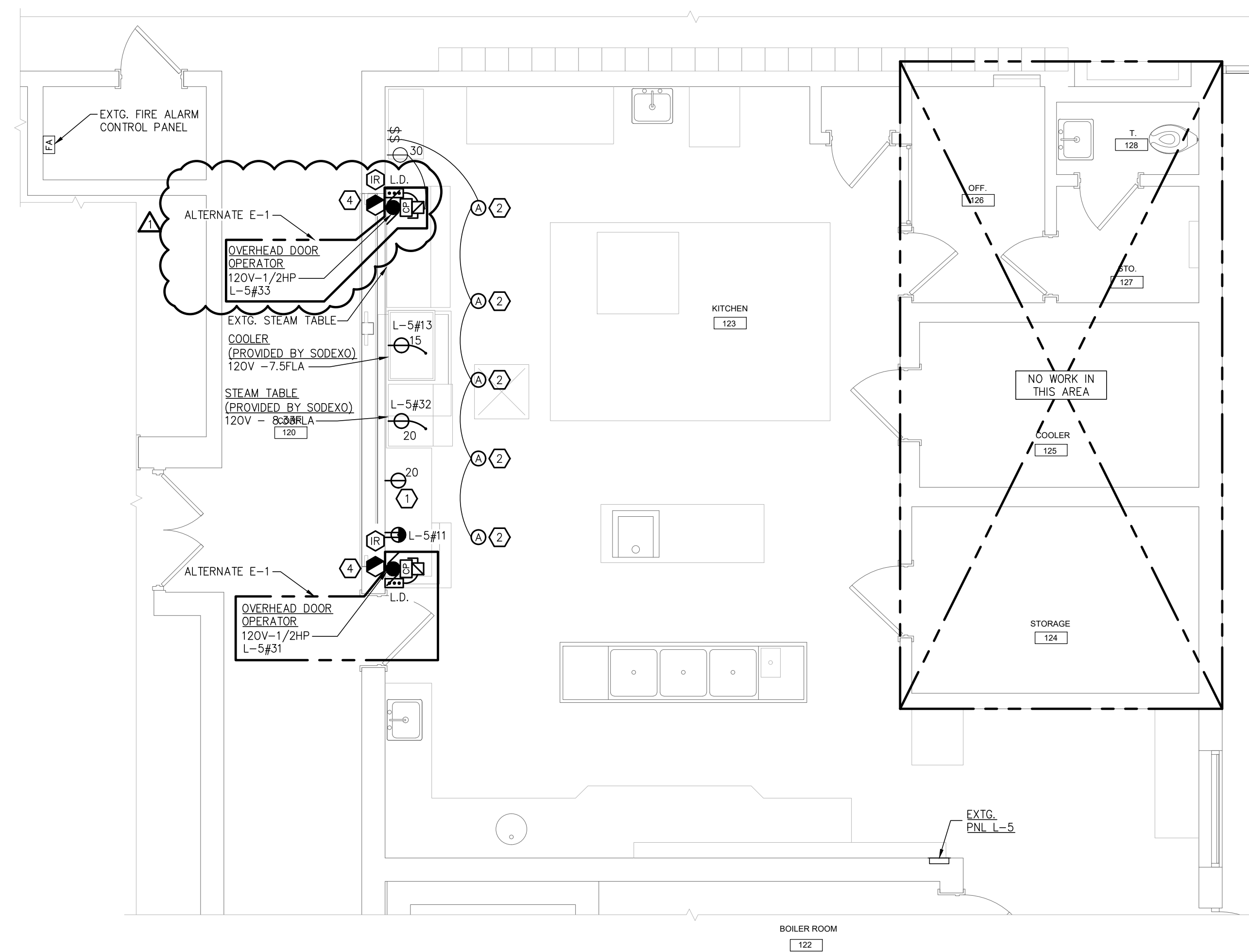


ELECTRICAL POWER & SYSTEMS PLAN – DEMOLITION

SCALE: 1/4" = 1'-0"

PLAN NOTES

- EQUIPMENT INDICATED FOR REMOVAL SHALL BE REMOVED WITH CARE. EXISTING BRANCH CIRCUIT WIRING SHALL BE REMOVED BACK TO SOURCE. ASSUMED SOURCE IS EXISTING PANEL L-5.
- EQUIPMENT INDICATED FOR REMOVAL SHALL BE REMOVED WITH CARE. EXISTING BRANCH CIRCUIT SHALL BE REWORKED AS NECESSARY. SEE THIS SHEET FOR POWER LAYOUT. ASSUMED SOURCE IS EXISTING PANEL, L-5, CCT#6.
- FIELD VERIFY EXISTING CIRCUIT FOR LIGHTS FED FROM PANEL L-5 FOR RE-USE. REWORK EXISTING CIRCUIT AS NECESSARY. SEE THIS SHEET FOR LIGHTING LAYOUT.



ELECTRICAL POWER & SYSTEMS PLAN

SCALE: 1/4" = 1'-0"

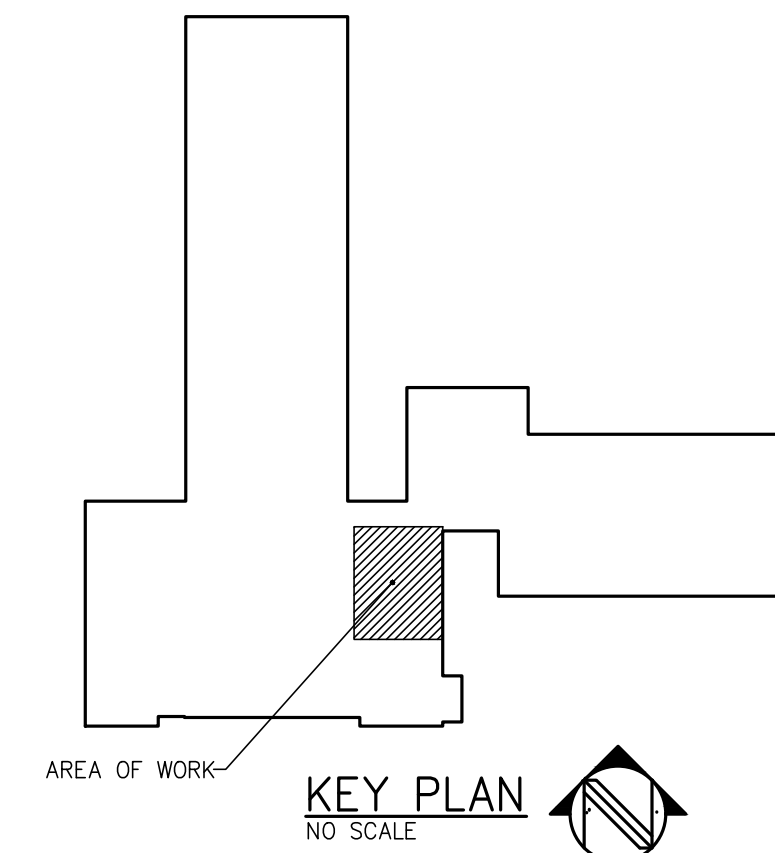
PLAN NOTES

- UTILIZE EXISTING BRANCH CIRCUIT FROM REMOVED EQUIPMENT ON DEMO PLAN, SHOWN ON THIS SHEET. INTERCEPT AND REWORK CIRCUIT FOR NEW DEVICES.
- UTILIZE EXISTING BRANCH CIRCUIT FROM REMOVED FIXTURES ON DEMO PLAN, SHOWN ON THIS SHEET. INTERCEPT AND REWORK CIRCUIT FOR NEW LIGHTING.
- ALL RECEPTACLES SHALL BE REPLACED AND REWORKED TO NEW WALL EXTENSION. MATCH EXISTING RECEPTACLES LOCATION BASED ON EQUIPMENT LOCATIONS. PROVIDE NEW WIRING, BOXES AND CONDUIT AS SEE FITS.
- SERVING DOOR FIRE ALARM RELEASE DEVICE FOR DOOR TO CLOSE DUE TO FIRE ALARM ACTIVATION - PROVIDED BY DOOR MANUFACTURER WITH REMOTE TEST STATION. LOCATION SHALL BE COORDINATED WITH ARCHITECTURAL DRAWINGS AND CONTRACTORS, E.C. SHALL INSTALL WIRING AND CONNECT TO EXISTING FIRE ALARM CONTROL PANEL (SHOWN THIS SHEET). EXTEND DETECTOR LOOP CIRCUIT FROM EXISTING FIRE ALARM SYSTEM IN AREA. COORDINATE WITH JOHNSON CONTROLS BEFORE ROUGH IN. CONTRACT WITH JOHNSON CONTROLS TO INCORPORATE DEVICES INTO EXISTING FIRE ALARM SYSTEM. CONTACT INFORMATION: JOHNSON CONTROLS, BILL EARP (419)460-0590.

ALTERNATES

ALTERNATE E-1: STATE THE AMOUNT TO BE ADDED TO THE BASE BID TO FURNISH ALL MATERIAL, LABOR AND EQUIPMENT NECESSARY FOR THE COMPLETE INSTALLATION OF THE FOLLOWING:

- FURNISH MOTORS, CONTROLS, AND FIRE ALARM TIE-INS FOR MOTOR OPERATED OVERHEAD DOORS.

