**HEATING, VENTILATING AND AIR CONDITIONING CONSTRUCTION**

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HEATING, VENTILATING AND AIR CONDITIONING CONSTRUCTION SPECIFICATION

SECTION 230015 – BASIC HVAC REQUIREMENTS

SCOPE

1. These specifications and the contract drawings are intended to be utilized by the Prime HVAC Contractor installing the heating, ventilating and air conditioning systems, and include all structural, plumbing, electrical and roofing work required for a complete project. These Specifications are not to be interpreted to contain certain basic system installation knowledge essential for a complete and quality installation.

2. The Contractor is to furnish labor, materials and equipment required to completely install each system indicated on the plans and as here within specified.

3. The Contractor is to carefully examine the site, plans and specifications and include labor and equipment necessary to perform, but not necessarily limited to the following work:

   A. Disconnect and remove existing air handling units, roof mounted condensing units, VVT dampers, ductwork, diffusers, etc. as indicated on the Drawings. Reclaim all R-22 refrigerant. Properly dispose of all equipment being removed. The Electrical Sub-Contractor is to disconnect all power wiring prior to start of work.

   B. Properly clean all existing refrigerant piping to prepare it for its reuse with R410a refrigerant. Note: the contractor is to verify existing pipe sizing is adequate for R410a use.

   C. Furnish and install two (2) new air handling units.

   D. Furnish and install two (2) rooftop mounted condensing/compressing units. Connect the new condensing/compressing units to the cleaned existing refrigerant piping and reconnect piping to the new cooling coils in the two (2) new air handling units. Charge units with R410a refrigerant to the charges required by the condensing unit manufacturer.

   E. Connect existing hot water supply and return piping to the two (2) new air handling units.

   F. Furnish and install new supply and return ductwork, supply diffusers, return grilles, variable volume/variable temperature (VVT) control dampers, sensors, thermostats, etc. as indicated on the drawings and as here-in specified to provide new VVT controls for the upgraded second and third floor HVAC systems.

   G. Any additional work as indicated on the Drawings and/or these Specifications.
GENERAL

1. The terms "the Contractor", "this Contractor" or "HVAC Contractor" mentioned in these specifications refers to the Prime HVAC Contractor responsible for all work and equipment for this project included in these Specifications.

2. The Contractor is to furnish equipment, labor, materials, tools, services and facilities necessary for installation of the heating, ventilating and air conditioning systems, in general, as noted under "scope" and more fully specified herein. The Contractor is to carefully examine the site, existing conditions, plans and specifications before submitting his proposal as he will be held responsible for the complete installation in every detail.

3. Applicable requirements of the "general conditions" and "general requirements" apply to this entire specification and are to have the same force and affect as if printed herewith in full.

4. Work and materials are to be installed subject to the approval of the Engineer and the Owner's Representative. Where the word "Engineer" appears in this specification, it means Engineer and Owner's Representative.

5. The Contractor is solely responsible for work, material, and equipment furnished for the contract, including those of his subcontractors, until completion of the project and final acceptance. Damaged work or materials are to be replaced. The Contractor is to provide necessary off-site storage for the protection of the material and equipment for the contract.

6. The Contractor is solely responsible for the health and safety of all workers, visitors, bystanders or any persons exposed to this jobsite. The Contractor is solely responsible for all safety training, construction techniques, proper use of equipment, etc. that may pose a risk. Nothing shown on the drawings or specifications is to be construed as relieving the contractor from this responsibility.

7. The drawings are indicative of the character and scope of the work and are diagrammatic and not intended to show all details. The Contractor is to report ambiguities or discrepancies to the Engineer for written clarification before submitting a bid. Important: The drawings are diagrammatic and are for bidding purposes. The Contractor is not to fabricate piping or ductwork from these drawings.

8. Construction is to be executed with the maximum speed consistent with good workmanship.

9. Before commencing work, the Contractor is to carefully examine the site and mechanical drawings. If any discrepancies occur between the drawings, or between site conditions and the drawings and specifications, he is to report such discrepancies to the Engineer in writing and obtain written instruction as to the manner in which to proceed. No departures from the contract drawings are to be made without prior written approval of the Engineer.

10. During the course of construction, conflicts and discrepancies which the contractor failed to notify the Engineer of are to be interpreted by the Engineer so as to obtain a consistent and workmanlike installation. The Contractor is bound by the Engineer's decision and is to carry out the work at no additional cost to the Owner.

11. Material and equipment to be furnished under the contract is to be new and conform to the grade, quality, style, size and standards as specified herein. Equipment is to be the latest standard product
as advertised in printed catalogs by reputable manufacturers for the purpose intended and have replacement parts available.

12. The Contractor is to assume sole responsibility for structural, mechanical, and electrical changes required to accommodate substituted material or equipment.

13. Equipment, material or apparatus of any one system is to be the product of one manufacturer, or equivalent products of a number of manufacturers which are suitable for use as indicated in the various systems. Similar equipment, material or apparatus of the same or similar type are to be as manufactured by the same manufacturer.

14. Equipment is to be installed in strict accordance with the manufacturer's instruction for type and capacity of each piece of equipment. The Contractor is to obtain these instructions from the manufacturer and include same with the submission of the equipment. The type, capacity, and application of equipment are to be suitable and capable of satisfactory operation for the purpose intended.

15. The Contractor is to give requisites, notices, obtain and pay for permits, and pay deposits and fees necessary for the installation tests and inspection of work provided under this specification. These tests are to be conducted as required by the regulations of the Local and/or State Authorities.

PROJECT MANAGEMENT

1. Management of the project is to be provided. It is essential that such management is provided, for without it, poor quality, waste, shortcuts and delays will result. It is important the work of this project be completed during the period specified. The Contractor is to assign and identify one (1) individual as the Project Manager who is to be capable to communicate electronically, i.e. via email, text message, smart phone, etc.

PROJECT RECORD DOCUMENTS

1. During the progress of the work, the HVAC Contractor, assigned Sub-Contractors and major Sub-Contractors employed by them, are to maintain a current (daily) record set of contract drawings (prints) and specifications, indicating thereon work installed at variance with such contract documents, including work covered by supplemental contracts, addenda, change orders or other bona fide sources.

2. At the completion of the construction work and prior to acceptance of the project, the Contractor is to furnish the Engineer a complete set of "record" red-lined prints indicated thereon changes and revisions from the original contractor documents and such additional details as to provide a complete reference document for use by Owner. If variations and details cannot be shown clearly thereon, then the Contractor is to prepare supplemental drawings adequate to impart the information.

3. Notations on "record" drawings are to be executed in a legible manner by the Contractor.

COMPLIANCE WITH CODES, LAWS AND REGULATIONS
1. Work is to conform to applicable codes including, but not limited to the following:

   A. The International Mechanical Code/2012 (or most recent edition adopted by the authority having jurisdiction).

   B. International Energy Conservation Code/2012 (or edition most recently adopted by the authority having jurisdiction).


   E. All other applicable local, state and national codes.

2. If an above named code has been replaced by an updated version and has been adopted by the authority having jurisdiction, the Contractor will be held responsible for complying with the same.

3. Materials and equipment under the contract are to be new and bear the underwriter's laboratories label wherever a standard has been established by that agency.

HAZARDOUS MATERIALS AND WASTE DISPOSAL

1. Hazardous materials: Contractors and Sub-Contractors are obligated to exchange information with the Owner on materials which could cause harm to employees and/or other personnel on or near the project site. A pre-construction meeting will be scheduled between the Contractor and Representatives of the Owner to review the project and the possible hazards involved. The Contractor is required to continue to up-date representatives of the Owner in writing whenever new chemicals or materials are introduced into the project site. The Contractor or Sub-Contractor is required to obey federal, state and local laws relating to chemicals and hazardous materials and also to promptly furnish any and documentation required by the Owner.

2. Waste Disposal: Disposal of unused material is the responsibility of the Contractor, Sub-Contractor or vendor who brought the material onto the project site.

COORDINATION/SCHEDULING OF WORK

1. Coordination with the Owner’s Representative is of utmost importance due to the fact that the building may be occupied during the construction period. All work schedules are to be approved weekly by the Owner’s Representative prior to commencing work.

2. The Contractor is to cooperate with his/her Sub-Contractors and arrange the work to eliminate confliction with the conduit, piping and equipment of other contracts, and to avoid conflictions with the existing items.

3. Although the Drawings are to be indicative of general routings, the actual location of pipes, ductwork and equipment are to be determined at the site. The Contractor is to confer with his Sub-Contractors and the Owner’s Representative as to the locations of different lines of pipes, ducts,
and equipment before erecting any work in order to avoid interference. The Contractor is to insure proper securing and anchoring of work.

4. Changes necessary due to lack of coordination or because of poor workmanship are to be made at no additional cost to the Owner, i.e., should any Contractor proceed with the installation of equipment, pipe, etc., prior to coordinating with the other Contractors and that equipment, pipe, etc., prevents proper installation of work of other trades, the offending Contractor is to remove and replace his work at his own cost.

5. Where the HVAC Contractor is installing new electrically operated equipment he is to furnish his Electrical Sub-Contractor pertinent information regarding electrical requirements of the motor operated and electrical control equipment to be furnished under this contract. Information is to include electrical characteristics, exact rough-in dimensions, information on remote control equipment, special instructions of the manufacturer and wiring diagrams if required.

6. Connections to heating and air conditioning equipment is to be made in a neat and workmanlike manner, placing the equipment in proper operating condition, with suitable provisions for maintenance or replacement, when available, the equipment manufacturer's recommendations are to be followed in making final decisions.

REMOVAL OF EXISTING MECHANICAL CONSTRUCTION

1. The HVAC Contractor is to disconnect and remove existing HVAC equipment as shown on the Drawings. The Scope of the removal work is generally indicated on the Drawings; however, not all items are shown - the Contractor must visit the site to review the amount of demolition required. This work is to include removal of accessories intimate to the removed item such as hangers, supports and like items. Off-site disposal of removed items is to comply with local, state and federal regulations. Refrigerant (if any) is to be reclaimed per Federal Regulations.

   **Important Note:** Scrap value of the equipment, piping, etc. being removed is to be taken into account when preparing bids.

2. Openings in existing construction and the repair and refinishing of such openings that are necessary for the entrance of new equipment or the removal of existing equipment are to be included in the Contract.

3. Proper recycling or disposal of removed items is mandatory.
SUBSTITUTIONS

1. The various materials and products specified in the Specifications by name or description are given to establish a standard of quality and of cost for bid purposes. It is not the intent to limit the acceptance to any one material or product specified but rather to name or describe a material or product as the absolute minimum standard that is desired and acceptable. A material or product of the lesser quality would not be acceptable.

2. **IMPORTANT**: Where a product is named by manufacturer and model number and other manufacturer's names are listed in parentheses (), those names in parentheses are considered to be substitute manufacturers whose equipment may be acceptable, providing they meet the intent of the Specification, and meet or exceed required capacities.

3. Where the words “or equivalent” are noted, the Contractor is free to provide equivalent items, however the final decision on those items being equivalent will be by the Engineer.

4. Where only one name is stated in this Specification, only that manufacturer's equipment will be acceptable unless otherwise approved by the Engineer or Owner’s Representative.

5. Equipment is to be installed in accordance with the manufacturer's data and recommendations.

6. Where equipment is not specified, it is intended that only first grade material be used. Only new equipment in good condition will be accepted. Equipment is subject to inspection and approval of the Engineer.

7. Items installed prior to approval by the Engineer are at the Contractor's risk. The Engineer may require non-approved items to be removed and replaced with specified items.

8. **EXTREMELY IMPORTANT**: Resubmission of items rejected or marked "Revise and Resubmit" will be reviewed one time by the Engineer at no cost to the Contractor. Should the resubmittal be rejected or marked "Revise and Resubmit", the Contractor will be invoiced for any additional time spent by the Engineer at his current billing rate.

WORK IN THE EXISTING BUILDING

1. The Contractor is to visit the site and thoroughly familiarize himself with the existing conditions before submitting his Proposal as he will be held responsible for the removal and/or relocation of certain existing equipment. The Contractor is to notify the Engineer of any discrepancies identified during his site visit that affect the design.

2. The Contractor is to thoroughly familiarize himself with the Specifications and Construction Drawings to determine the extent of the HVAC work and the work indicated there-in.
CUTTING AND PATCHING

1. The HVAC Contractor will be responsible for all cutting and patching of existing walls, floors and ceilings as necessary for installation of piping and equipment on this project. The HVAC Contractor will be responsible for patching and finishing such openings.

2. If roof work is required a Roofing Sub-Contractor is to be employed and is to be responsible for all cutting and patching of the roof.

3. No cutting is to be done which may in any way affect the building structurally.

4. Patching is to match adjacent surfaces, and is to be finished with the same material, paint, etc., as adjacent surfaces. Where walls are to be patched and painted, paint the entire wall to eliminate areas where paint doesn’t match.

5. Where ceiling tile or ceiling material must be cut for removal of existing or installation of new equipment, ductwork or piping, the HVAC Contractor is responsible for such cutting and patching where required, and is to furnish and install new ceiling tile if tiles are damaged during installation.

COORDINATION OF PIPING/DUCTWORK AND EQUIPMENT WITH EXISTING INTERFERENCES

1. The Drawings are diagrammatic due to the small scale and it is not possible to indicate each item required for a total operating system. However, the HVAC Contractor is to visit the site and carefully map out rises, drops and where equipment is to be placed prior to fabricating ducts, pipes, etc. The Contractor is to provide such offsets, valves, fittings and specialties as required in ductwork and piping to avoid interferences. The HVAC Contractor is to carefully investigate conditions affecting his work and to coordinate this work with that of other contractors to prevent interferences. Where interferences develop at the site, the Engineer is to determine which equipment must be relocated regardless of which was first installed. Relocation of work required because of lack of coordination between Contractors will ultimately be the financial responsibility of the Prime Contractor.

EQUIPMENT SUPPORTS, STANDS, ETC.

1. Where ceiling or wall mounting of equipment is indicated or specified, use suspended platform or strap hangers, bracket or shelf, whichever is most suitable for equipment and its location, unless indicated otherwise on the Drawings. Construct of structural steel members, steel plates, hanger rods, etc., as required or as indicated on the Drawings. Brace and fasten to building structure or to inserts as approved by the Engineer.

2. Equipment suspension assemblies are to be constructed of supporting members of strength to safely withstand stresses to which they may be subjected and to distribute properly the load and impact over building areas. Conform to applicable technical societies' standards and to codes and regulations of all agencies having jurisdiction.

EQUIPMENT CONNECTIONS AND MAINTENANCE PROVISIONS
Allegany College of Maryland  
Gateway Building  
Second & Third Floor HVAC Upgrades

1. Connections to HVAC equipment is to be made in a neat and workmanlike manner, placing the equipment in proper operating condition, with suitable provisions for maintenance or replacement, when available, the equipment manufacturer's recommendations are to be followed in making final decisions.

SHOP DRAWINGS

1. The Contractor is to furnish shop drawings for each major piece of equipment as listed below and as herein specified to the architect for review by the Engineer. The number of copies of these shop drawings are to be as required by the Prime HVAC Contractor for his files, Sub-Contractors and vendors, and copies of maintenance data for maintenance manuals, plus two (2) copies (one (1) copy for the Engineer and one (1) copy for the Owner).

2. The submittals are to be complete with necessary construction and functional details requisite for a thorough evaluation. Such items as are rejected are to be promptly resubmitted in conformity with the specification requirements. Corrections or comments made on shop drawings during this review will not relieve the Contractor from compliance with requirements of the drawings and specifications. This check is only for review of general compliance with the information given in the contract documents. The Contractor is to be responsible for: confirming and correlating quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of other trades and performing his work in a safe and satisfactory manner.

3. Information and data are to be submitted for the following items:

   A. Air Balance Reports
   B. Air Handling Units
   C. Condensing/Compressing Units
   D. Copies of Warranty Cards
   E. Ductwork Insulation
   F. Grilles, Registers, and
   G. Letter of Certification That Instructions Have Been Given
   H. Maintenance Manuals
   I. Manual Volume Dampers
   J. Refrigerant Pipe Cleaning System
   K. Variable Volume/Variable Temperature

4. In the event of a dispute as to whether or not a particular item of equipment or material meets the specification requirements, the decision of the Engineer is final. Refer to SUBSTITUTIONS as hereinbefore specified.
RECEIPT OF EQUIPMENT

1. New equipment being used on this project, whether delivered to jobsite or to this Contractor’s place of business is to be examined (to determine if the equipment was damaged) prior to signature of receipt by the Contractor’s Representative. It is the Contractor's responsibility to file damage claims with the mover (truck, railroad, etc.) at time of receipt of damaged equipment.

STORAGE OF MATERIAL

1. The Contractor is to erect and maintain proper facilities for protecting materials and equipment furnished under this Contractor during each phase of construction until acceptance by the Engineer. Any damaged materials or equipment is to be repaired or replaced by the Contractor at his own expense to the satisfaction of the Engineer and the Owner's Representative.

2. Protection is to include sheds or other buildings as required for protection of materials and equipment. In the event the available areas on the site are inadequate, the Contractor is to, at his own expense, provide suitable storage under roof at other locations.

PROTECTION OF EQUIPMENT

1. It is to be the responsibility of the Contractor to protect equipment, piping, insulation, controls and similar items of equipment from dirt, grime, plaster and water during each phase of construction. This protection is to be provided by off-site storage inside building, sheds, etc. and covering with transparent plastic sheeting, caps or as required to the satisfaction of the Engineer.

ELECTRICAL REQUIREMENTS FOR EQUIPMENT INSTALLATION

1. A fused disconnect switch is to be furnished by the equipment manufacturer or by the HVAC Contractor for each new condensing/compressing unit. Disconnect switch is to be NEMA 3R fused, weathertight switch. Provide a fused disconnect switch for each new air handling unit.

2. All electrical work required for the completion of the entire project is to be performed by a Registered Electrician who is either an employee of the Prime HVAC Contractor or a Sub-Contractor to the Prime HVAC Contractor. Refer to Division 260000 Sections of this Specification for electrical requirements.

3. Temperature control components such as thermostats as well as control wiring, incidental power wiring, conduit, etc., as required by this specification, are to be furnished and installed by the HVAC Contractor.

4. For all three (3) phase equipment, the unit manufacturer or the Contractor is to provide phase loss/phase reversal/low voltage protection, either internal to the unit or as options to the disconnect switch.

5. Electrical equipment, components and wiring furnished and installed by the HVAC Contractor are to conform to the following electrical requirements, codes and regulations:
6. **Underwriter's Labels:** Where applicable, materials and equipment are to bear the label as listed by the National Board of Fire Underwriter's Laboratory.

7. **Regulations:** Electrical installation is to meet the requirements of the National Electrical Code of National Board of Fire Underwriters amended to date. In addition, any state, municipal or other authority's laws, regulations or rules applicable to the work are to be followed.

**DIRT, NOISE AND CLEAN UP**

1. The Contractor is to do cutting and patching in a manner to cause the least dust, dirt and noise.

2. The Contractor is to keep the building free of rubbish and material during the course of construction insofar as his work is concerned.

3. The exterior and interior premises of the building are to be kept as clean as possible during the entire construction. Daily clean-up will be mandatory.

4. When, in the opinion of the Engineer, any accumulation of material is obstructing construction progress, the Contractor is to immediately remove such material.

5. Upon completion of the project, the Contractor is to remove rubbish, surplus equipment, etc., and have each area cleaned spotless to a standard as approved by the Engineer.

6. At the completion of construction, the Contractor is to thoroughly clean equipment, leaving same in first-class working condition, clean permanent filters and install clean, throw-away filters into each piece of equipment.

**INSPECTION**

1. The following operations are to be performed in preparation for final inspection. This Contractor is to demonstrate to the Owner and the Engineer that all new equipment is operating in compliance with the drawings and specifications.

   A. **Machinery:** Machinery is to be initially serviced. Machinery is to be test operated and necessary adjustments made to make it perform in compliance with the drawings and specifications.

   B. **Controls:** All controls will be tested and adjusted by the HVAC Sub-Contractor (or his/her Automatic Temperature Control Sub-Contractor) to achieve the intent of these specifications. Controls are to be adjusted while the system is operating under full load conditions.
TESTING AND BALANCING

1. The following testing and balancing is to be conducted by the HVAC Contractor or his/her Balancing Sub-Contractor:

   A. **Air Distribution Systems**

      1) **Testing:** Provide testing report, certify test methods and instruments used. Provide latest calibration date for instruments used. Test for the following items:

         a. AHU’s: motor amperage (record actual and nameplate F.L.A.).

         b. Indoor and outdoor db and wb temperatures just prior to run testing equipment.

         c. New AHU’s: Supply air and return air db and wb temperatures after fifteen (15) minutes of operation.

         d. Inlet and discharge pressure at all new AHU’s.

      2) **Balancing:** Provide Balance Reports on forms approved by AABC or NEEB. Modify forms to suit this project. Certify test methods and instruments used. Provide latest calibration date for instruments and equipment used. Verify fans are running in proper rotation direction and all filters are new or clean. Adjust air flows within 5% of required flow. Balance the following:

         a. Total supply, return and outside air CFM quantities at all new RTU’s.

         b. Supply air CFM at each new supply diffuser during normal equipment operation. Record size and type of diffuser, which system it is supplied by and room name and number in which it is installed.

         c. Record any balancing problems encountered, probable reason for problem and suggested solutions.

GUARANTEE AND WARRANTIES

1. The Contractor is to guarantee for a period of one (1) year from the date of final acceptance that material and workmanship furnished under the contract are free from defects. The Contractor is to replace any equipment or material found defective within the guarantee period at no cost to the Owner.

2. The Contractor is to also, during the one year guarantee period, be responsible for the proper adjustments of systems, equipment, controls and apparatus installed by him and do work necessary to insure efficient and proper functioning of the system and equipment.

3. Provide copies of completed warranty card that are to be sent back to equipment manufactures for all equipment including compressors with extended warranties.

INSTRUCTIONS AND MAINTENANCE MANUALS
1. The Contractor is to furnish the services of competent personnel to instruct employees designated by the Owner in the proper operation and maintenance of the equipment and systems installed under the contract. The Contractor is to allot a minimum of four hours (4) by his Project Foreman and the Controls Sub-Contractor to give Owner’s personnel instructions on operation and maintenance of new rooftop unit.

2. The Contractor is to furnish the Owner with three (3) copies of a bound "Maintenance Manual" containing complete operating instructions, manufacturer's catalog numbers and complete description and parts list of each piece of equipment furnished under the contract.

- End of Section -
HEATING, VENTILATING AND AIR CONDITIONING CONSTRUCTION SPECIFICATION

SECTION 232113 - DISTRIBUTION PIPING AND ACCESSORIES

PIPING SYSTEMS - GENERAL

1. Furnish and install piping systems indicated on the Drawings and specified herein for the installation of equipment specified under this Contract.