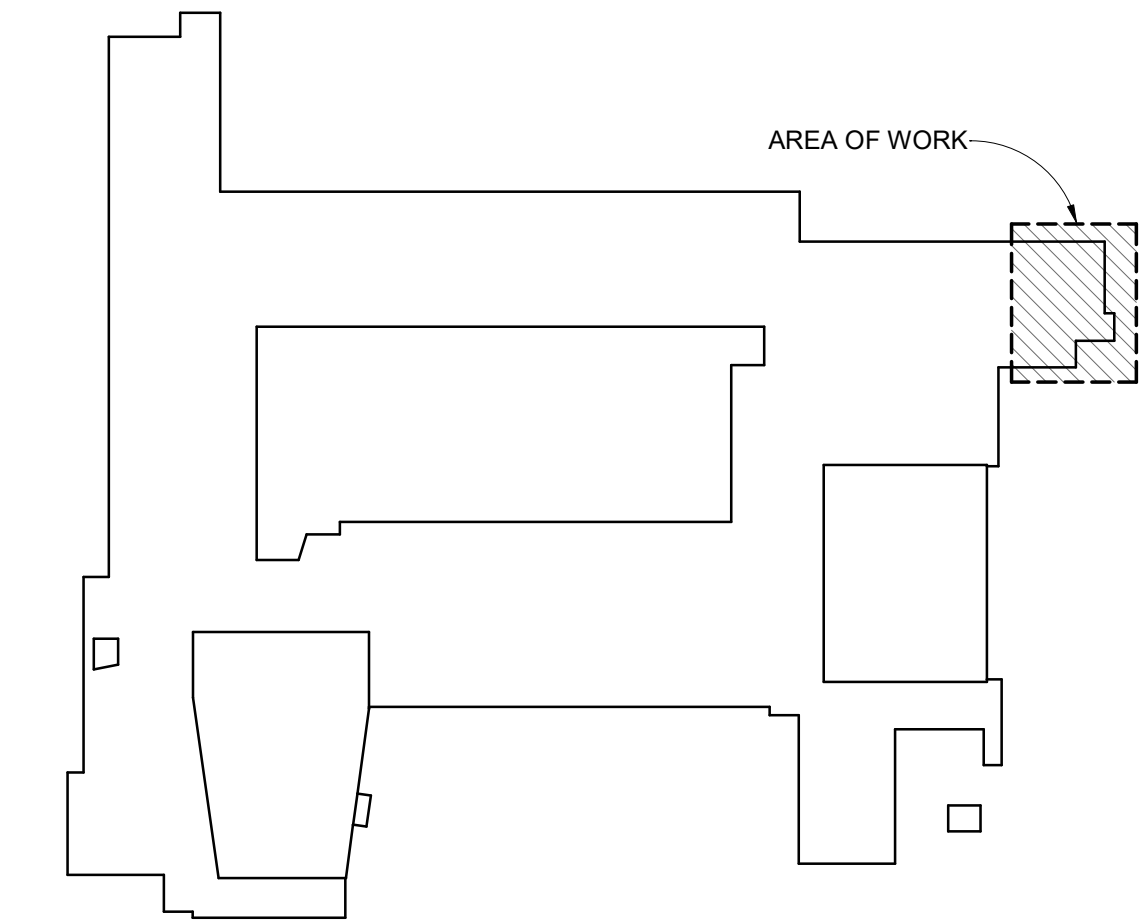


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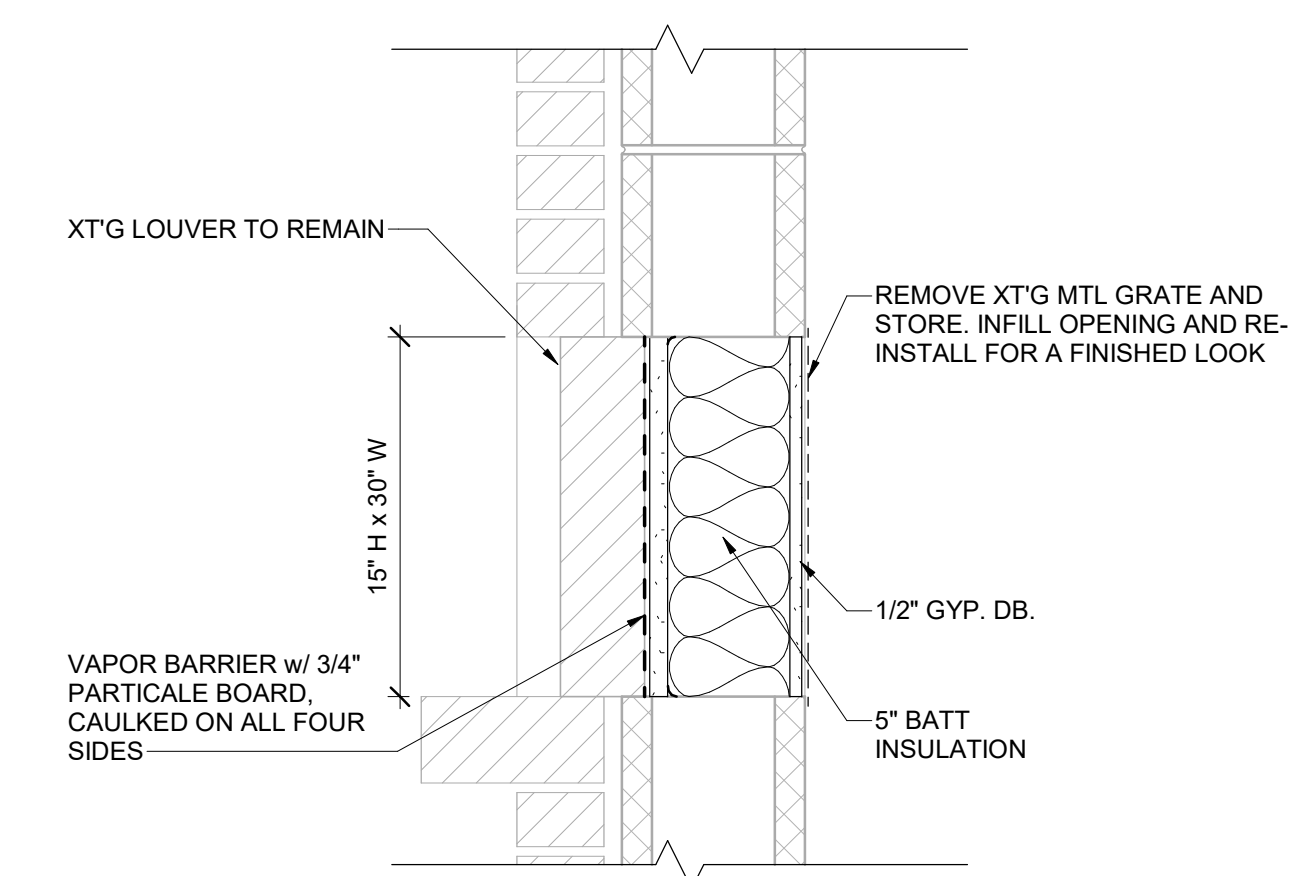


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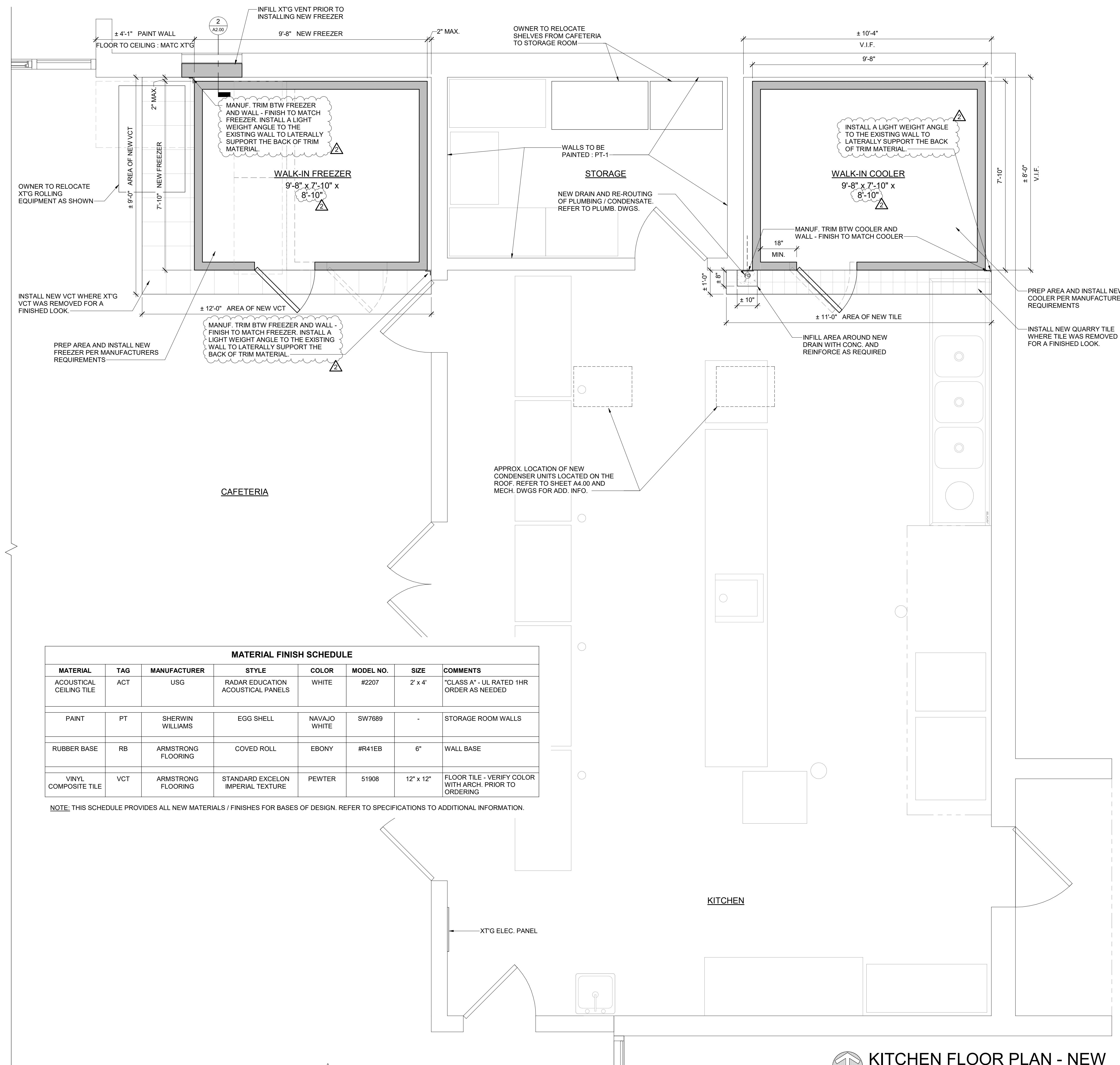


KEY PLAN
SCALE: 1" = 80'-0"



2
A2.00 **TYP. WALL OPENING INFILL**
SCALE: 1 1/2" = 1'-0"

- CONSTRUCTION SCOPE:**
- INSTALL NEW COOLER IN THE SAME LOCATION IN THE KITCHEN. AREA TO BE CLEANED PRIOR TO INSTALL.
 - INSTALL NEW FREEZER IN SIMILAR LOCATION INSIDE THE CAFETERIA. AREA TO BE CLEANED PRIOR TO INSTALL.
 - PATCH IN NEW QUARRY TILE IN THE KITCHEN ADJACENT TO THE NEW COOLER.
 - PATCH IN NEW VCT IN THE CAFETERIA ADJACENT TO THE NEW FREEZER.
 - INFILL XT'G WALL VENT TO THE EXTERIOR. NO LONGER NEEDED PRIOR TO INSTALLING NEW FREEZER.
 - PATCH / PAINT WALLS AS REQUIRED.
 - MISCELLANEOUS ROOF MODIFICATIONS WILL BE NEEDED:
 1. ROOF PENETRATIONS
 2. NEW CURBS
 3. PATCHING EPDM AS NEEDED



MATERIAL FINISH SCHEDULE							
MATERIAL	TAG	MANUFACTURER	STYLE	COLOR	MODEL NO.	SIZE	COMMENTS
ACOUSTICAL CEILING TILE	ACT	USG	RADAR EDUCATION ACOUSTICAL PANELS	WHITE	#2207	2' x 4'	"CLASS A" - UL RATED 1HR ORDER AS NEEDED
PAINT	PT	SHERWIN WILLIAMS	EGG SHELL	NAVAJO WHITE	SW7689	-	STORAGE ROOM WALLS
RUBBER BASE	RB	ARMSTRONG FLOORING	COVED ROLL	EBONY	#R41EB	6"	WALL BASE
VINYL COMPOSITE TILE	VCT	ARMSTRONG FLOORING	STANDARD EXCELON IMPERIAL TEXTURE	PEWTER	51908	12" x 12"	FLOOR TILE - VERIFY COLOR WITH ARCH. PRIOR TO ORDERING

NOTE: THIS SCHEDULE PROVIDES ALL NEW MATERIALS / FINISHES FOR BASES OF DESIGN. REFER TO SPECIFICATIONS TO ADDITIONAL INFORMATION.