2. Pipes are to be cut accurately to measurements established at the building and be worked into place without springing or forcing, properly clearing windows, doors and other openings. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted. Threaded pipe is to have full clean-cut threads. Pipes are to have burrs removed by reaming. Pipe is to be installed so as to provide proper drainage to permit free expansion and contraction without causing damage. Changes in direction are to be made with fittings. Open ends of pipe lines and equipment are to be properly capped or plugged during the installation to keep dirt and other foreign matter out of the system. Pipe is to be thoroughly cleaned before erection and must be cleaned after erection to remove any foreign material.

3. Systems of refrigerant piping and condensate drainage piping are to be installed in general, as indicated on the Drawings. Piping is to be installed concealed unless shown otherwise on the Drawings. Where piping is not concealable, run neatly as high as possible parallel with the building wall.

4. Because of the small scale on the Drawings, it is not possible to indicate offsets, fittings or similar items which may be required to make a complete operating system. The Drawings are generally diagrammatic and indicative of the work to be installed. The HVAC Contractor is to carefully investigate conditions affecting his work and install his work in such a manner that interference between pipes, conduit, ducts, equipment, architectural and structural features will be avoided and furnish and install such offsets or fittings as may be required to meet the conditions at the building and avoid such interference.

CLEANING OF EXISTING REFRIGERANT PIPING

1. The Contractor is to very thoroughly clean all existing R-22 refrigerant piping to be reused for R410a refrigerant. Cleaning is to be done using the “Nu-Calgon Rx-11 Flushing System”.

2. The Nu-Calgon Rx-11 flush is a unique solvent formulated for flushing refrigerant piping systems. The Contractor is to contact Nu-Calgon and purchase the recommended amount of flush and all accessories required to provide a clean piping system for the installation of R410a.
REFRIGERANT PIPING

1. All new refrigerant suction and discharge piping is to be ASTM B-88, Type "L" hard tempered copper tubing with wrought copper fittings brazed with silver solder. For brazing, solder melt temperature must exceed 1100°F. Piping must be thoroughly cleaned prior to installation. Suction piping inside and outside building and discharge piping outside of the building is to be insulated with 1/2" Rubatex flexible pipe insulation. Refrigerant piping outside the building is to be insulated and then the insulation is to be coated with two (2) coats of a weather-proofing material specifically formulated to protect insulation from sun and weather to prevent deterioration of pipe insulation. **NOTE:** The use of ARC pre-cleaned and capped type "L" copper tubing is encouraged to save field cleaning.

CONDENSATE DRAINAGE PIPING

1. Condensate drain system for cooling coils is to be constructed with ASTM B-88, Type "L" hard tempered copper tubing and wrought solder joint fittings assembled with 50-50 solder connections. Drain lines are to be connected to each condensate drain riser, cooling coil drain pan and auxiliary drain connection and extended by the HVAC Contractor as indicated on the floor plans. Copper drain lines are to be insulated with 1/2" Rubatex flexible pipe insulation (joints on condensate drainage pipe insulation are to be sealed with vapor barrier adhesive).

2. Contractor may use PVC Schedule 40 piping with cemented fittings in lieu of copper specified above where building codes (and the Owner) permit. PVC drain lines need not be insulated. **NOTE:** PVC drain lines may not be installed in areas above ceilings used as return air plenums.

3. Cooling coil drain lines are to be trapped per unit manufacturer's recommendations and slope a minimum of 1/4" per foot of horizontal run.

PIPE HANGERS AND SUPPORTS

1. Provide an adequate pipe suspension system in accordance with recognized engineering practices, using standard, commercially accepted pipe hangers and accessories.

2. Catalog numbers are taken from the Erico Hanger Company, Inc., catalog to indicate the type of equipment required. Hangers and accessories as manufactured by Fee and Mason, Modern or PHD will be accepted.

3. Perforated band iron, wire or chain will not be permitted for hangers or support pipes.

4. Hangers are to be provided with means of vertical adjustment. If adjustment is not incorporated into the hanger, turnbuckle is to be installed.

5. Hangers are to be Erico Hanger Company numbers as follows:

   A. For insulated and un-insulated copper refrigerant piping, use Model 402 copper electroplated black steel clevis hanger.
NOTE: Where piping is insulated, insulation is to cover hangers neatly to the full thickness specified for the piping.

6. Hangers for pipe with operating temperatures below 60°F (15.55°C) (copper condensate drainage piping) are to be Erico Hanger Company, numbers as follows: (piping is to be insulated as specified with condensate piping):

   A. For insulated copper pipe, use Model 403 galvanized clevis to be furnished with 12" long, 16 gage, one-half round, galvanized steel insulation shield spot welded to hanger. Hangers are to carry insulation shields which are to be installed outside of insulation. Care is to be taken to avoid damaging the vapor barrier on cold piping during installation.

7. Hangers for PVC condensate drain pipe are to be Erico Model 404 steel clevis hanger coated with PVC.

8. Hanger rods are to be threaded 2-1/2" on each end or continuous thread. Eye rods are to be welded. Rods for every type of piping are to be sized as follows:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Hanger Rod Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot; thru 2&quot;</td>
<td>3/8&quot; diameter</td>
</tr>
</tbody>
</table>

9. For straight horizontal runs of piping, maximum spacing of hangers are to be as follows:

<table>
<thead>
<tr>
<th>Copper Tubing</th>
<th>PVC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot; and 3/4&quot; - 5'</td>
<td>3/4&quot; - 3'</td>
</tr>
<tr>
<td>1&quot; - 6'</td>
<td>1&quot; and up - 4'</td>
</tr>
</tbody>
</table>

10. Where concentrated loads of valves, fittings, etc., occur, closer spacing may be necessary. Hangers are to be installed not more than 12" from each change in direction of pipes.

11. Where piping is adjacent to walls or columns, wall brackets for hanger rod suspension may be used as required by loading.

12. Furnish and install hanger rod supports as required by building construction such as beam clamps, side beam connectors, concrete inserts, clips, etc. These supports are to be furnished by the same manufacturer as the hanger selected.

13. Trapeze hangers constructed of structural steel (channel or angle) will be considered for multiple runs of pipe as approved by the Engineer.

14. Supplementary steel required for the installation of piping hangers and supports is to be furnished and installed by the HVAC Contractor and receive one (1) shop coat of primer paint. Hangers exposed in finished areas without ceilings (Mechanical Rooms, etc.) are to be painted to match ceiling or walls.

- End of Section -
HEATING, VENTILATING AND AIR CONDITIONING CONSTRUCTION SPECIFICATION

SECTION 233110 – AIR DISTRIBUTION SYSTEMS AND ACCESSORIES

SHEETMETAL DUCTWORK

1. Ductwork:
   
   A. Supply Ductwork: Supply air ductwork to be constructed of galvanized sheetmetal. If the existing ductwork is lined, provide new lined ductwork to match existing. If existing ductwork is not lined, new ductwork is to be wrapped with ductwrap insulation. Lining and ductwrap are to be as here-in-after specified.
   
   B. Return Air Ductwork: Return air ductwork is to be constructed of galvanized sheetmetal. If the existing ductwork is lined, provide new lined ductwork to match existing. If existing ductwork is not lined, new return ductwork is to be unlined/unwrapped galvanized sheetmetal.


3. Low Pressure Systems: Ductwork is to comply to standard rectangular duct construction which provides for velocities not to exceed 2,500 fpm and static pressure not to exceed 1.0 in W.G., STD classification, denoting standard construction classification.

4. Construction: Ductwork is to be constructed in accordance with Chapter 2 "Rectangular Duct Construction" of the Duct Construction Standards. Steel duct gauge and reinforcement options are to conform to Table 2-2 on Page 2.16.

5. Sizes: Duct sizes indicated on the plans are clear inside dimensions, and do not include duct lining (if duct lining is required).

6. Hangers: To be constructed in accordance with Chapter 5 "Hangers and Supports" of the Duct Construction Standards.

7. Elbows - Vaned: Square and radius elbows in supply and exhaust air ductwork are to have vanes and are to be constructed in accordance with Figure 4-2 of the Duct Construction Standards (Type RE-2 and Type RE-3).

8. Branch Connections: To be constructed in accordance with Figures 3-5 & 3-6 (for round ducts) and Figures 4-5 or 4-6 (for rectangular ducts) of the Duct Construction Standards. For rectangular ducts, branches are to be nested fittings with 45 deg. entry take-off for rectangular taps and bellmouth round takeoffs for round taps. Install manual volume control dampers (VCD's) at each branch duct take-off whether or not shown on the Drawings. Volume dampers are to be rectangular or round to suit duct and are to conform to pages 7.5, 6 & 7 and Figures 7.4 and 7.5 of the Duct Construction Standards.

9. Access Doors: Access doors in ducts are to be hinged and insulated in accordance with Figures 7-2 and 7-3 of the Duct Construction Standards.
10. **Duct Sealing:** All transverse joints, longitudinal seams and duct wall penetrations in sheetmetal ductwork are to be sealed airtight with Hardcast duct sealant mastic and embedded fabric system to minimize duct leakage. The Uni-Cast two (2) part duct sealing system may also be used. To conform to the requirements of the International Energy Conservation Code, Section 503.2.7.1.1, duct sealing is to conform to seal Class "A" as indicated on Table 1 – 1 on Page 1.11 of the Duct Construction Standards.

11. **Field Location and Dimension Changes:** Routings indicated on the Drawings are to be adhered to in general, but where required by field conditions or coordination may be relocated slightly. Where field measurements indicate that clearances are not adequate to pass the ducts of size shown, ducts may be resized, providing cross sectional area is kept constant where major relocation or resizing is required, it is to be done only with the approval of the Engineer.

12. **Connections To Equipment:** Duct connections to motor operated equipment (rooftop units) are to be made with flexible connections as hereinafter specified. Where duct connection dimensions are not indicated on the plans, ducts are to be sized to fit equipment openings.

13. **Flexible Connections:** Flexible connections are to be made between air handling equipment and ductwork as required to prevent vibration transmissions, excessive movement of long ducts and wherever ducts cross building expansion joints. Flexible connections are to be made of neoprene coated glass fabric or fire and water resistant cotton duct having a finished weight of approximately 20 ounces per square yard equal to Ven-Fab manufacture, or similar flexible flame retardant material specifically manufactured for this application. Connections (collars) are to be approximately 4" long and are to be installed with just sufficient slack to prevent transmission of vibration. Circular collars are to be sealed to fans and ducts with 12 gage metalbands 1" wide. Rectangular collars are to be secured to ducts and fans with 1" x 1/8" flat bars fastened with screws or bolts at 8" intervals or with slip joints similar to those specified for duct joints, the fabric being tightly crimped into the slip joint and the complete joint being fastened with sheetmetal screws at 8" intervals. Collars are to be painted. Metal for fastening collars are to be the same as specified for ducts and bracing. Refer to Fig. 7-8 of the Duct Construction Standards.

14. **Flexible Ducts:** Where indicated on the Plans, connections to diffusers are to be made with flexible ducts. Flexible ducts are to conform to U.L. Standard 181 Class 1 and be installed in accordance with pages 3.33 through 3.39 of the "Duct Construction Standards". Make flexible duct connections to diffusers per Figure 7-7. Flexible ducts are to be insulated with 1" thick, 3/4 lb. density fiberglass. Inside air passage is to be corrosion-resistant reinforcing wire helix permanently bonded and enclosed in a polyester film. Insulation jacket is to be sheathed in a vapor barrier of flame-resistant vinyl. Duct is to comply with NFPA-90A. Flexible duct is to be Thermaflex Type GKM or equivalent. Flexible duct lengths may not exceed 6'-0".

15. **Duct Lining:** Where called for in this Specification, ducts are to be lined with 1" thick 1-1/2 lb./cu. ft. flexible fibrous glass duct liner coated with gray, fire resistive coating. Liner is to comply with U.L. 181 requirements. Liner is not to exceed 25 Flame Spread and 50 smoke developed when tested at ASTM E84, NFPA 255 and UL 723. Mechanical fasteners are to be installed according to Figures 7-11 and 7-12 of the SMACNA-HVAC Duct Constructions Standards for velocity less than 2,500 fpm. Liner is to be installed according to the requirements of "Installation Standards for Rectangular Ducts Using Flexible Liner" on Pages 7.13 through 7.19 of the latest edition of SMACNA-HVAC Duct Construction Standards.

16. **Duct Wrap Insulation:** Where called for in this Specification, wrap ductwork with 1-1/2" thick, 3/4 lb./cu. ft. density fiberglass duct insulation with aluminum exterior vapor barrier. Ductwrap is
not to exceed 25 Flame Spread and 50 smoke developed when tested at ASTM E84, NFPA 255 and UL 723. Seal all joints with aluminum tape.

**DUCTWORK SUPPORTS**

1. Horizontal sheetmetal rectangular ducts are to be supported by a pair of galvanized steel hanger straps or rods spaced at a maximum of 8'-0" o.c. with strap and rod sizes conforming to Table 5-1: "Rectangular Duct Hangers - Minimum Size" for 8' spacing as shown in the 2005 edition of the SMACNA-HVAC Duct Construction Standards, page 5.7. Horizontal rigid sheetmetal round ducts are to be supported by a single hanger strap or rod spaced at a maximum of 12'-0" O.C. with strap and rod sizes conforming to Table 5-2: "Minimum Hanger Sizes for Round Duct" as shown in the 2005 edition of the SMACNA – HVAC Duct Construction Standards, Page 5.9. Support all flexible duct a maximum of 3'-0" on centers with hanger straps as recommended by the flexible duct manufacturer.

**GRILLES, REGISTERS AND DIFFUSERS**

1. Registers, grilles and diffusers are to be furnished and installed where indicated on the Drawings. Except where otherwise noted, numbers and the sizing of these items have been taken from the catalog of Metal Aire, Inc. to establish a standard of quality and to allow for the approximate sizing of required outlets. Other acceptable manufacturers are Krueger, Price, Titus and Carnes, provided sizing is based on that manufacturer's engineering information and the Contractor assumes responsibility for changes in the size of supply and return outlets. Manufacturer of air distribution equipment is to guarantee that his equipment will perform under the conditions set forth on the plans, in accordance with the requirements of the "Air Diffusion Council. for proper distribution of air in occupied area and the velocity of the occupied area is to not exceed 50' per minute with a minimum of 1-1/2 of temperature differential at the 6'-0" comfort level.

2. Air distribution equipment is to be model numbers and of capacities as scheduled and noted on the Drawings.

**NOTE:** The Contractor is to verify the ceiling type specified for each area of the building (i.e. flat or drop reveal). Provide appropriate frames for diffusers.

**MANUAL VOLUME CONTROL DAMPERS**

1. Furnish and install volume control (balancing) dampers to balance air systems, at locations shown on Plans or in accordance with this Specification. Volume control dampers are to meet the following minimum construction standards:

   A. Frame is to be 22 gage galvanized steel structural hat channel with tabbed corners for reinforcement.

   B. The blades are to be single skin, 22 gage galvanized steel.

   C. Bearings are to be corrosion resistant, molded synthetic sleeve type turning in an extruded hole in the damper frame.
D. Axles are to be square or hexagonal positively locked into the damper blade with locking hand quadrant to be field mounted.

E. Dampers are to be in every respect equivalent to Ruskin Model MD25.

- End of Section -
HEATING, VENTILATING AND AIR CONDITIONING CONSTRUCTION SPECIFICATION

SECTION 236200– SPLIT SYSTEM CONDENSING UNITS

SPLIT-SYSTEM AIR-COOLED CONDENSING UNITS

GENERAL

1. Furnish and install Two (2) new air cooled, split system, roof mounted condensing units as manufactured by York (Trane or Carrier). Units shall be manufactured in a facility registered under the ISO 9002 manufacturing quality standard. Units shall be UL and CSA approved. Unit shall be packaged to allow outdoor storage. Hermetic compressors shall be covered by a five year limited warranty. All other unit parts shall be covered by a full year limited warranty.

DESCRIPTION

1. Units are to be completely assembled, piped and wired at the factory to provide one-piece shipment and rigging. Each unit is to be pressurized with a holding charge of Refrigerant-R-410A for storage and/or shipping. All sheet metal parts are to be constructed of commercial grade (G90) galvanized steel. After fabrication, each part is to be thoroughly cleaned to remove any grease or dirt from its surfaces. The external parts are to be coated with a powder paint to assure a quality finish for many years. The UL approved coating system shall have passed the 1000 hour, 20% salt spray test per ASTM Standard B117.

UNIT CABINET

1. Cabinet shall be constructed of 18 gauge, zinc-coated steel, finished with a powder paint process capable of withstanding a minimum of 1000 salt spray hours according to ASTM B117. Cabinet screws shall comply with the ASTM B117 salt spray test for a minimum of 1000 hours. Panels shall be removable for easy access to all internal components during maintenance and service. Cabinet shall feature a separate access panel for the controls so that unit airflow need not be disturbed during servicing. Permanently attached base rails shall have lifting holes for ease of installation.

COMPRESSOR

1. Compressor shall be a scroll compressor with integral motor overload protection. Compressors shall have a factory mounted crankcase heater to keep refrigerant from diluting the compressor oil in the sump. Crankcase heater shall be field replaceable without removal of the charge. Compressor shall be mounted on isolators to limit the transmission of sound and vibration.
CONDENSER AND FANS

1. Fan motors shall be direct-drive with propeller-type condenser fans which discharge air vertically upward. Fan motors shall be totally enclosed with permanently lubricated ball-bearings for longer wear during start and stop cycles. Fan motors shall have inherent overload protection.

REFRIGERANT COMPONENTS

1. Coils:
   A. Condenser coils shall have Micro-Channel aluminum tube, aluminum fins.
   B. Coil shall be of the direct expansion, draw through design.
   C. Coil shall have an integral subcooler designed into the coil.

2. Refrigerant Circuit and Refrigerant Safety Components:
   A. Refrigeration system contains both high and low pressure cut-outs.
   B. Service valves to ease installation and recovery of refrigerant.
   C. External ports to accommodate gauge lines, allowing for easy servicing of the unit.
   D. Each unit ships with a filter drier for field installation.
   E. Holding charge of R-410A.
   F. Discharge line stub-out to allow for hot gas bypass line connections.

UNIT CONTROLS

1. Unit shall be complete with self-contained low-voltage control circuit protected by a resettable circuit breaker on the 24-volt transformer side.
2. Unit shall incorporate a lockout circuit which provides reset capability at the space thermostat or base unit should any of the following standard safety devices trip and shut off compressor:
3. Loss-of-charge/Low-pressure switch.
4. High-pressure switch.
5. Freeze-protection thermostat, evaporator coil. If any of the above safety devices trip, an LED (light-emitting diode) indicator shall flash a diagnostic code that indicates which safety switch has tripped.
6. Unit shall incorporate “AUTO RESET” compressor over temperature, over current protection.
7. Unit shall operate with conventional thermostat designs and have a low voltage terminal strip for easy hook-up.
8. Unit control board shall have on-board diagnostics and fault code display.
9. Standard controls shall include anti-short cycle and low voltage protection, and permit cooling operation down to 40 °F.

10. Control board shall monitor each refrigerant safety switch independently.

11. Control board shall retain last 5 fault codes in non-volatile memory, which will not be lost in the event of a power loss.

THE INSTALLER SHALL:

1. Furnish evaporator units in accordance with the performance schedules shown on the plans. Install each unit as shown on the plans in accordance with the manufacturer’s recommendations and all applicable national and local codes.

UNIT OPERATING CHARACTERISTICS

1. Unit shall be capable of starting and running at 125° F outdoor temperature, exceeding maximum load criteria ARI Standard 340/360. The compressor, with standard controls, shall be capable of cooling operation down to 40° F outdoor temperature standard.

ELECTRICAL REQUIREMENTS

1. All unit wiring shall enter unit cabinet at a single factory provided location to minimize cabinet penetrations and avoid unit field modifications.

EACH UNIT SHALL INCLUDE THE FOLLOWING ACCESSORIES:

1. Factory mounted HACR breaker

2. Low Ambient Kit to allow cooling to 0F

3. Factory furnished hail guards
HEATING, VENTILATING AND AIR CONDITIONING CONSTRUCTION SPECIFICATION

SECTION 238219 – AIR HANDLING UNITS

PART 1: GENERAL

1.1 SECTION INCLUDES:

1) Air Handling Units, are to consist of centrifugal belt drive fans, coils, drain pans, filters and controls housed in a cabinet. Units are to be designed to condition a space by circulating air over finned coils which contain a conditioning fluid. Fluids will be hot water and refrigerant. Air Handling Units are to be used in both heating and cooling applications.

2) Air Handling Units are to be Magic Aire as Manufactured by United Electric Company. Units as manufactured by Trane or Carrier may also be acceptable if they physically fit into the limited space now occupied by the existing units.

1.2 RELATED SECTIONS

1) Section 23 00 15 -.Basic HVAC Requirements
2) Section 23 21 13 - Distribution Piping and Accessories
3) Section 23 31 10 - Air Distribution Systems and Accessories
4) Section 23 62 00 - Split System Condensing Units
5) Section 23 31 10 - Air Distribution Systems and Accessories
6) Section 23 95 00 – Automatic Temperature Controls

1.3.1 Each air handling unit is to be built to comply and perform to the following standards as applies:

1) Insulation and adhesive shall meet NFPA-90A requirements for flame spread and smoke generation.
2) AMCA 210, ASHRAE 51: Airflow
3) ARI 410: Coil Capacity – Hydronic
4) ARI 210: Coil Capacity – DX
5) ANSI/UL – 1995: Safety Agency Listing of base or standard equipment is ETL, ETL file #491893
6) Material Specifications Standards:
   a) ASTM A525, A527: Sheet Metal
   b) ASTM B68, B75, B88, B251: Copper Tubing per
   c) ASTM B209: Aluminum
7) Major Components Standards:
   a) NEMA per UL/CSA: Motors
   b) UL/CSA: Wire
   c) UL/CSA: Electrical
   d) ASHRAE 52: Filters per UL,
   e) UL 181, UL 723 (25/50), ASTM E-84: Fiberglass Insulation
   f) ASTM B117: Paint per
   g) UL-1995: Electric Heater, factory installed assembly (HB)
   h) UL-1996: Electric Heater, field-installed accessory (BM,BV)
1.4 PRODUCT CONSTRUCTION. Critical characteristics – refer to unit schedule for some items:

1) Belt Drive 
2) CFM 
3) External Static Pressure (ESP) to include dirty filter factor 
4) Horizontal Inlet and Outlet airflow configuration: 
5) Cooling: DX = R410A 
6) Entering Water Temp and GPM 
7) DX: Sat Cond Temp, Sat Evap Temp, Entering DB/WB 
8) Heating: Hot Water; 
9) Filter: Basic Throw-away / Merv-level 7 
10) Supply Voltage and phase 
11) Other items, unique requirements or accessories: 
12) Single Point Electrical Connection: ) 
13) Valve Package (field installed – confirm with ATC Sub Contractor who is to furnish and install). 
14) QUALITY ASSURANCE 
15) Coil(s) shall be factory tested for leakage at minimum of 500 psig air pressure under water. 
16) Valve Package shall be factory tested to withstand 50 psi pressure degradation with no losses. 

1.5 DELIVERY, STORAGE, AND HANDLING 

1) Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material. 
2) Inspection: Inspect all items for transit damage or any indication of re-pack. Follow manufacturer directions for filing freight claims. 
3) Storage: Store materials in a dry, sheltered area, protected from damage and in accordance with manufacturer's instructions. 
4) Handling: Handle and lift products in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage. 