KITCHEN FLOOR PLAN - NEW
SCALE: 1/2" = 1'-0"

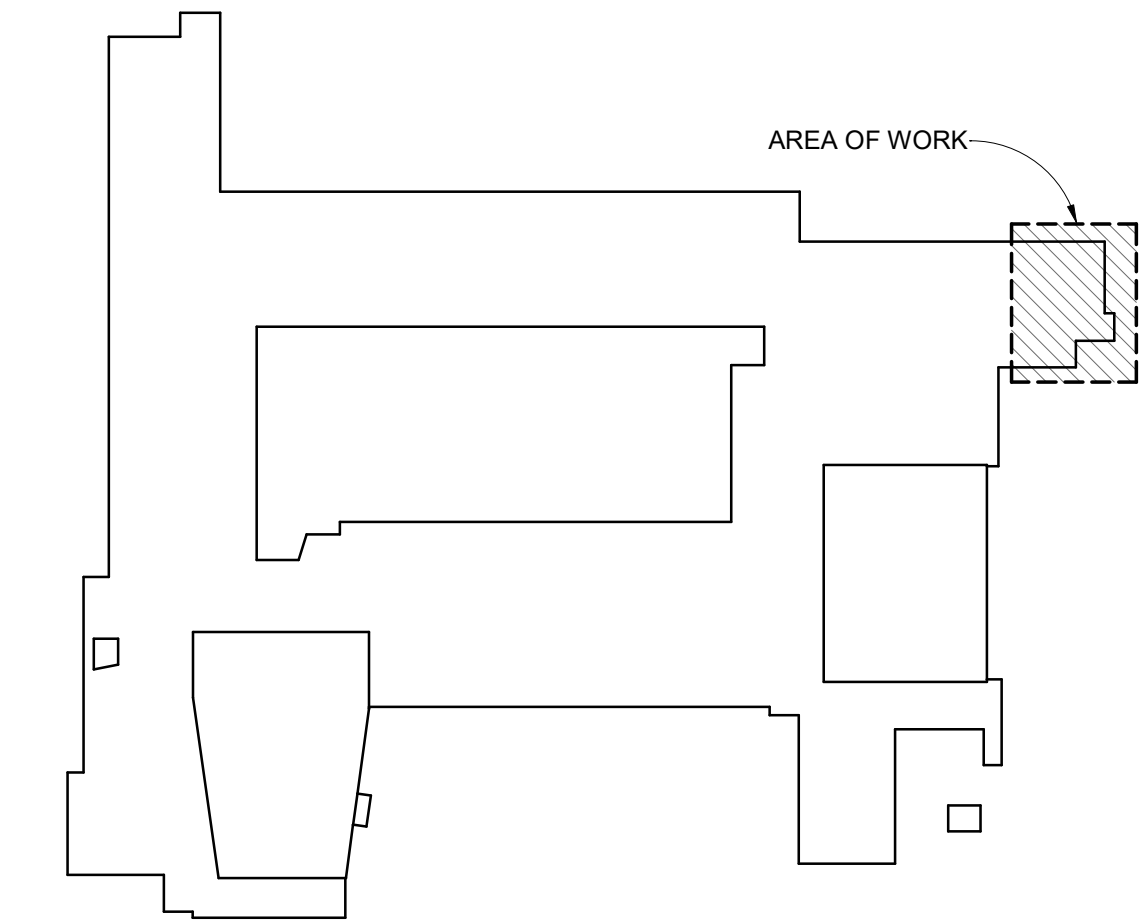
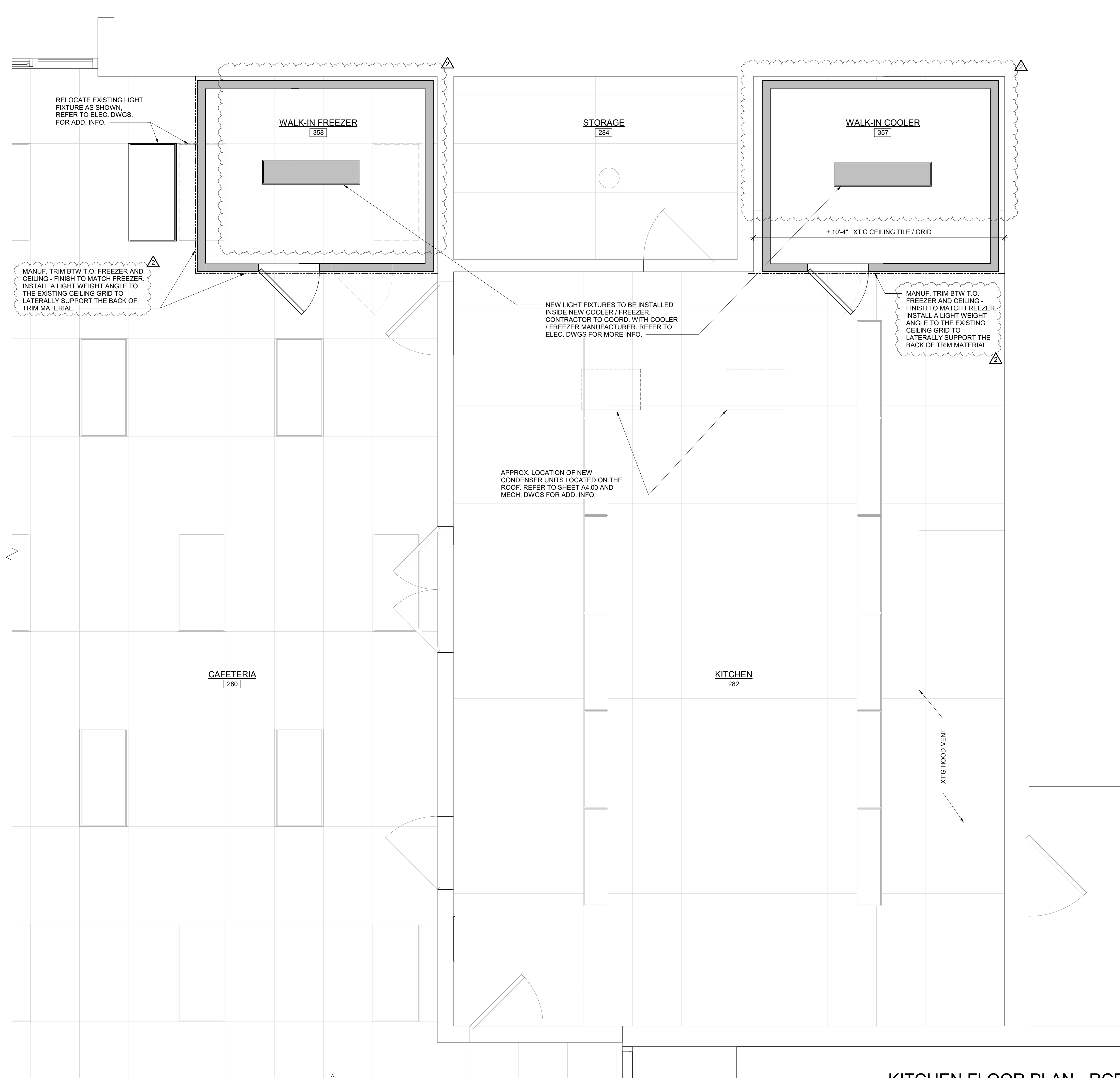
COOLER / FREEZER REPLACEMENT & RELATED WORK

ARBORWOOD SOUTH ELEMENTARY
1008 RIVERVIEW AVENUE, MONROE, MICHIGAN 48162
MONROE PUBLIC SCHOOLS
1275 NORTH MACOMB STREET, MONROE, MICHIGAN 48162

JOB # **24103**

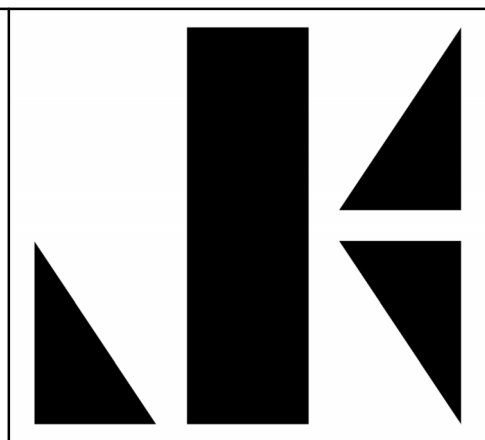
FISRT FLOOR PLAN CONSTRUCTION

A2.00



KEY PLAN
SCALE: 1" = 80'-0"

KITCHEN FLOOR PLAN - RCP
SCALE: 1/2" = 1'-0"



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DATE	DESCRIPTION
03.18.2024	BIDDING & STATE REVIEW
04.10.2024	ADDENDUM #2

COOLER / FREEZER REPLACEMENT & RELATED WORK
AT
ARBORWOOD SOUTH ELEMENTARY
1008 RIVERVIEW AVENUE, MONROE, MICHIGAN 48162
FOR
MONROE PUBLIC SCHOOLS
1275 NORTH MACOMB STREET, MONROE, MICHIGAN 48162

JOB # 24103

REFLECTED CEILING PLAN

A3.00

4/11/2024 3:05:27 PM Autodesk Docs\MPIS - Arborwood South - 24103 - Cooler\24103 - AWS Cooler & Freezer - 2024.rvt



CEL0095AS6AMAB0200 - SUBMITTAL

Project Name:	QUOTE MPS ARBORWOOD	Project Location:	US
Quote ID:	R209296	Item #:	2000
Submitted For:	DORIAN	Submitted On:	01/05/2024
Submitted By:	Mike Mathiasen	Submitted From:	
Identity #:		Tag:	

For Record For Approval By: _____ Date: _____

General Product Information

Product Family:	CEL	Motor type:	2 SPEED EC
Defrost Type:	Air	Number of Fans:	2
Voltage (Volts/Ph/Hz):	115/1/60	Fan HorsePower:	120
Refrigerant Type:	R404A	Fins per Inch:	6

Performance Data

TD (°F)	SST (°F)	Capacity Application Capacity* (BTU/h)	CFM	Air Flow		Altitude (ft)	AWEF Value	
				Standard	w/Coilars		Cooler > 32	Freezer < 32
10	25.0	10,000	1305	12	20	0	9	N/A

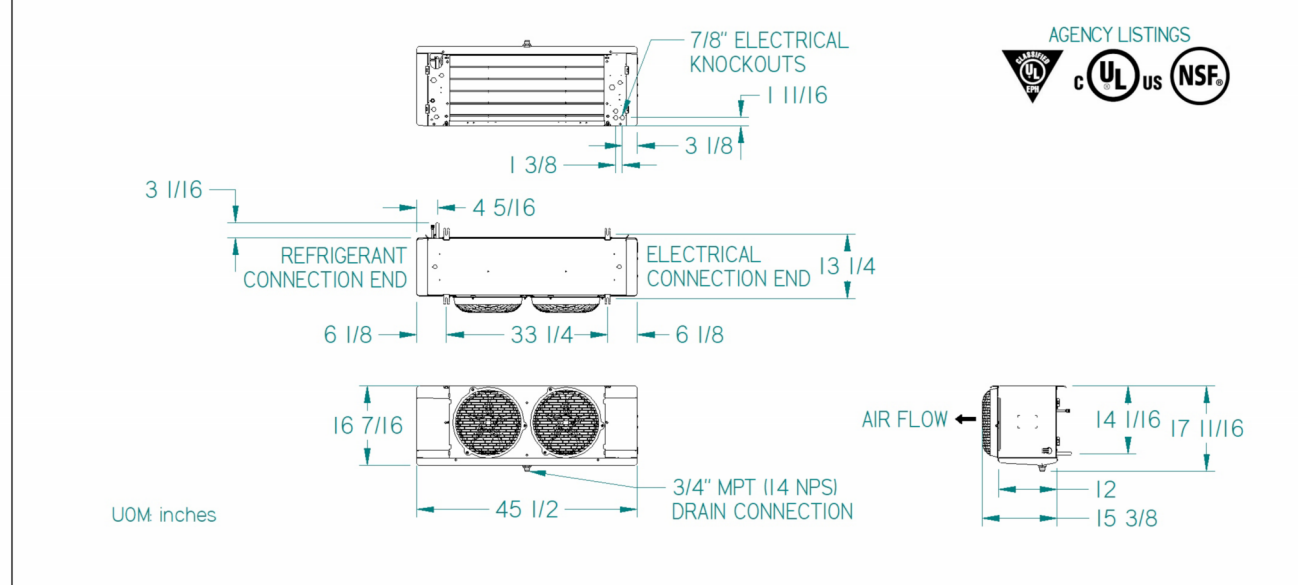
Electrical Data

Fan Motor(s)		Defrost Heater(s)		Drain Pan Heater(s)	
Watts	Amps	Watts	Amps	Watts	Amps
110	1.8				