PART 2: PRODUCTS 

2.1 Manufacturer 

Basis of design Magic Aire (United Electric Company) Fan Coils, 501 Galveston Street, Wichita Falls, TX 76301. Phone (940) 397-2100. Web Site www.magicaire.com. Units as manufactured by Trane or Carrier may also be acceptable if they physically fit into the limited space now occupied by the existing units. 

2.2 Belt Drive Air Handlers 

General: 
1) Factory-assembled, horizontal discharge air, draw-thru type air handler / fan coil unit suitable for concealed or exposed installation in two or four pipe configuration. 
2) Unit shall be completed per customer order with water, DX coil(s); fan, motor; belt drive; double sloped IAQ drain pan on models HB and filters.
2.3 Construction and Components:

1) HB60 (15 ton)
   i) Motor mount 14 ga.
   ii) Top, bottom 16 ga.
   iii) Blower Rails 18 ga.
   iv) Cabinet 19 ga
   v) Drain pan 19 ga.

1) Insulation: Cabinet to be lined with:
   a) Units shall be equipped with 1-in. thick, 1.5-lbs/ft3, Exact-O-Kote® IAQ insulation containing an EPA-registered immobilized antimicrobial agent tested in accordance with ASTM G21 and G22. Physical Properties:
      i) Temperature Limit: 250oF (121oC)
      ii) Fire Hazard Classification: 25/50 (per ASTM E 84 and UL 723 and CAN/ULC S102-M88). Meets NFPA 90A and 90B.
      iii) Maximum Air Velocity: 5,000 fpm (1,500 mpm). Exact-O-Kote® is tested at two and one-half times (12,500 fpm) (3,800 mpm) the maximum recommended service velocity. It meets the requirements of UL 181.
      iv) ASTM C 1071: Exact-O-Kote® has been tested and conforms to the physical properties and requirements of ASTM C 1071.
      v) Temperature operating limits -3300F minimum to 2100F maximum (ASTM C 411)
      vi) Density = 1.5 lbs / ft3 (ASTM D 1622 & 3575)
      vii) Thermal Conductivity = 0.25 BTU-in/hr-ft2-0F (ASTM C 177 & 518)
      viii) Water Vapor Permeability 0.0 perm-in (ASxTM E 96)
      ix) Water Absorption 0.0% (by volume) (ASTM C 209)
      x) Linear Shrinkage @ 2000F < 4.0% (ASTM C 534)
      xi) Mold Growth/Humidity; Air Erosion No mold growth; No erosion (UL 181, Sections 12 & 17)
      xii) Flame Spread (up to 1” wall) not greater than 25 (ASTM E 84, CAN/ULC-S102.2-M88)
      xiii) Smoke Developed (up to 1” wall) not greater than 50 (ASTM E 84, CAN/ULC-S102.2-M88)

2) Piping and Drain Pans: Cabinet to be equipped with choice of drain pan. Confirm availability of options beyond standard:
   a) Construction:
      i) Piping penetrations through the cabinet will be isolated with rubber/plastic grommets or bushings.
      ii) Drain pan will be serviceable from same end as Cooling Coil piping connections unless specified otherwise.
      iii) When specified, metal pans will be treated externally with antimicrobial (as available)/ anti-condensation agent.

   b) Options
      i) Molded plastic, shall be double-sloped IAQ drain pan and shall extend under the full length and width of the coil(s) with a ¾-in FPT connection for use with ¾-in PVCx3/4-in MPT adapter or ¾-in MPT male outlet. Standard on:
         (1) HB 08 to HB 40
         (2) BV 08 to BV 20

3) Duct Connections: Supply and return duct connections shall be approx. one inch long.

4) Fans: Units shall be equipped with:
   a) Belt-driven, double-width fan wheels shall have forward-curved blades and be statically and dynamically balanced.
   b) Fan drive shall consist of variable-pitch motor pulley, fixed-pitch fan pulley and V-belt.
   c) Fans and scrolls shall be of galvanized steel.
d) Removable side panels shall be provided for access to the fan/motor assembly.

5) Coils: Unit shall be equipped with a standard capacity (3) or (4)-row HW and a DX cooling coil.
   a) Coils shall have a working pressure of 400 psig at 200 F
   b) Aluminum fins bonded to the tubes by mechanical expansion
   c) Provide end plates and coil baffles of
      i) 18ga G90 galvanized steel with extruded holes mechanically bonded to tubes, standard.
   d) Hydronic coils
      i) Equipped with manual air vent.
      ii) HB30 to HB80 shall have 1/2” o.d. copper tubes
   e) Direct Expansion coils: Dual Circuit Require on each unit
      i) 1/2” o.d. smooth copper tubes, suitable for R-22 heat pump or cooling service, and R-410A cooling service only.
   (1) HB60 Dual Circuit
   (2) R-410A: 8, 12.5, 15 and 20-ton nominal TXV size: non-biflow, 1/8” equalizer line, 1/8” sensing bulb line, o.d. female sweat connections, non-bleed, externally adjustable (12.5T and 15T only) or fixed superheat set point (8T and 20T only). Sensing bulb to be field-located and installed.

Operating Characteristics:
   i) A two coil unit installed in a 4-pipe system shall be capable of providing sequenced heating and cooling as determined by the controls provided by others.
   f) Coil Arrangement Offering: Coil configuration shall be limited as shown by model:
      i) 4 pipe preheat, DX 6 row max with 4 row HW – 10 row max.
   g) Expansion Device: Units to be equipped as selected with expansion device appropriate to application, options:

6) Motor(s):
   a) General: Follow manufacturer guidelines for fan motor brake horsepower. Specifier to select from available motor options per current manufacturer catalog / software.
   b) Types: Fan motors shall be open, drip-proof, single-speed, 60 Hz, 1750 rpm single or 3-phase, suitable for continuous duty at 104-deg F (40 C) in 115, 208, 230, or 277 volts (60 Hz). Three-phase motors are available in 208, 230, or 460 volts (60 Hz). Single-phase motors shall be provided with low-vibration, low-noise resilient mount.
   c) Motor mounted on base with tension adjustment feature.
   d) Motor bearings will be permanently lubricated type.
   e) Motor mounting shall be mounted on same hand as existing.
   f) Options:
      i) Provide High Efficiency motors: Units shall be equipped with NEMA Premium inverter duty rated three phase motors (as available)
      ii) Horsepower and Voltage is to be as scheduled on the drawings.

7) Blowers:
   a) Statically and dynamically balanced for specified performance.
   b) Provide ball bearing type bearings, permanently lubricated and sealed for life.
   c) Bearings isolated from blower housing with elastomer mounts.
   d) Blower housing isolated from cabinet by elastomer separator.
   e) Provide wheel as appropriate to application (select)
      i) Forward curved
      ii) Backward curved (as available)
      iii) Plug fan (as available)
8) Drive System:
   a) Equip with variable pitch drive pulley, fixed diameter driven sheave and keyed shaft.
   b)
9) Filters: Filter selections by customer per manufacturer catalog / software:
   a) (Optional) 2” pleated filter(s), MERV-7, shall be installed as indicated on the equipment schedule.

10) Optional Accessories:
    a) Provide spring isolator hanging kit: HB

END OF SECTION
HEATING, VENTILATING AND AIR CONDITIONING CONSTRUCTION SPECIFICATION

SECTION 239500 – AUTOMATIC TEMPERATURE CONTROLS

AUTOMATIC TEMPERATURE CONTROL SYSTEM

1. Furnish and install a complete electric/electronic type automatic temperature control system and components as required to complete the control scheme for all HVAC equipment herein specified and indicated on the Drawings. The ATC system is to be as manufactured by Watt Master and Honeywell Controls (or approved equivalent).

2. The system is to be complete in all respects including all materials, equipment and services necessary and is to be installed by the HVAC Contractor (or by an ATC Sub-Contractor to the HVAC Contractor). **Note:** Where controls for certain system components are to be furnished by the equipment manufacturer, installation and wiring of those controls is to be by the HVAC Contractor or his/her ATC Sub-Contractor.

3. Electrical power wiring for equipment and associated motors will be furnished and installed by the Electrical Contractor. All control wiring is to be furnished and installed under the HVAC Contract. All controls, transformers, relays, interlock wiring, low and 120 volt power for operators, etc., required for proper control system operation is to be furnished and installed by the HVAC Contractor. Where it is necessary for the Contractor to install electrical wiring in connection with the Automatic Temperature Control Systems, the wiring systems are to be in strict accordance with the National Electrical Code. Installation of 120 V power circuits required for the control system is to be extended from junction boxes provided by the Electrical Contractor.

4. All line voltage and low voltage wiring is to be installed in rigid conduit or electrical metallic tubing, as per the National Electric Code, in all areas and concealed locations. Wiring for the Control Systems, except low voltage conductors, is to be single conductor copper not less than No. 12 AWG, with 600 volt type THWN insulation, except where the Temperature Control Manufacturer requires special types and sizes. All wiring in panel construction may be No. 14, 16 or 18 AWG copper as recommended by the Temperature Control Manufacturer providing same is properly protected and/or is in accordance with the National Electric Code. All low voltage conductors are to be of types as herein indicated. Other types and sizes required by the Temperature Control Manufacturer are to be submitted for approval. No temperature control wiring installed under this Contract is to be installed in the building lighting and power circuit system.

5. Low voltage, 2-conductor wire is to be black twisted (6 turns per foot) 16 AWG or 18 AWG wire, as indicated, 1/32, 80° Centigrade, 300 volt PVC insulation.

6. Low voltage, 3-conductor wire is to be red, yellow, blue, twisted (6 turns per foot) 16 AWG wire, as indicated, 1/32, 80° Centigrade, 300 volt PVC insulation.

7. Cable is to be type as specified and as manufactured by Alpha Wire Company, Belden Wire Company, Standard Wire and Cable or an approved equivalent.
8. The Contractor is to submit a Description of Operation and Schematic Drawings of the entire control system to the Engineer for approval before starting the work. Bulletins describing each item and component are to be included in the submittal information.

9. The Contractor and Control Manufacturer are to closely coordinate the requirements for auxiliary contactors where other equipment is to be interlock wired. Also, all relays, wiring and all additional controls required to cause equipment to function as hereinafter specified under SEQUENCE OF CONTROL is to be provided.

10. The Contractor is to be responsible for verifying the operation of the control system, calibrating and setting thermostats and devices, and clearly labeling thermostats, switches and other control devices with embossed tape.

11. At the completion of the installation, the Contractor is to adjust completely the entire control system to provide satisfactory temperatures in all sections of the building within acceptable limits under the supervision of the Temperature Control Manufacturer's Supplier.

12. The Contractor is to instruct the owner's operating personnel in the operation of the temperature control system. Upon completion of the work, the Contractor is to provide two (2) final sets of Description of Operation and Schematic Drawings of the control system in booklet form, with instruction manual apparatus bulletins, parts lists, etc., for distribution to the Owner. The Owner's operating personnel are to be instructed in the operation and maintenance of the temperature control system. The Contractor is to obtain from the Owner's representative a signed receipt that he received the operation manual and complete instructions of the operation of the Temperature Control System.

13. The Contractor is to guarantee all equipment furnished under the Automatic Temperature Control portion of the Specification against original defects for a period of one (1) year from the date of final acceptance and keep the control system in adjustment throughout the first year after final acceptance by the Owner. Normal maintenance of the system is not considered part of the guarantee.

14. All primary control devices (Thermostats, sensors, actuators, controllers, etc.) shall be of the same manufacturer to insure compatibility, single source of supply and minimum parts inventory. Secondary devices (Relays, transformers, switches, lights, etc.) may be of other manufacture, but the ATC equipment supplier must guarantee their compatibility and ease of procurement.

**CONTROL SYSTEMS/SEQUENCES**

New Air Handling Units AHU-4 and AHU-5, and new Condensing Units RCU-4 and RCU-5, are to be controlled by two (2) separate Watt Master “System Managers” with individual Unit Managers. Should the System Manager become disabled for any reason, the Unit Manager is to retain control of its respective individual system. “VVT” controls (Variable Volume/Variable Temperature) are to provide for individual dampers to control room or zone airflow and air temperature.
1. **VVT Control of AHU-4/RCU-4 and AHU-5/RCU-5:**

   A. Each system is to be controlled by a stand alone Watt Master "Auto-Zone Plus" (or Honeywell) variable volume, variable temperature (VVT) control system. Each VVT control system is to be as hereafter specified, with heating controls to control existing three-way hot water valve and two stage cooling control of RCU-4 and RCU-5 and control of all zone dampers.

   B. Each system is to be accessible from a remote location through a future modem connected to a phone line or internet connection. A phone line modem and interconnection wiring to phone line and system or internet connection may be furnished by the Owner in the future.

   1) **General**

      a. **Description**

         (1) The extent of the VVT System work is indicated by the Drawings, Schedules and Specifications.

         (2) Provide all materials, equipment, tools, rigging and perform all labor required to install systems complete as indicated, as required by applicable codes and as specified.

         (3) Manufacturers: Watt Master "Auto-Zone" (or Honeywell).

      b. **Submittals**

         (1) Submit manufacturer's catalog cuts clearly indicating model number, performance data, diversions, drawings and diagrams as necessary to show complete compliance with Specifications.

         (2) Submit complete detailed control diagrams, sequences and wiring diagrams for all systems. All control components are to be identified by function and part number. Complete performance on each component is to be provided.

         (3) Submit a written description of the VVT control sequences.

   2) **Products**

      a. **Direct Digital Control System (DDCS):** This system is to include, but is not limited to the following items:

         (1) Be comprised of individual room/zone sensors, microprocessor control center, connecting communication bus, modulating zone and bypass dampers, supply air temperature sensors, static pressure sensors, fan terminal controllers, system control transformers and other required appurtenances including relays, etc., for the complete control of the HVAC split systems and hot water heating coils with sequence of operation as herein specified.
(2) Does not require the use of battery back-up to support time clocks and non-volatile memory storage. The time clocks must be capable of retaining the correct time for a minimum of 72 hours and the non-volatile memory storage is to be indefinite during a power interruption. The system is to restart itself and immediately begin normal operation when power is restored. System with battery powered memory backup are not acceptable.

(3) Be capable of operating as a stand-alone system and not require a computer to prompt any functions for normal operation. Systems requiring a computer on line constantly for their operations are not acceptable.

(4) Operate within a temperature range of 40°F to 122°F.

(5) By addition of future modems, each system is to be controllable from a remote IBM compatible personal computer.

b. Master Controller

(1) Each master controller (MC) is to communicate with and control up to 16 individual control zones from a single port location. Individual zone configuration, monitoring and diagnosis is to be permissible from the control center location and remote via modem.

(2) The MC is to include a LCD display and keypad for individualized zone programming, setpoints and monitoring of damper positions, zone setpoints, system static pressure.

(3) The MC is to include factory pre-programmed system parameters, including minimum on/off time cycles (4 minutes minimum) for both heating and cooling, control temperature differentials and default valves.

(4) Damper positions are to be read from central MC LCD based on feedback potentiometers located in damper actuators. Systems indicating position based on drive time are not acceptable.

(5) Individual minimum/maximum damper positions for ventilation are to be individually programmed at MC. Systems incorporating mechanical stops to provide minimum/maximum positions are not acceptable.

(6) The MC is to perform automatic recalibration of all dampers and pressure sensors a minimum of once each 24 hour period.

(7) During system start-up, the MC is to prevent system operation during an initialization period whereby an internal system check is performed to assure proper configuration, zone and bypass damper operation/calibration. Any problems detected are to activate a fault indication.
(8) The MC is to incorporate an internal security system to prevent unauthorized tampering of system configuration. Locking covers over control center is not acceptable.

(9) The MC is to transfer data along the communications loop at a rate of four (4) seconds per zone on a continual basis.

(10) The following data is to be transferred between the MC and each individual zone controller along the communications loop at a rate of four (4) seconds per zone:

a. Supply Air Temperature
b. Schedule (Occupied-Unoccupied)
c. Main Fan - On/Off
d. Force Mode
e. Zone (Room) Temperature
f. Damper Position
g. Current Cooling Setpoint
h. Current Heating Setpoint
i. Client Setpoint Adjustment
j. Calibration Flag
k. Status Information:
   *Schedule
   *Bad Zone Sensor
   *Zone Override Button
   *Damper Failure
l. Minimum Damper Position Set
m. Maximum Damper Position Set
n. Night Cooling Setpoint
o. Night Heating Setpoint
p. Day Cooling Setpoint
q. Day Heating Setpoint
r. Vent Position Set

(11) The following failure modes and self diagnostics are to be displayed at the control center:

a. Alarm Status Indication (Digital Readout)
   *No Alarms
   *Bad Duct Sensor
   *Static Null Alarm
   *Bad Static Sensor
   *Bypass Damper Fail
   *Bad Zone Sensor (+Zone #)
   *Zone Damper Fail (+Zone #)
   *Mavarick Zone (+Zone #)
   *Missing Zone (+Zone #)
b. Zone Scan LED Indication
   *1 Pulse: System is running normally in non-override condition
   *2 Pulses: System is running normally in override condition
   *3 Pulses: System is experiencing zone sensor failure
   *4 Pulses: System is experiencing zone damper failure
   *5 Pulses: Unit has not communicated with MC for over five (5) minutes
   *SCAN LED: Locked full ON or full OFF: Zone controller is not operating program correctly

(12) The communications loop is to be wired in accordance with manufacturer's recommendations and be of manufacturer's specified wire type and size.

c. Zone Dampers

(1) Elliptical zone dampers are to be mounted in a round housing and manufactured of 20 gauge galvanized sheet metal casing and include factory installed 24 VAC modulating type actuator. Solid state zone control boards are to be provided loose for field installation in damper control panel.

(2) Damper is to be elliptical in shape with neoprene edge gaskets sandwiched between two 20 gauge sheet metal plates to insure tight close off and prevent gasket separation in air stream. Round dampers with glued-on insulation is not acceptable.

(3) The damper actuator is to require a 24 VAC power supply and incorporate internal feedback potentiometer.

(4) The zone controller is to be expandable to permit addition of auxiliary heat control by future addition of a "Fan Terminal Controller" with auxiliary heat relay. The future expansion board required is to be solid state and be field installed into zone damper control panel. Loose mechanical relays and subpanels are not acceptable.

(5) Individual zone dampers are to be addressed to provide proper communication with MC panel.

(6) Up to two slave dampers can be controlled from primary zone damper.

(7) The communications loop is to be wired in accordance with the manufacturer's recommendations and be of manufacturer's specified wire type and size.

(8) Zone dampers are not to be used as balance dampers.

d. Zone Sensors

(1) One zone sensor is required per zone and is to sense zone temperature and communicate with zone damper/master control center.
(2) Zone sensor is to permit individual zone setpoint adjustment to +/-2°F.

(3) Zone sensor is to permit two (2) hour override time period that will interrupt the night set-back period.

(4) Zone sensors are to be wall mounted.

e. **Supply Air Temperature Sensor**

   (1) One (1) sensor required per system.

   (2) Supply air sensor is to be duct mounted upstream of bypass damper connection to supply air duct as close to unit as possible.

f. **Static Pressure Sensor**

   (1) One sensor required per system to measure and convert static pressure into an electrical signal to the master control center.

   (2) Sensor is to include mounting brackets, sensor tubing, etc., that is required for mounting in supply air ductwork and located per manufacturer's recommendations.

g. **Bypass Dampers**

   (1) Bypass dampers are to be of same construction as zone dampers.

   (2) Install bypass damper indoors as close to unit as possible per manufacturer's recommendations.

h. **Sequence of Operation**

   (1) Occupied Period

      a) The AHU fan is to run continuously.

      b) The microprocessor control center LED's will denote HVAC Status-On indications for fan, heat, cool and bypass damper position.

      c) The control center display screen will show time, date, current mode and any alarm conditions present.

      d) The MC is to poll the entire system continuously at a rate of four (4) seconds per zone.

      e) Zone temperatures more than 1°F above/below setpoint is to act as a vote for cooling or heating operation. The highest demand dictates cooling or heating operation.
f) If any zone is out greater than 4°F from setpoint, this zone is to become priority and dictate cooling or heating operation.

g) Minimum on and off times must be satisfied before auto changeover. A priority call cancels when space temperature falls to within 2°F of setpoint.

h) If a zone remains a priority for 30 minutes, it will initiate an alarm at the control center. The zone controller will continue to control to its setpoint.

i) With SA temperatures above 58°F, cooling (or economizer) is to energize on a call for cooling and run minimum of four (4) minutes.

j) If supply air falls below 45°F, cooling is to be immediately disabled.

k) During cooling operation, all zone dampers are to modulate to achieve their desired setpoints.

l) On a call for heat the existing three (3) way hot water control valve is to modulate open to provide heat. **NOTE:** Where existing hot water finned tube is controlled by existing VVT system, the new VVT system is to first open the existing finned tube control valve and then is to control AHU existing control valve.

m) If supply air temperature rises above 150°F, all heating is to be immediately disabled.

n) During heating operation, zones dampers are to modulate to achieve their desired setpoints.

o) Bypass damper is to modulate to maintain static pressure setpoint.

p) Daily occupied program schedule is to be per owner's instructions.

(2) **Unoccupied Period**

a) System fan is to cycle on a call for heating or cooling. After two minutes of fan operation, heating or cooling is activated.

b) Zone dampers remain in their maximum position when fan is off.

c) Operation occurs same as occupied cycle except to unoccupied setpoints. Set heating at 65°F, cooling to 80°F - both adjustable.
(3) **System Overrides**

a) Auto Mode - System changes from occupied to unoccupied per programmed schedule.

b) Occupied Override - System will operate in the continuous occupied mode.

c) Unoccupied Override - System will operate in the continuous unoccupied mode.

d) Fan Only Mode - The fan is to run continuously with heating and cooling locked out. Zone dampers will be at their maximum positions.

e) Zone Override - Initiated from zone sensor, zone override puts the system into occupied mode of operation for a two (2) hour period.

3) **Execution**

a. **Installation**

(1) The Complete DDCS control system is to be installed by the HVAC Contractor (or his ATC Sub-Contractor) who is thoroughly versed in the installation of Direct Digital Control Systems. This Contractor's personnel is to have complete factory training in the installation of the VVT control system.

(2) The wiring of the DDCS is to be done under the direct supervision of the manufacturer and will be in accordance with Code Authorities having jurisdiction.

(3) The Electrical Contractor will furnish and wire 120 volt circuits to junction boxes (indicated on the Drawings) for use by the HVAC Contractor to provide power for transformers.

(4) All necessary transformers, relays, interconnecting wiring and other electrical devices necessary for this system to perform as specified are to be furnished and installed by the HVAC Contractor.

(5) Installation work is to be coordinated with other trades such that no re-work, cutting or patching will be required.

(6) Work is to be installed in accordance with current industry practices. Only top quality workmanship will be accepted. Any work not properly executed in compliance with these Specifications will be removed and replaced without additional cost to the Owner.
b. **Instructions, Service and Warranty**

(1) After completion of the installation, start-up of each system is to be completed by a factory authorized technician. Thermostats and related components will be adjusted, as well as the equipment being controlled by the specified control system is to be in operation and fully checked out. The entire system must be in operation for a one (1) week period prior to seeking acceptance from the Architect.