Unit Specifications

Connections (in.)						Approx. Net Weight (lbs)
Coil Inlet	Suction	External Equalizer	Drain	Side Port	Hot Gas Drain Pan	
1/2	5/8	1/4	3/4			51

Dimensional Drawing(s)



Page 3 of 8



CEL0095AS6AMAB0200 - SUBMITTAL

Project Name:	QUOTE MPS ARBORWOOD	Project Location:	US
Quote ID:	R209296	Item #:	2000
Submitted For:	DORIAN	Submitted On:	01/05/2024
Submitted By:	Mike Mathiasen	Submitted From:	
Identity #:		Tag:	

Standard Features

EASE OF INSTALLATION SERVICE

- ALL ELECTRICAL COMPONENTS FACTORY WIRED TO TERMINAL BOARD AND IDENTIFIED, MAKING IT EASY TO FIELD WIRE THE UNIT

RELIABLE DURABLE

- HEAVY GAUGE GRAINED ALUMINUM CABINET CLEANS EASILY AND LOOKS ATTRACTIVE
- MOLDED FAN GUARD AND ACCESS PANELS ARE MADE OF STRONG, DURABLE, AND NSF AND UL SANITATION RATED PLASTIC MATERIAL
- SMART CONNECTIONS TO REDUCE POTENTIAL FOR LEAKS

VERSATILE

- LARGE DIAMETER DRAIN HOLE (3/4\"/>

PERFORMANCE

- EC MOTORS STANDARD ON ALL MODELS FOR IMPROVED UNIT EFFICIENCY

Options

Mounted Options

- Brand Label - CLIMATE CONTROL
- DTFD Option - None
- Fan Guard - Molded
- Drain Pan Type - Stucco
- Fan Material - Aluminum
- INTELLIGEN WashSense/IRL-System Control Card Add-on - NO
- Liquid Temperature - 55
- Value Family - L

Minimum Unit Clearances



* Capacities shown are Application Capacities reflecting nominal operation at 10°F TD. For models within the scope of the DOE AWEF (Annual Walk-In Energy Factor) standard, the Net Capacity is determined by the AHRI 1250 test method. DOE will publish this compliance data at www.regulations.doe.gov

NOTE: IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO PROVIDE THE COOLER / FREEZER, AND COORDINATE ALL WORK ASSOCIATED. THE DRAWINGS SPECS PROVIDED IS BASIS OF DESIGN.

Page 4 of 8



CCH0010MCACZA0000 - SUBMITTAL

Project Name:	QUOTE MPS ARBORWOOD	Project Location:	US
Quote ID:	R209296	Item #:	1000
Submitted For:	DORIAN	Submitted On:	01/05/2024
Submitted By:	Mike Mathiasen	Submitted From:	
Identity #:		Tag:	cooler

For Record For Approval By: _____ Date: _____

Standard Features

CABINET AND CONSTRUCTION

- MICROCHANNEL COIL TECHNOLOGY STANDARD ON ALL UNITS

QUALITY

- ALL UNITS ARE COMPLETELY LEAK TESTED IN A HELIUM ENVIRONMENT. BUMP TESTED AND ALLOWED TO CYCLE OFF ON THE HIGH AND LOW PRESSURE ELECTRICAL PANEL
- ELECTRICAL CIRCUITS ARE COMPLETELY CHECKED FOR CONTINUITY
- PIPING IS LAID OUT TO MINIMIZE STRESS AND VIBRATION AND IS PRESENT TO ELIMINATE LEAKS
- ENCAPSULATED, AUTO-RESET, HIGH AND LOW PRESSURE CONTROLS TO ELIMINATE LEAKS (ADJUSTABLE LOW PRESSURE CONTROL STANDARD)
- PAINTED STEEL CABINETS FOR SUPERIOR STRENGTH AND CORROSION PROTECTION
- HEAVY DUTY STEEL, 1-1/2\"/>

SERVICEABILITY

- SUCTION SERVICE VALVES FOR HERMETIC AND SCROLL COMPRESSORS LOCATED OUTSIDE THE CABINET FOR QUICK INSTALLATIONS
- RECEIVER WITH FUSIBLE PLUG, LIQUID SHUTOFF VALVE AND CHARGING PORT IS STANDARD
- LARGE ELECTRICAL PANEL FOR EASE OF ACCESS
- PREPARED WIRING HARNESSES FOR TIGHT CRIMP CONNECTIONS AND CONSISTENT LABELING
- UNIT STAYS ON IF THE HOOD IS REMOVED FOR SERVICING
- SIGHT GLASS IS EASILY VIEWABLE

Options

Mounted Options

- Preferred Package Code - A000
- Motor - FIXED SPEED EC
- Receiver Options - STANDARD
- Liquid Line Options - F1 TEE DRIER AND SIGHT GLASS
- Discharge Line Options - HEAD PRESSURE VALVE 150W
- Fused Disconnect - NO FUSED DISCONNECT
- Coilcase Heater - CRANKCASE HEATER
- Pre Charged - NONE
- Hot Gas Defrost Inlet - NONE

Brand Label - CLIMATE CONTROL

- Coil Selection - MICROCHANNEL COIL
- Defrost Timer Options - NO TIMER
- Suction Line Options - SUCTION TUBE ONLY
- Cabinet Selection - Painted
- Pressure Options - ADJUSTABLE LOW - FIXED HIGH
- Phase Loss Monitor - NONE
- Snow Legs - NONE

Minimum Unit Clearances

Walls or Obstructions for Horizontal Air Flow

Multiple Units with Horizontal Air Flow

* Capacities shown are Application Capacities reflecting nominal operation at 10°F TD. For models within the scope of the DOE AWEF (Annual Walk-In Energy Factor) standard, the Net Capacity is determined by the AHRI 1250 test method. DOE will publish this compliance data at www.regulations.doe.gov

Page 2 of 8



CCH0010MCACZA0000 - SUBMITTAL

Project Name:	QUOTE MPS ARBORWOOD	Project Location:	US
Quote ID:	R209296	Item #:	1000
Submitted For:	DORIAN	Submitted On:	01/05/2024
Submitted By:	Mike Mathiasen	Submitted From:	
Identity #:		Tag:	cooler

For Record For Approval By: _____ Date: _____

General Product Information

Product Family:	JRTS	Compressor Brand:	Copeland
Application:	Outdoor	Compressor Type:	Scroll
Temperature Range:	Medium Temp	Compressor Hp:	1
Voltage (Volts/Ph/Hz):	208-230/3/60	Compressor Model:	ZS20KAE-TFS-118
Refrigerant Type:	R404A	Number of Compressor(s):	1
Piping:	Standard	Coil Type:	Microchannel

Performance Data

Ambient Temperature (°F)	Saturated Suction Temperature (°F)	Application Capacity* (BTU/h)	Altitude (ft)	AWEF Value
95	25.0	9,700	0	7.6

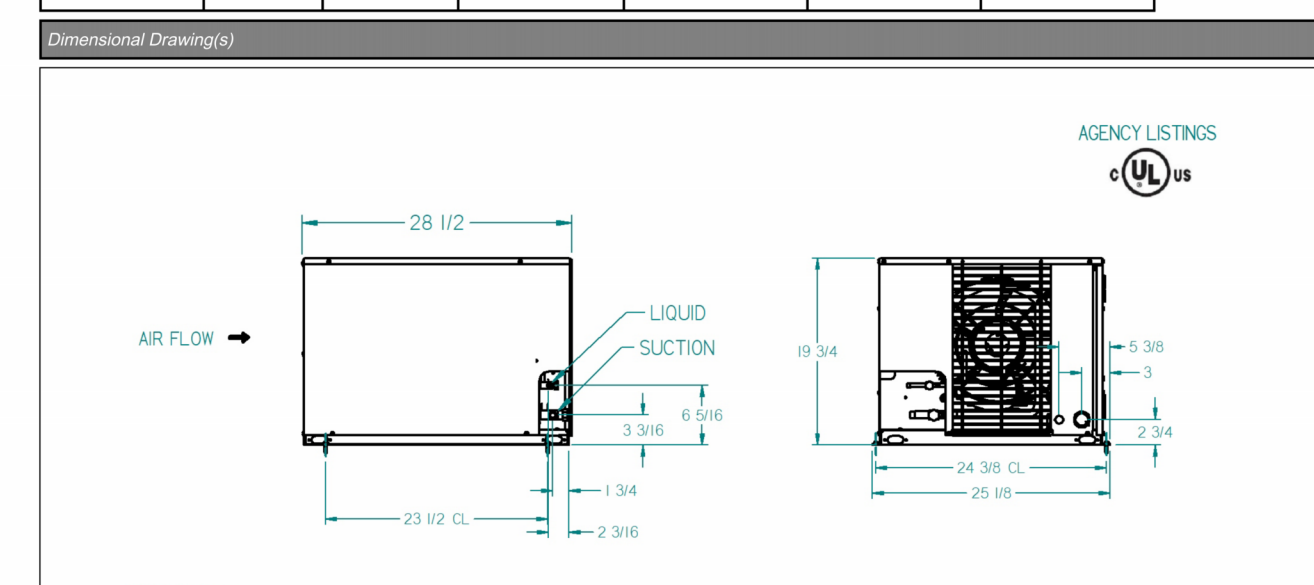
Electrical Data

Compressor(s)		Fan Motor(s)		Defrost		High or Low Amps?		Electric Ratings		Evap Fan Amps	Defrost Heater Amps
RLA	LRA	Quantity	Hp	FLA	Type	Number of Contacts	MCA	MOPD			
7.2	55	1	1/15	0.6	AIR DEFROST		15	15	5	15	