(2) After each system has been started by the factory technician, the factory technician is to provide two (2) days of instruction to the Owner's personnel. Instructions to include use of remote computer terminal for system control.

(3) The control system herein specified is to be free from defects in workmanship and material under normal use and service. If, within twelve (12) months from date of acceptance by Owner, any of the equipment herein described is proved to be defective in workmanship or material, it will be repaired, adjusted or replaced free of charge by the installing contractor.

2. **Existing Motor Operated Duct Dampers**

   A. Motor operated dampers on existing outside air duct connections to AHU’s are to be interlocked to open whenever the unit fan operates in occupied mode, but are to remain closed at all times in unoccupied mode.

3. **Existing Roof Exhaust Fan REF-3 and REF-4**

   A. Existing roof exhaust fans serving Toilet Rooms on each floor are to be wired to start when VVT systems are indexed to “occupied” and are to be de-energized whenever the VVT system is indexed to unoccupied.

**CONDENSATE MONITOR CONTROL SYSTEMS**

1. Furnish and install individual electronic condensate Control Systems as manufactured by Water Gard (1-888-652-9800) (or approved equivalent) for each AHU.

2. Install Part No. 401475A clip-on sensor (with control board) to be attached to the primary drain pan of the DX coil. Should the drain pan become full up to the level of the clip-on sensor, the unit is to be shut down and the alarms are to be initiated.

3. Provide one (1) Audible Alarm Part No. 222016 to include 95-deci-bel intermittent tone and one (1) on/off switch. Also provide Visual Remote Warning Light part No. 222018.

4. Install control board warning lights and audible alarms with on/off switch inside Mechanical Room housing the AHU in close proximity to the AHU. System is to be installed per the manufacturer's installation and wiring instructions. Label controls as required to alert maintenance personnel.

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SECTION 261000 - BASIC ELECTRICAL REQUIREMENTS

SCOPE

1. This Specifications and the Contract Drawings are intended to be utilized by the Electrical Sub-Contractor (who is to be a Sub-Contractor to the Prime HVAC Contractor) to install certain electrical and communications equipment, but are not to be interpreted to contain certain basic system installation knowledge essential for a complete and quality installation.

2. The Contractor is to furnish labor, materials and equipment required to completely install each system indicated on the Plans and as here within specified.

3. The Contractor is to carefully examine the site, Plans and Specifications and include labor and equipment necessary to perform, but not necessarily limited to, the following work:

   A. Selective demolition as shown on the Drawings.

   B. The furnishing and installing of power wiring, circuit breakers, and junction boxes for electrically operated equipment set under this/other contracts.

   C. The furnishing and installing of wiring for Duct Smoke Detectors.

ITEMS TO BE COORDINATED WITH OTHER CONTRACTORS

1. The Electrical Sub-Contractor is to coordinate the following items with the Prime HVAC Contractor:

   A. Disconnection of power wiring from existing HVAC equipment being removed/abandoned.

   B. Power wiring requirements for new electrically operated HVAC equipment.

ITEMS TO BE COORDINATED WITH OWNER'S REPRESENTATIVE

1. The Electrical Sub-Contractor is to coordinate the exact locations and installation techniques of new wiring with the Owner’s representative.

GENERAL

1. The Contractor is to furnish equipment, labor, material, tools, services, facilities and supervision necessary for installation of the electrical systems, in general, as noted under SCOPE and more fully specified herein and shown on the Drawings. The Contractor is to carefully examine the site, existing conditions, Plans and Specifications before submitting his proposal as he will be held responsible for a complete installation in every detail.
2. Applicable requirements of the "General Conditions" and "Special Provisions" apply to this entire Specification and are to have the same force and effect as if printed herewith in full. Certificates of approval and/or inspection are to be forwarded to the Owner.

3. In cases where a device or part of the equipment is herein referred to in the singular, such reference is to apply to as many such items as are required to complete the installation.

4. The terms "The Contractor", "This Contractor" or Electrical Contractor mentioned in these Specifications, hereinafter refer to the Electrical Sub-Contractor (to the Prime HVAC Contractor) responsible for the work and the equipment included in these Specifications.

5. Before commencing work, the Contractor is to carefully examine the Architectural, Structural, Mechanical and Electrical Drawings for each phase of construction. If any discrepancies occur between the Drawings or between the Drawings and Specifications, he is to report such discrepancies to the Architect in writing and obtain written instructions as to the manner in which to proceed. No departures from the Contract Drawings are to be made without the prior written approval of the Architect.

6. Equipment, material or apparatus of any one system must be the product of one manufacturer, or equivalent products of a number of manufacturers which are suitable for use as indicated in the various systems. Similar equipment, materials or apparatus of the same or similar type is to be equipment of the same manufacturer.

7. Equipment is to be installed in strict accordance with the manufacturer's instructions for the type and capacity of each piece of equipment. The Contractor is to obtain these instructions from the manufacturer and include same with the submission of the equipment. The type, capacity and application of equipment are to be suitable and capable of satisfactory operation for the purpose intended.

8. The Contractor is to give requisites, notices, obtain and pay for permits and pay deposits and fees necessary for the installation, tests and inspection of work provided under this Specification. These tests are to be conducted as required by the regulations of the local and/or state authorities.

INSTRUCTIONS TO BIDDERS

1. Materials and equipment furnished under the Contract are to be new and bear the Underwriter's Laboratories, Inc., label wherever a standard has been established by that Agency. Construction is to be executed with the maximum speed consistent with good workmanship. The complete installation is subject to the approval of the Architect.

2. The complete electrical installation is to be subject to regulations of the National Board of Fire Underwriters and applicable Federal (including OSHA), State and Local codes, ordinances and regulations and is hereby made a portion of these Specifications and is to have the same force as if printed in full herein.
3. Anything drawn or specified is not to be construed to conflict with any Local, Municipal, State or Federal law, regulation or ordinance which governs the installation of any electrical or related work. Items are not to be installed in conflict with any code or regulation. Any conflicts are to be resolved before installation by the Contractor at no additional cost.

4. The Contractor is to be solely responsible for construction, materials and equipment furnished for the Contract until completion of the project and final acceptance. Damaged work or materials are to be replaced by this Contractor at his own expense. Contractor is to provide necessary storage sheds for protection of material and equipment for the Contract.

5. The Contractor is to assume sole responsibility for general construction, structural and electrical changes and costs related to these changes required to accommodate approved substituted material or equipment. Approved substitutions are to be installed at no additional cost.

6. Drawings are indicative of the character and scope of work and are not intended to show each detail.

7. The Contractor is to cooperate with the Architect and other contractors and arrange the schedule of work to eliminate conflict with the equipment of other trades. In case of conflicts, the Architect is to have the final decision.

8. The actual location of wiring, outlets and equipment is to be determined at the site.

9. Changes necessary due to lack of coordination or because of poor workmanship, as determined by the Architect, are to be made by the Contractor at no additional cost to the Owner.

10. The Contractor is to report ambiguities or discrepancies to the Architect for written clarification before submitting a bid.

11. During the course of construction, conflicts and discrepancies which the Contractor failed to notify the Architect above are to be interpreted by the Architect so as to obtain a consistent and workmanlike installation. The Contractor is to be bound by the Architect's decision and carry out the work at no additional cost to the Owner.

12. Inspection fees, backcharges and permits and certificates required for the installation, tests and inspections of work provided under this Contract are to be paid for by the Electrical Contractor. Prior to bidding, the Contractor must contact each utility and/or service company to obtain their exact requirements.

**COMPLIANCE WITH CODES, LAWS AND REGULATIONS**

1. Bidders must have determined applicability, became thoroughly familiar with, and are required as part of this Contract to comply with local municipality, county, state and federal codes, statutes, ordinances, rules and regulations as well as specific requirements of authorities, agencies and utilities having jurisdiction. The Contractor's work on this project must be in accordance with each statute and the cost of compliance (inspection fees, review fees, tapping fees and/or backcharges, permits certificates and like items) are to be included in the Contractor's bid price.
2. Work is to conform to applicable codes including, but not limited to the following:

   A. The 2009 International Energy Conservation Code (or edition as currently adopted by the authority having jurisdiction).
   
   B. The 2009 International Building Code (or edition as currently adopted by the authority having jurisdiction).
   
   C. The 2011 National Electric Code [or edition as currently adopted by the authority having jurisdiction - of the National Fire Protection Association (NFPA)].
   
   
   
   F. Any applicable federal, state and local codes, ordinances and regulations in effect.

3. If an above named code has been replaced by an updated version and has been adopted by the authority having jurisdiction, the Contractor will be held responsible for complying with the same.

4. Materials and equipment under the Contract are to be new and bear the Underwriter's Laboratories label wherever a standard has been established by that agency.

HAZARDOUS MATERIALS AND WASTE DISPOSAL

1. Hazardous Materials: Contractors and Sub-Contractors are obligated to exchange information with the Owner on materials which could cause harm to employees of the Owner and/or other personnel on or near the project site. The Contractor and/or Sub-Contractor is required to continue to up-date representatives of the Owner in writing whenever new chemicals or materials are introduced into the project site. The Contractor or Sub-Contractor is required to obey federal, state and local laws relating to chemicals and hazardous materials and also to promptly furnish documentation required by the Owner.

2. Waste Disposal: Placing of materials into the waste stream of the Owner is prohibited. Disposal of unused and/or demolished material is the responsibility of the Contractor, Sub-Contractor or vendor who brought the material onto or is removing demolished materials from the project site.

EXAMINATION OF PROJECT DRAWINGS AND SPECIFICATIONS

1. The Electrical Contractor is to carefully examine the Electrical, Mechanical and Architectural Drawings and Specifications. If any discrepancies occur between the Drawings and/or between the Drawings and the Specifications, he is to report such discrepancies to the Architect in writing and obtain written instructions as to the manner in which to proceed.
2. Discrepancies are to be reported to the Architect at least ten (10) days prior to the submission of bid. In the event that such discrepancies are not reported and claims for extra charges to any contract result, such claims will be allocated to and paid for by the Contractor, who in the opinion of the Architect, is the responsible party.

COORDINATION

1. Changes necessary due to lack of coordination or because of poor workmanship are to be made at no additional cost to the Owner, i.e., should any Contractor proceed with the installation of equipment, pipe, etc., prior to coordinating with the other Contractors and that equipment, pipe, etc., prevents proper installation of work of other trades, the offending Contractor is to remove and replace his work at his own cost.

2. The actual location of conduit and equipment is to be determined at the site. The Contractor is to confer with the various other project contractors as to the location of the different lines of pipes, ducts and equipment installed under their contracts before erecting any work in order to avoid interference. The Contractor is to cooperate with other contractors for the proper securing and anchoring of work.

3. The Contractor is to verify the electrical requirements for mechanical equipment with the Heating, Plumbing and Prime Contractors before purchasing any electrical equipment (switchboard, panelboards, circuit breakers, etc.) and wiring.

STORAGE OF MATERIAL

1. The Contractor is to erect and maintain proper facilities for protection of materials and equipment furnished under this Contract during each phase of construction until final acceptance by the Architect. Any damaged materials or equipment is to be repaired or replaced by the Contractor at his own expense to the satisfaction of the Architect.

2. Protection is to include sheds or other buildings as required for protection of the materials and equipment. The Architect is to designate areas for storage on the site. In the event the designated areas are inadequate, the Contractor is to, at his own expense, provide suitable storage under roof at other locations.