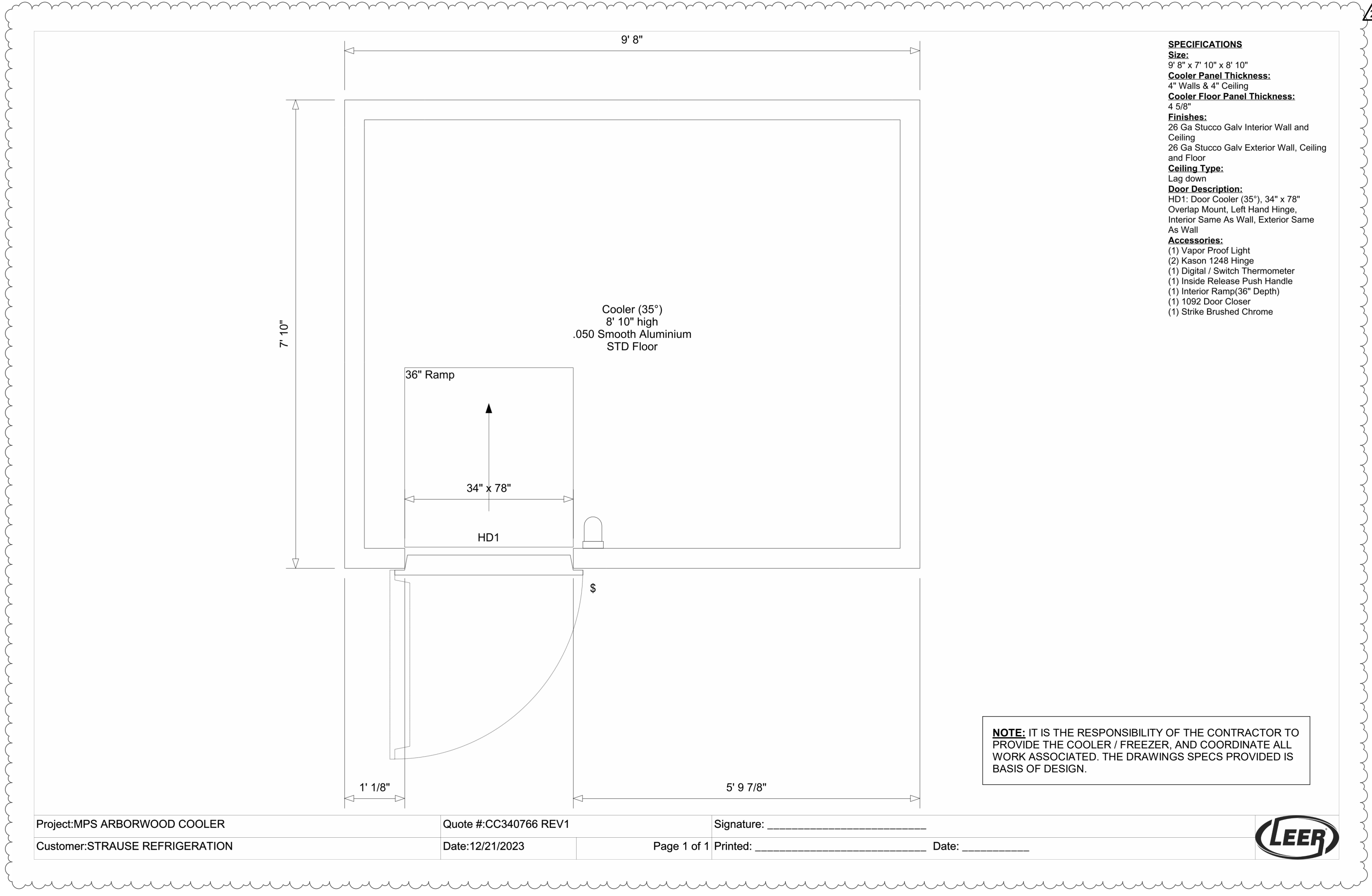
Unit Specifications

Connections (in.)			Receiver 30% Full (lbs)	Fan Motor(s) Diameter (in)	Sound Data (dB)	Approx. Net Weight (lbs)
Liquid Line	Suction	Standard	Over Sized			
0.375	0.625	9		14	61	179

Dimensional Drawing(s)



Page 1 of 8



SPECIFICATIONS
Size:
 9' 8" x 7' 10" x 8' 10"
Cooler Panel Thickness:
 4" Walls & 4" Ceiling
Cooler Floor Panel Thickness:
 4 5/8"
Finishes:
 26 Ga Stucco Galv Interior Wall and Ceiling
 26 Ga Stucco Galv Exterior Wall, Ceiling and Floor
Ceiling Type:
 Lag down
Door Description:
 HD1: Door Cooler (35"), 34" x 78" Overlap Mount, Left Hand Hinge, Interior Same As Wall, Exterior Same As Wall
Accessories:
 (1) Vapor Proof Light
 (2) Kason 1248 Hinge
 (1) Digital / Switch Thermometer
 (1) Inside Release Push Handle
 (1) Interior Ramp(36" Depth)
 (1) 1092 Door Closer
 (1) Strike Brushed Chrome

NOTE: IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO PROVIDE THE COOLER / FREEZER, AND COORDINATE ALL WORK ASSOCIATED. THE DRAWINGS SPECS PROVIDED IS BASIS OF DESIGN.

Project: MPS ARBORWOOD COOLER
 Customer: STRAUSE REFRIGERATION
 Quote #: CC340766 REV1
 Date: 12/21/2023
 Signature: _____
 Date: _____



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DATE	DESCRIPTION
03.18.2024	BIDDING & STATE REVIEW
04.10.2024	ADDENDUM #2

COOLER / FREEZER REPLACEMENT & RELATED WORK

AT **ARBORWOOD SOUTH ELEMENTARY**
 1008 RIVERVIEW AVENUE, MONROE, MICHIGAN 48162

FOR **MONROE PUBLIC SCHOOLS**
 1275 NORTH MACOMB STREET, MONROE, MICHIGAN 48162

JOB # 24103

WALK-IN COOLER SPECS

A8.00



CEL0100BS6EEAB0200 - SUBMITTAL

Project Name:	QUOTE MPS ARBORWOOD	Project Location:	US
Quote ID:	R2989296	Item #:	4000
Submitted For:	DORIAN	Submitted On:	01/05/2024
Submitted By:	Mike Mathiasen	Submitted From:	
Identity #:		Tag:	

For Record For Approval By: _____ Date: _____

General Product Information

Product Family:	CEL	Motor type:	EC
Defrost Type:	Electric	Number of Fans:	2
Voltage (Volts/Ph/Hz):	208-230/1/60	Fan HorsePower:	1/20
Refrigerant Type:	R404A	Fins per Inch:	6

Technical Information

Performance Data

TD (°F)	SST (°F)	Capacity Application Capacity* (BTU/h)	CFM	Air Flow		Altitude (ft)	AWEF Value
				Fan Diameter (in.)	Air Throw (ft)		
10	-20.0	9,900	1281	12	Standard	0	Cooler > .32 Freezer <= .32

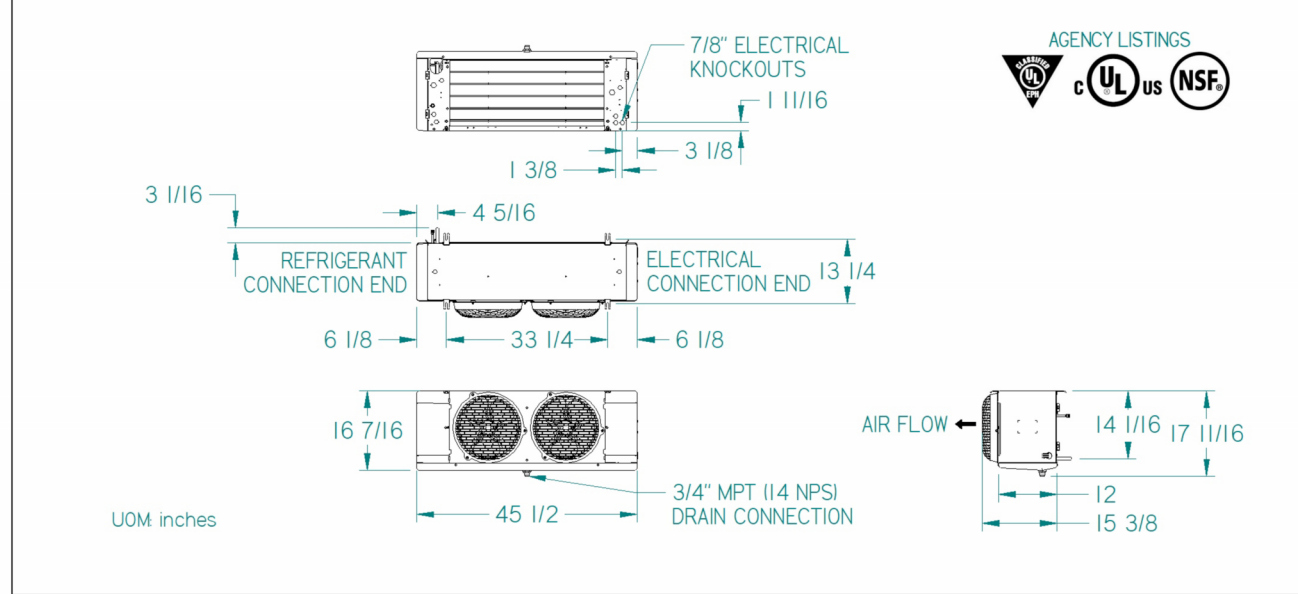
Electrical Data

Fan Motor(s)		Defrost Heater(s)		Drain Pan Heater(s)	
Watts	Amps	Watts	Amps	Watts	Amps
118	1	2100	9.1		

Unit Specifications

Connections (in.)						Approx. Net Weight (lbs)
Coil Inlet	Suction	External Equalizer	Drain	Side Port	Hot Gas Drain Pan	
1/2	7/8	1/4	3/4			59

Dimensional Drawing(s)



Page 7 of 8



CEL0100BS6EEAB0200 - SUBMITTAL

Project Name:	QUOTE MPS ARBORWOOD	Project Location:	US
Quote ID:	R2989296	Item #:	4000
Submitted For:	DORIAN	Submitted On:	01/05/2024
Submitted By:	Mike Mathiasen	Submitted From:	
Identity #:		Tag:	

Standard Features

- EASE OF INSTALLATION SERVICE**
- ALL ELECTRICAL COMPONENTS FACTORY WIRED TO TERMINAL BOARD AND IDENTIFIED, MAKING IT EASY TO FIELD WIRE THE UNIT

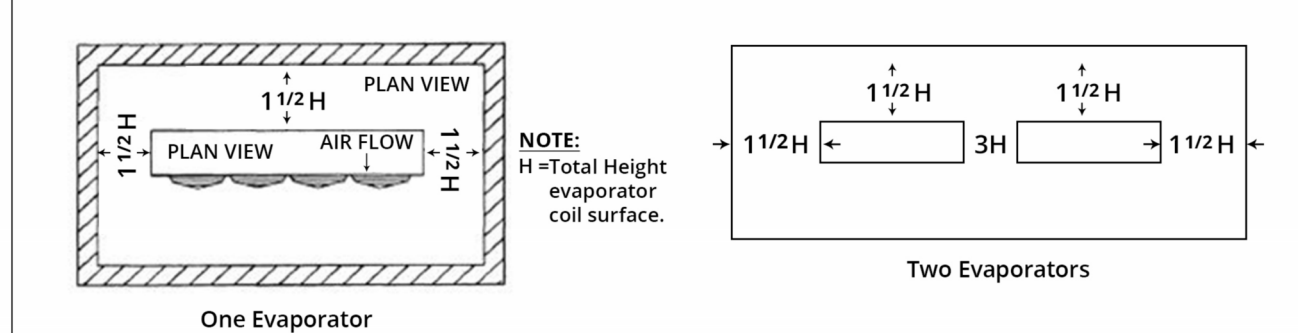
- RELIABLE DURABLE**
- HEAVY GAUGE GRAINED ALUMINUM CABINET CLEANS EASILY AND LOOKS ATTRACTIVE
 - MOLDED FAN GUARD AND ACCESS PANELS ARE MADE OF STRONG, DURABLE, AND NSF AND UL SANITATION RATED PLASTIC MATERIAL
 - SMART CONNECTIONS TO REDUCE POTENTIAL FOR LEAKS

- VERSATILE**
- LARGE DIAMETER DRAIN HOLE (3/4" ID) IS LOCATED TOWARDS THE BACK OF THE UNIT
 - MINIMAL HEIGHT OF THE LOW PROFILE SERIES MAKES IT IDEAL FOR LOW CEILING COOLERS
 - CABINET DESIGN FEATURES HINGED, REMOVABLE FRONT ACCESS PANELS ON EACH SIDE FOR EASY ACCESS TO ELECTRICAL AND REFRIGERATION COMPONENTS
 - LIQUID LINE SOLENOID WIRE HARNESS IS FACTORY-INSTALLED FOR QUICK INSTALLATION
 - MOTORS PLUG INTO WIRING HARNESS FOR EASIER SERVICING
 - HINGED, REMOVABLE DRAIN PAN FOR EASY AND SAFE ACCESS
 - PRE-DRILLED HOLES ON THE BACK OF THE UNIT FOR ROOM THERMOSTAT
 - QUICK REMOVAL FAN GUARD/MOTOR ASSEMBLY FOR EASY SERVICE OR REPLACEMENT OF AIR MOVER PARTS
 - INTERNAL PANELS ARE ISOLATED FOR QUIET OPERATION
 - INTERNALLY ENHANCED TUBING AND FIN DESIGN FOR HIGHER EFFICIENCY

Options

- Mounted Options**
- Brand Label - CLIMATE CONTROL
 - Drain Pan Defrost Voltage - 208-230/1/60
 - Fan Blade - Standard
 - Cabinet Type - Stucco
 - Controller Option - IntelliGen
 - INTELLIGEN Integration Card Add On - NO
 - Coil Mechanical Option - IntelliGen (EV24BWAED / L-1-112)
 - Customer Specified Valve Type - EVV
 - Motor - Fixed Speed EC
 - DTFD Option - None
 - Fan Guard - Mounted
 - Drain Pan Type - Stucco
 - Fin Material - Aluminum
 - INTELLIGEN WashSense/Mini-System Control Card Add on - NO
 - Liquid Temperature - 95
 - Valve Family - L

Minimum Unit Clearances



* Capacities shown are Application Capacities reflecting nominal operation at 10°F TD. For models within the scope of the DOE AWEF (Annual Walk-In Energy Factor) standard, the Net Capacity is determined by the AHRI 1250 test method. DOE will publish this compliance data at www.regulations.doe.gov

NOTE: IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO PROVIDE THE COOLER / FREEZER, AND COORDINATE ALL WORK ASSOCIATED. THE DRAWINGS SPECS PROVIDED IS BASIS OF DESIGN.

Page 8 of 8



CCH0030LCBCZA0000 - SUBMITTAL

Project Name:	QUOTE MPS ARBORWOOD	Project Location:	US
Quote ID:	R2989296	Item #:	3300
Submitted For:	DORIAN	Submitted On:	01/05/2024
Submitted By:	Mike Mathiasen	Submitted From:	
Identity #:		Tag:	Freezer

For Record For Approval By: _____ Date: _____

Standard Features

- CABINET AND CONSTRUCTION**
- MICROCHANNEL COIL TECHNOLOGY STANDARD ON ALL UNITS

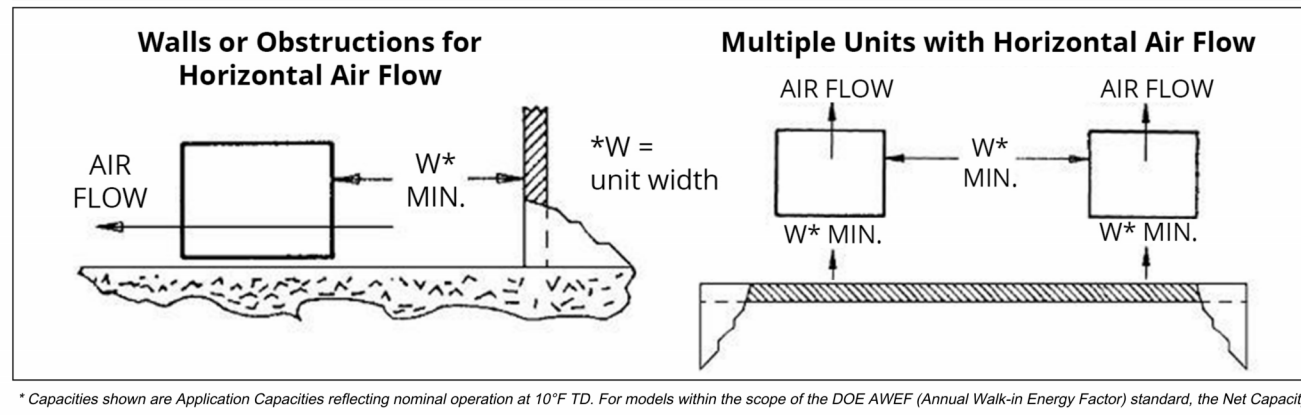
- QUALITY**
- ALL UNITS ARE COMPLETELY LEAK TESTED IN A HELIUM ENVIRONMENT, BUMP TESTED AND ALLOWED TO CURE OFF ON THE HIGH AND LOW PRESSURE CONTROL. EACH UNIT HAS A COPY OF THE RUN DATA SHIPPED INSIDE THE ELECTRICAL PANEL.
 - ELECTRICAL CIRCUITS ARE COMPLETELY CHECKED FOR CONTINUITY
 - PIPING IS LAD OUT TO MINIMIZE STRESS AND VIBRATION AND IS PRESENT TO ELIMINATE LEAKS
 - ENCAPSULATED, AUTO-RESET, HIGH AND LOW PRESSURE CONTROLS TO ELIMINATE LEAKS (ADJUSTABLE LOW PRESSURE CONTROL STANDARD)
 - PAINTED STEEL CABINETS FOR SUPERIOR STRENGTH AND CORROSION PROTECTION
 - HEAVY DUTY STEEL, 1-1/2" TALL BASE

- SERVICEABILITY**
- SUCTION SERVICE VALVES FOR HERMETIC AND SCROLL COMPRESSORS LOCATED OUTSIDE THE CABINET FOR QUICK INSTALLATIONS
 - RECEIVER WITH FUSIBLE PLUG, LIQUID SHUTOFF VALVE AND CHARGING PORT IS STANDARD
 - LARGE ELECTRICAL PANEL FOR EASE OF ACCESS
 - PRE-FABRICATED WIRING HARNESSES FOR TIGHT CRIMP CONNECTIONS AND CONSISTENT LABELING
 - UNIT STAYS ON IF THE HOOD IS REMOVED FOR SERVICING
 - SIGHT GLASS IS EASILY VIEWABLE

Options

- Mounted Options**
- Preferred Package Code - A000
 - Motor - PSC
 - Receiver Options - STANDARD
 - Liquid Line Options - FILTER DRIER AND SIGHT GLASS
 - Discharge Line Options - HEAD PRESSURE VALVE 145W
 - Fused Disconnect - NO FUSED DISCONNECT
 - Coilcase Heater - CRANKCASE HEATER
 - Pre Charged - NONE
 - Hot Gas Valve Installed - NONE
 - Brand Label - CLIMATE CONTROL
 - Coil Selection - MICROCHANNEL COIL
 - Defrost Timer Options - NO TIMER
 - Suction Line Options - SUCTION TUBE ONLY
 - Cabinet Selection - Painted
 - Pressure Options - ADJUSTABLE LOW - FIXED HIGH
 - Phase Loss Monitor - NONE
 - Snow Legs - NONE

Minimum Unit Clearances



* Capacities shown are Application Capacities reflecting nominal operation at 10°F TD. For models within the scope of the DOE AWEF (Annual Walk-In Energy Factor) standard, the Net Capacity is determined by the AHRI 1250 test method. DOE will publish this compliance data at www.regulations.doe.gov

Page 6 of 8



CCH0030LCBCZA0000 - SUBMITTAL

Project Name:	QUOTE MPS ARBORWOOD	Project Location:	US
Quote ID:	R2989296	Item #:	3300
Submitted For:	DORIAN	Submitted On:	01/05/2024
Submitted By:	Mike Mathiasen	Submitted From:	
Identity #:		Tag:	Freezer

For Record For Approval By: _____ Date: _____

General Product Information

Product Family:	HTS	Compressor Brand:	Copeland
Application:	Outdoor	Compressor Type:	Scroll
Temperature Range:	Low Temp	Compressor Hg:	3
Voltage (Volts/Ph/Hz):	208-230/1/60	Compressor Model:	ZP90KE-TFS-231
Refrigerant Type:	R404A	Number of Compressor(s):	1
Piping:	Standard	Coil Type:	Microchannel

Technical Information

Performance Data

Ambient Temperature (°F)	Saturated Suction Temperature (°F)	Application Capacity* (BTU/h)	Altitude (ft)	AWEF Value
95	-20.0	9,120	0	3.15

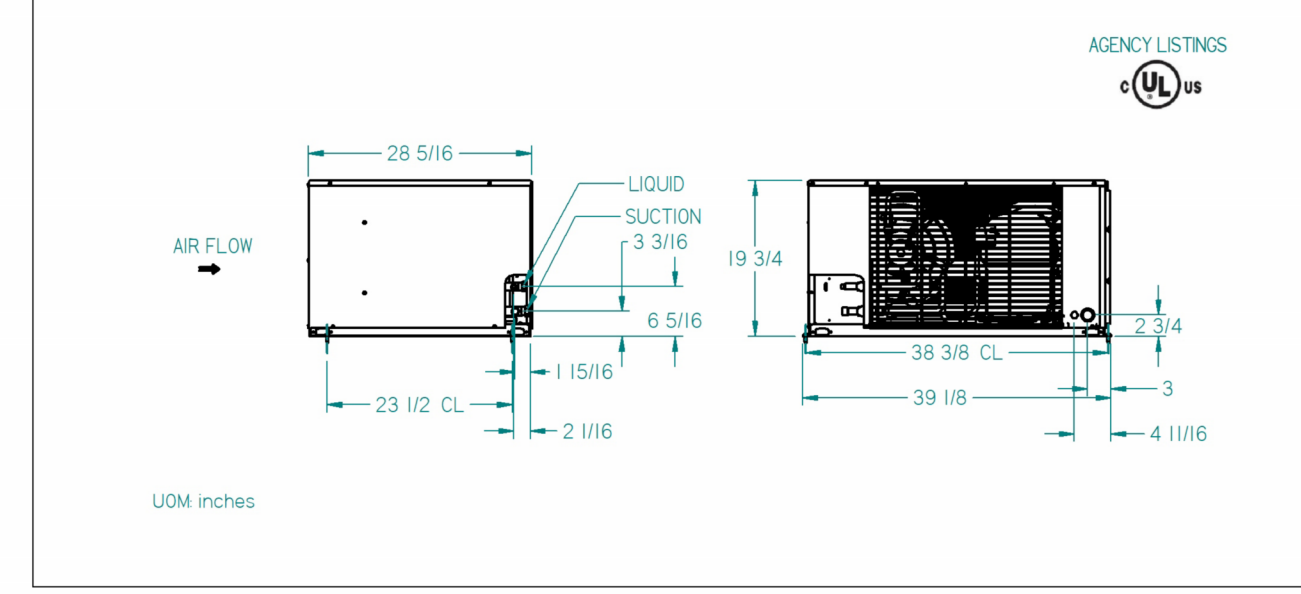
Electrical Data

RA	LSA	Quantity	Hp	FLA	Defrost Type	High or Low Amps?	Electric Ratings			
							Number of Contactors	MCA	MOPD	Evap Fan Amps
9.9	77	2	1/15	1	AIR DEFOREST		15	20	9	23

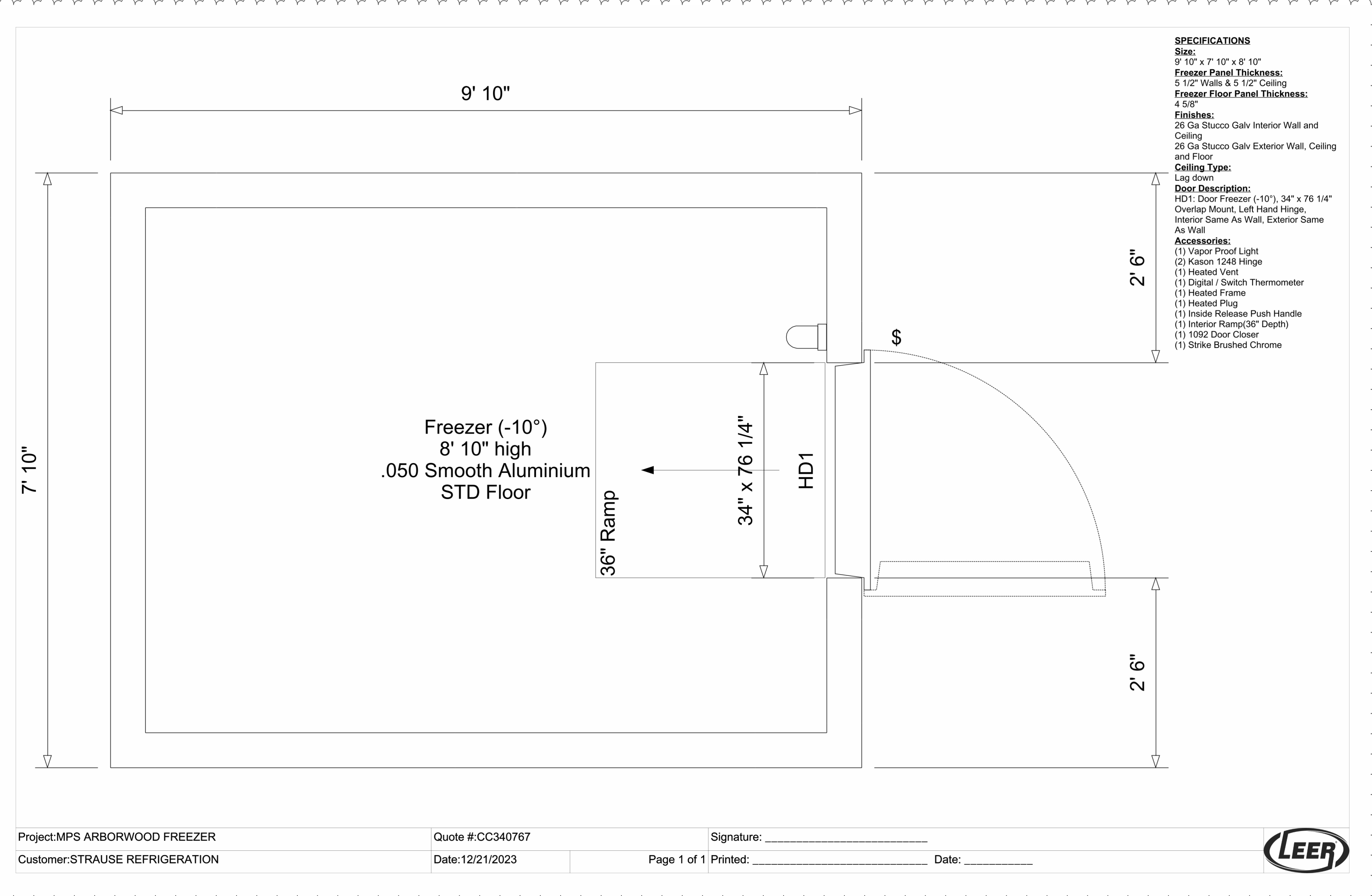
Unit Specifications

Connections (in.)		Receiver 40% Full (lbs)		Fan Blade(s) Diameter (in)		Sound Data (dB)	Approx. Net Weight (lbs)
Liquid Line	Suction	Standard	Over Sized	Standard	14		
0.5	0.875	14	20	14	14	64	230

Dimensional Drawing(s)



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Project: MPS ARBORWOOD FREEZER Quote #: CC340767 Signature: _____
 Customer: STRAUSE REFRIGERATION Date: 12/21/2023 Page 1 of 1 Printed: _____ Date: _____



KOHLER ARCHITECTURE
 1110 WEST FRONT STREET
 MONROE, MICHIGAN 46161
 WWW.KOHLERARCHITECT.NET



DATE	DESCRIPTION
03.18.2024	BIDDING & STATE REVIEW
04.10.2024	ADDENDUM #2

COOLER / FREEZER REPLACEMENT & RELATED WORK

AT **ARBORWOOD SOUTH ELEMENTARY**
 1008 RIVERVIEW AVENUE, MONROE, MICHIGAN 48162

FOR **MONROE PUBLIC SCHOOLS**
 1275 NORTH MACOMB STREET, MONROE, MICHIGAN 48162

JOB # 24103

WALK-IN FREEZER SPECS

A8.05

PLUMBING GENERAL NOTES

PART 1 GENERAL

1.01 PURPOSE

THESE OUTLINE SPECIFICATIONS ARE NOT INTENDED TO COVER ALL NECESSARY ITEMS, BUT TO SERVE AS A GUIDE TO FURNISH AND INSTALL A COMPLETE PLUMBING SYSTEM AS DESCRIBED HEREIN.

1.02 SCOPE OF WORK

FURNISH AND INSTALL THE PLUMBING SYSTEMS AS SHOWN ON THE DRAWINGS AND SPECIFIED HEREIN. THIS SHALL INCLUDE BUT NOT BE LIMITED TO THE FOLLOWING.

- A. EXCAVATION AND BACKFILL REQUIRED FOR THE INSTALLATION OF THE PLUMBING SYSTEMS.
- B. CUTTING AND PATCHING REQUIRED FOR THE INSTALLATION OF THE PLUMBING SYSTEMS.
- C. REMOVALS AS REQUIRED AND/OR AS INDICATED.
- D. SANITARY WASTE AND VENT PIPING SYSTEM INCLUDING PIPING TO ALL FIXTURES OR EQUIPMENT AS INDICATED.
- E. FIRE STOP INCLUDING SLEEVES THRU RATED WALLS AND FLOORS.
- F. ALL FITTINGS, HANGERS, SLEEVES, ESCUTCHEON PLATES, ANCHORS, GUIDES, ETC. REQUIRED FOR THE PLUMBING SYSTEM INSTALLATION, CHLORINATION, TESTING, ADJUSTMENT AND CLEANING OF ALL SYSTEMS AND EQUIPMENT.
- H. TEST THE SANITARY PIPING SYSTEM HYDROSTATICALLY AFTER INSTALLATION TO 10 FT. OF HEAD (4.3 PSI MAXIMUM). TESTING WITH COMPRESSED AIR OR GAS MAY RESULT IN INJURY OR DEATH.
- I. INSTRUCTION OF OWNERS' PERSONNEL AND OPERATING MANUALS FOR ALL EQUIPMENT.
- J. PERMITS, APPLICATIONS, TESTS AND ANY OTHER FEES RELATED TO THIS WORK.

1.03 CONTRACT DRAWINGS

IN GENERAL, DRAWINGS ARE SCHEMATIC IN NATURE AND ARE INTENDED AS A GUIDE TO THE CONTRACTOR, BUT DO NOT NECESSARILY SHOW ALL DETAILS, OFFSETS, ETC. ALL DRAWINGS ARE TO BE THOROUGHLY INSPECTED. THE CONTRACTOR'S WORK SHALL CONFORM TO THE INFORMATION CONTAINED IN THIS SPECIFICATION AND/OR AS INDICATED IN THE LATEST REVISION OF THE DRAWINGS REFERRED TO THEREIN. THE CONTRACTOR SHALL CONSULT WITH THE ENGINEER REGARDING ALL QUESTIONS ON WHICH HE MAY BE IN DOUBT BEFORE PROCEEDING WITH FABRICATION OF PARTS AFFECTED. THE CONTRACTOR SHALL PREPARE ALL ADDITIONAL DETAIL OR FIELD INSTALLATION DRAWINGS NECESSARY AT HIS OWN EXPENSE. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND CONDITIONS INDICATED ON THE ENGINEER'S LAYOUT DRAWINGS AND DETERMINE IF ANY CHANGES ARE REQUIRED IN PIPING RUNS, DRAINS, ETC., TO AVOID INTERFERENCE. MAJOR CHANGES SHALL NOT BE MADE WITHOUT THE APPROVAL OF THE ENGINEER. WHILE THE DRAWINGS ARE TO BE ADHERED TO AS CLOSELY AS POSSIBLE, THE CONTRACTOR HAS THE RIGHT TO VARY THE RUN OF CONDUITS, PIPING AND/OR DUCTS DURING PROGRESS OF THE WORK AS MAY BE FOUND NECESSARY OR DESIRABLE TO AVOID INTERFERENCES. MAJOR REVISIONS SHALL BE VERIFIED WITH THE ENGINEER.

1.04 VERIFICATION

BEFORE RUNNING ANY PIPING, ETC., WITHIN THE BUILDING, THIS CONTRACTOR SHALL ASSURE HIMSELF THAT THEY CAN BE INSTALLED AS CONTEMPLATED WITHOUT TRAPPING OR INTERFERING WITH COLUMNS, BEAMS, PIPING, FIXTURES, ETC. ANY NECESSARY MAJOR DEVIATION SHALL BE REFERRED TO THE ENGINEER FOR ADJUSTMENT BEFORE LINES ARE RUN. AT NO INCREASE IN CONTRACT PRICE. OF NECESSITY, OPENINGS, SUPPORTING STEEL, FIELD-BUILT CURBS, SPACE REQUIREMENTS, ETC., WERE DESIGNED AROUND SPECIFIC PARAMETERS. WHEN THE CONTRACTOR DETERMINES THE MAKE OF EQUIPMENT TO BE PROVIDED FOR THE JOB, IT SHALL BE HIS RESPONSIBILITY TO VERIFY AND COORDINATE UNIT DIMENSIONS WITH THE GENERAL CONTRACTOR AND ALL OTHER INTERESTED CONTRACTORS ON THE JOB. IT SHALL ALSO BECOME THE CONTRACTOR'S RESPONSIBILITY TO CHANGE AS NECESSARY, THROUGH THE ENGINEER, ALL REQUIRED DIMENSIONS SO THAT OPENINGS, SUPPORTING STEEL, CURBS, ELECTRICAL DATA, ETC., WILL FIT THE EQUIPMENT SUPPLIED. ANY ADDITIONAL COST WILL BE THE SOLE RESPONSIBILITY OF THIS CONTRACTOR. IN ADDITION, ELECTRICAL POWER, INTERLOCK AND CONTROL DIAGRAMS AND PIPING ARRANGEMENTS WERE DESIGNED AROUND ONE SPECIFIC MANUFACTURER. IF ADDITIONAL WIRING, PIPING CONTROLS, ETC., IS REQUIRED FOR OTHER EQUIPMENT, THIS CONTRACTOR SHALL INCLUDE THE COST OF THE SAME IN HIS PRICE. DIMENSIONS, ELEVATIONS AND RELATIVE LOCATIONS OF EXISTING EQUIPMENT, SEWERS, PIPES, DUCTS, CONDUITS, ETC., IN PLACE AS SHOWN ON THE DRAWINGS, ARE TAKEN FROM AS-BUILT AND RECORD DRAWINGS AND ARE DEEMED RELIABLE ONLY INsofar AS GENERAL LAYOUT IS CONCERNED. SUCH DIMENSIONS SHALL NOT BE USED FOR LAYOUT DRAWINGS OR DETAILING OF COMPONENTS. THE RESPONSIBILITY FOR CHECKING IN PLACE ITEMS WILL BE THE CONTRACTOR'S. ALL MEASUREMENTS, THE EXACT DETERMINATION OF RELATIVE ELEVATIONS OR LOCATIONS, THE ASCERTAINING OF ACCURACY OF ALL GIVEN ELEVATIONS AND DIMENSIONS AND THE OBTAINING OF ALL NECESSARY ADDITIONAL INFORMATION TO INSURE THE PROPER FIT AND COORDINATION OF ALL CONDUIT EQUIPMENT, DUCTS, AND PIPING SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.

1.05 CONNECTIONS TO EXISTING WORK

PLAN THE INSTALLATION OF NEW WORK AND CONNECTIONS TO EXISTING WORK TO INSURE MINIMUM INTERFERENCE WITH THE REGULAR OPERATION OF THE EXISTING FACILITIES. SUBMIT TO THE ARCHITECT, FOR HIS APPROVAL, A PROGRESS SCHEDULE INDICATING ALL NECESSARY TEMPORARY SHUTDOWNS OF EXISTING SERVICES. ALL SHUTDOWNS SHALL BE MADE AT SUCH TIMES AS WILL NOT INTERFERE WITH REGULAR OPERATION OF THE EXISTING FACILITIES AND ONLY AFTER WRITTEN APPROVAL FROM THE ARCHITECT.

1.06 NEW WORK

UNLESS OTHERWISE NOTED, ALL WORK INDICATED THROUGHOUT THESE DRAWINGS SHALL BE CONSIDERED TO BE NEW WORK AND SHALL BE INCLUDED AS AN INTEGRAL PART OF THIS CONTRACT.

1.07 REFERENCED STANDARDS

2018 MICHIGAN PLUMBING CODE
2015 MICHIGAN BUILDING CODE

1.08 APPROVED MANUFACTURERS

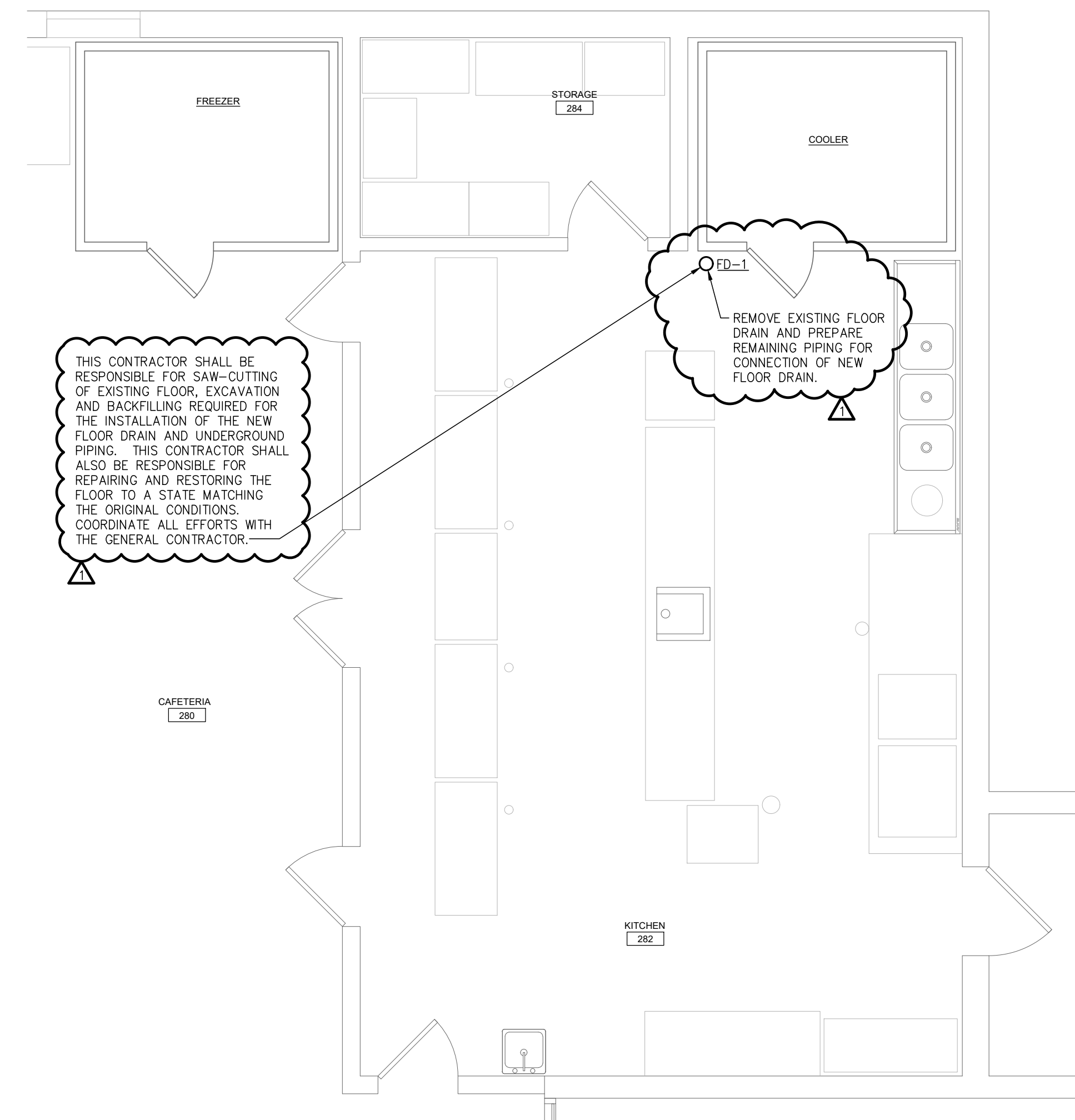
- 1. CLEANOUTS; ZURN, J.R. SMITH, MIFAB
- 2. FLOOR DRAINS; ZURN, J.R. SMITH, MIFAB

PART 2 EXECUTION

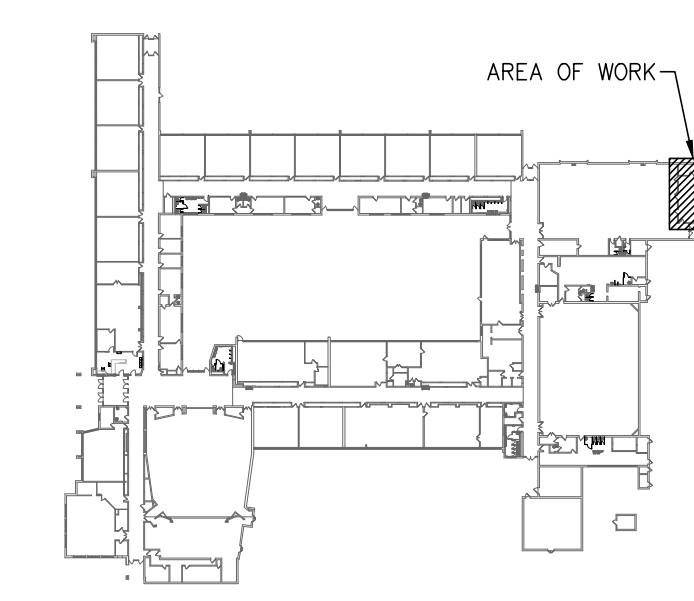
- A. ALL EQUIPMENT INSTALLATION PROCEDURES SHALL BE BASED ON FUNDAMENTAL ENGINEERING AND CONSTRUCTION PRINCIPLES IN CONFORMANCE WITH ALL APPLICABLE CODES, STANDARDS AND ORDINANCES.
- B. THE PLUMBING CONTRACTOR SHALL INSTALL ALL PLUMBING EQUIPMENT IN CONFORMANCE WITH MANUFACTURER ISSUED INSTRUCTIONS AND RECOMMENDATIONS.
- C. THE PLUMBING CONTRACTOR SHALL NOT KNOWINGLY INSTALL WORK THAT IS IN ERROR.
- D. PROVIDE TWO (2) YEAR WARRANTY ON ALL LABOR AND MATERIALS UNLESS NOTED OTHERWISE.
- E. THE PLUMBING CONTRACTOR IS RESPONSIBLE FOR ALL PERMITS AND FEES REQUIRED FOR HIS WORK.
- F. THE PLUMBING CONTRACTOR SHALL PROVIDE AS-BUILT DRAWINGS OF HIS COMPLETED WORK.
- G. THE SYSTEMS REPRESENTED IN THESE CONTRACT DOCUMENTS HAVE THE INTENT OF PROVIDING ENERGY-EFFICIENT, SAFETY AND COMFORT FOR THE PROPOSED FACILITY.
- H. THE PLUMBING CONTRACTOR SHALL COORDINATE HIS WORK WITH ALL OTHER TRADES ON THE PROJECT.

PLUMBING LEGEND

- V --- SANITARY VENT PIPING
- V --- EXISTING SANITARY VENT PIPING
- SAN --- SANITARY PIPING BELOW FLOOR
- SAN --- EXISTING SANITARY PIPING BELOW FLOOR
- SAN --- SANITARY PIPING ABOVE FLOOR
- ////// PIPING DEMOLITION
- EQ. FLOOR CLEANOUT
- WCO WALL CLEANOUT
- A.F.F. ABOVE FINISHED FLOOR
- F.F.E. FINISHED FLOOR ELEVATION
- I.E. INVERT ELEVATION
- P.C. PLUMBING CONTRACTOR
- G.C. GENERAL CONTRACTOR
- CONNECTION OF NEW TO EXISTING
- PIPING ELBOW DOWN
- PIPING ELBOW UP
- PIPING TEE DOWN
- PIPING TEE UP



PARTIAL PLUMBING PLAN
SCALE: 1/4" = 1'-0"



KEY PLAN
SCALE: NONE

PLUMBING FIXTURE SCHEDULE

DESCRIPTION	SYMBOL	CW	HW	WASTE	VENT	SPECIFICATIONS
FLOOR DRAIN	○	FD-1	---	---	3"	ZURN #ZN415B, COATED CAST IRON BODY, BOTTOM OUTLET, COMBINATION INVERTIBLE MEMBRANE CLAMP AND ADJUSTABLE COLLAR AND 5" ROUND "TYPE B" POLISHED NICKEL BRONZE STRAINER. PROVIDE ZURN #Z1072 BARRIER TYPE TRAP SEAL PROTECTION DEVICE.

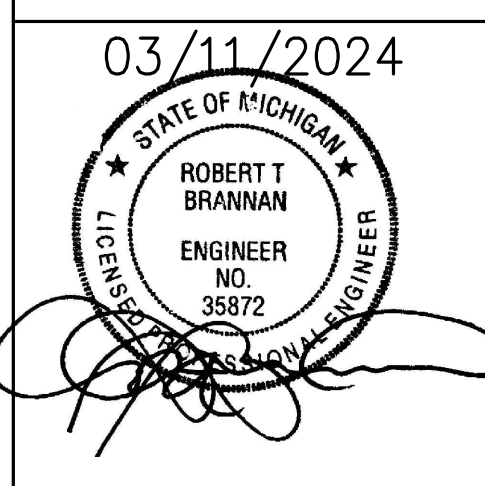
PLUMBING DRAWING LIST

DWG. NO.	TITLE	FILE NO.
P1.01	PLUMBING SPECIFICATIONS AND PARTIAL PLAN	24003612P1.01.dwg

THIS ITEM HAS BEEN ELECTRONICALLY SIGNED AND SEALED BY ROBERT TIMOTHY BRANNAN, PE. USING A DIGITAL SIGNATURE AND DATE. PRINTED COPIES OF THIS DOCUMENT ARE NOT CONSIDERED SIGNED AND SEALED, AND THE SIGNATURE MUST BE VERIFIED ON ANY ELECTRONIC COPIES.



03/11/2024



DATE	DESCRIPTION
03.18.2024	BIDDING & STATE REVIEW
04.10.2024	ADDENDUM #2

COOLER / FREEZER REPLACEMENT & RELATED WORK

AT
FOR
ARBORWOOD SOUTH ELEMENTARY
1008 RIVERVIEW AVENUE, MONROE, MI 48162
MONROE PUBLIC SCHOOLS
1275 N. MACOMB STREET, MONROE, MI 48162

JOB # 24103

PLUMBING SPECIFICATIONS AND PARTIAL PLAN
P1.01