3. The storage of materials, equipment and other related items is to be closely coordinated with other contractors. The Contractor is to visit the site before submitting a proposal to become familiar with the area as it affects storage and protection of materials and equipment.

CUTTING AND PATCHING

1. Unless otherwise noted on the Drawings, the Electrical Sub-Contractor will be responsible for all cutting and patching of new and existing interior walls, floors and ceilings as necessary for installation of new conduits, panelboards, junction and device boxes, etc. on this project. The Electrical Contractor will be responsible for flashing, sealing, patching and finishing such openings, including final finishes.
2. Unless noted otherwise on the Drawings, cutting and patching of new openings in the roof and exterior walls is to be performed by the Electrical Sub-Contractor. **Note:** All cutting of roof openings, installation of curbs, installation of vents and patching of roof is to be done by a bonded Roofing Sub-Contractor to maintain all roof warranties.

3. No cutting is to be done which may in any way affect the building structurally.

4. Patching is to match adjacent surfaces, and is to be finished with the same material, paint, etc., as adjacent surfaces.

5. Where new or existing ceiling tile or ceiling material must be cut for removal of existing or installation of new equipment, ductwork or piping, the Electrical Sub-Contractor is responsible for such cutting and patching where required. **NOTE:** In no case is ceiling tile to be used for support of equipment or wiring being installed in ceilings. Ceiling tile or material must be replaced or repaired by this Contractor if it is damaged during this installation.

**DUST, DIRT AND NOISE**

1. The Contractor is to do cutting and patching in a manner to cause the least dust, dirt and noise. Walls, floors, furniture, etc., are to be properly protected by the use of coverings, drop cloths or barriers as required.

2. The exterior and interior premises of the building are to be kept as clean as possible during the entire construction.

3. At no time is the Contractor to interfere with the normal operation of the building by allowing debris, excess material, excess earth, etc., to remain on the premises. Daily clean up is required.

4. Dust and dirt are to be removed in the building areas by the use of an industrial type vacuum cleaner.

**CONTINUITY OF SERVICE**

1. Uninterrupted electrical service is to be maintained during the entire time required for the complete installation of the work contemplated under these Specifications and Drawings.

2. The Contractor is to arrange his work and proceed in such a manner as will least interfere with the normal use of the building and facilities. Temporary equipment, cable and whatever else is necessary are to be provided as required to maintain electrical service. Temporary service facilities, if required at any time, are not to be disconnected or removed until new services are placed in proper operation.

3. If any service or system must be interrupted, the Contractor is to request permission in writing stating the date, time, etc., that system or service is to be interrupted and the areas affected. This request is to be made in sufficient time for proper arrangements to be made. Written permission is to be obtained from the Owner before interrupting the electrical service.
4. Interruptions of electrical service and work are to be done at the time designated by the Architect and Owner.

SHOP DRAWINGS

1. The Contractor is to submit detailed Shop Drawings and descriptive data for each item of equipment to the Architect for approval. The following is a list of item categories for which Shop Drawings are to be submitted to the Architect:

   A. Fuses
   B. Safety Switches
   C. Substituted Items
   D. Maintenance Manuals

2. Shop Drawings are to be furnished for equipment in addition to those items on the above list as required by the Architect. Contractor is to furnish at least six (6) Contractor approved copies of each Shop Drawing.

3. Samples of any material deemed necessary by the Architect during the course of construction is to be submitted to the Architect upon request.

4. The Contractor is to obtain manufacturer's printed installation directions to aid in properly executing the work on equipment requiring such directions, or where in the opinion of the Architect, the directions are necessary. The printed installation directions are to be submitted to the Architect prior to the time of installation for use in supervising the work.

5. The Contractor is to furnish Shop Drawings to the Prime Contractor or other contractors affected, indicating foundations, chases, floor or wall openings or other items where coordination with other contractors is required.

SUBSTITUTIONS

1. The various materials and products specified in the Specifications by name or description are given to establish a standard of quality and of cost for bid purposes. It is not the intent to limit the acceptance to any one material or product specified, but rather to name or describe a material or product as the absolute minimum standard that is desired and acceptable. A material or product of lesser quality would not be acceptable.

2. Equipment is to be installed in accordance with the manufacturer's data and recommendations.

3. Where equipment is not specified, it is intended that only first grade material be used. Only new equipment in good condition will be accepted. Equipment is subject to inspection and approval of the Architect.
4. Any item installed without specified approval for substitution may be directed to be removed and replaced with the specified item at the Engineer’s option.

5. **EXTREMELY IMPORTANT:** Resubmission of items rejected or marked “Revise and Resubmit” will be reviewed one time by the Engineer at no cost to the Contractor. Should the resubmittal be rejected or marked “Revise and Resubmit”, the Contractor will be invoiced for any additional time spent by the Engineer at his current billing rate.

**PAINTING**

1. In each area, panelboard covers, cabinets, grilles, exposed conduits or other exposed surfaces, installed under this Contract, except stainless steel, or other special finishes, will be painted by the **Electrical Contractor**. Existing exposed electrical items such as exposed conduits that are to be reused are to be painted by the Electrical Contractor.

2. Items installed are to be painted by the Contractor as follows:

   A. Paint is to be applied as per manufacturer's printed instructions by persons experienced in the use of such paint. Paint is to be manufactured by Rust-Oleum Corporation or approved equal.

   B. The surfaces are to be wire brushed, scraped or sanded to remove dirt, rust and rough surfaces. Clean surfaces with solvent. Galvanized surfaces are to be treated with acetic soda and sol soda or other approved solutions and washed with clear water before painting. Surfaces are to be dried thoroughly before applying paint.

   C. When requested, the Contractor is to submit manufacturer's written statement that a particular brand or type of paint is recommended and guaranteed by him for surfaces on which it will be applied. No equipment, raceways, etc., is to be painted until same has been tested and approved. Name plates on equipment are to be clean and free of paint. Surfaces painted under this Contract are to be finished in a manner satisfactory to the Architect. Surfaces painted under this Contract are to be painted with two (2) coat application - primer coat and two (2) finish coats - of the color of painted selected by the Architect.

   D. Paint spots on walls, floors and adjoining surfaces which have been splattered resulting from painting performed under this Contract are to be removed and left in a manner satisfactory to the Architect.

**PROTECTION OF EQUIPMENT**

1. It is the responsibility of the Contractor to protect electrical equipment, fixtures, conduit, outlets and similar items of equipment from dirt, grime, plaster and water during each phase of construction. This protection is to be provided by covering with transparent plastic sheeting, caps or as required to the satisfaction of the Architect.
RECEIPT OF EQUIPMENT

1. New equipment being used on this project, whether delivered to the jobsite or to this Contractor’s place of business is to be examined (to determine if the equipment was damaged) prior to signature of receipt by the Contractor’s representative. It is the Contractor’s responsibility to file damage claims with the mover (truck, railroad, etc.) at the time of receipt of damaged equipment.

INSTRUCTIONS AND MAINTENANCE MANUALS

1. This Contractor is to furnish the services of competent personnel to instruct employees designated by the Owner in the proper operation and maintenance of the equipment and systems installed under the Contract. The Contractor is to allot a minimum of four (4) hours by his Project Foreman to commission and give Owner instructions on this project.

2. A Letter of Certification itemizing the equipment, system, instructor and bearing the signature of the instructors and employees instructed is to be delivered to the Owner upon final completion of the project. The Letter of Certification is to not the number of hours spent on explanation and actual operation of systems with Maintenance Personnel. The Owner may (at his own expense) videotape all or portions of the instruction.

3. The Contractor is to furnish the Owner with three (3) copies of a bound "Maintenance Manuals" containing complete operating instructions, preventive maintenance procedures, manufacturers' catalog numbers and complete description and parts list of each piece of equipment furnished under the Contract.

BALANCING

1. The system of feeder and branch circuits for power and lighting is to be connected to panelboard busses in such a manner that loads connected thereto will be balanced on each phase as closely as practical. Should there be any unfavorable condition of balance on any part of the electric systems, the Electrical Contractor is to make such changes that may be suggested by the Architect to remedy the unbalanced condition at no additional cost.

EQUIPMENT TESTS

1. When the installation is complete and ready for acceptance, tests and inspection are to be made by this Contractor in the presence of the Architect to ascertain compliance with the Contract.

2. Contractor is to immediately remedy defects and shortcomings. Additional tests are to be performed at no additional contract cost.

3. Equipment furnished to the Electrical Contractor by another contractor is to be tested in the presence of that contractor to determine satisfactory operation and performance of function intended.

4. Do testing when so directed by the Architect before final acceptance.
ELECTRICAL TESTS

1. The Contractor is to make voltage and megger tests of circuits as requested by the Architect and/or any inspection department having jurisdiction. The Electrical Contractor is to furnish and install equipment and labor required for these tests.

CLEANING UP

1. The Contractor is to keep the building free of rubbish and material during the course of construction so far as his Contract is concerned.

2. When, in the opinion of the Architect, any accumulation of material is obstructing the construction progress, the Contractor is to immediately remove such material.

3. Upon completion of the project, the Contractor is to remove rubbish, surplus equipment and have areas broom clean.

4. The Contractor is to thoroughly clean fixtures and equipment as necessary leaving same free of dust, dirt and fingerprints.

5. Interiors of switchboards, panelboards, cabinets and equipment enclosures are to be thoroughly cleaned of dust, dirt, bits of wire, insulation and other debris.

6. Fingerprints and smears on ceilings and painted walls are not to be tolerated. Restore to original clean condition, satisfactory to the Architect.

GUARANTEE

1. The Contractor is to guarantee for a period of one (1) year from the date of final acceptance in writing by the Architect that material, equipment and workmanship, furnished under the Contract, are free from defects. The Contractor is to replace any equipment or material found defective within the guarantee period at no cost to the Owner.

SPECIAL ENGINEERING SERVICES

1. In the instance of complex or specialized electrical systems, such as fire alarm, the installation, final connections and the testing of such systems are to be made under the direct supervision of competent authorized service engineers who are to be in the employ of the respective equipment manufacturer.

2. Any expenses incurred by these equipment manufacturer's representatives are to be bore by the Electrical Contractor.
ACCESS PANELS

1. The Contractor is to furnish access panels no less than 12" by 16" unless otherwise noted on the Drawings for access to concealed pull boxes, junction boxes or similar items where no other means of access is provided. The Electrical Contractor is to deliver access panels to the General Contractor for installation.

2. Access panels are to be steel constructed with No. 16 gauge wall or ceiling frame and No. 14 gauge panel door. Doors are to be provided with concealed hinges secured with suitable clips and counter sunk screws.

3. Outside of access panel is to finish flush with finished wall or ceiling surfaces and have a shop coat of paint to match the adjacent areas.

4. Access panels installed in fire rated ceilings or walls are to be similar rated.

MISCELLANEOUS STEEL

1. Furnish and install necessary steel angles, beams, channels, hanger rods and other supports for equipment and piping furnished under this Contract requiring support or suspension from building structure except support steel where otherwise noted on the Plans.

SLEEVES AND LINTELS

1. The Contractor is to furnish and set sleeves for conduits passing through exterior masonry walls, above grade, waterproof walls, between floors and through roofs. Sleeves are to be constructed of 20 gauge galvanized steel and be finished flush on both sides of the wall. Sleeves through waterproof walls are to be special sleeves designed and manufactured for waterproof walls being installed.

2. Sleeves in floors are to be standard weight galvanized steel pipe with smooth edges with annular space filed with a waterproof packing and both ends caulked tight with lead and oakum. Sleeve construction is to be set 1" above finished floor level.

3. Sleeves through roof are to include pitch pocket consisting of 16 ounce copper flashing with 12" square base flashing and 6" high cylindrical sleeve 1/2" diameter larger than conduit or pipe. Space between conduit and sleeve is to be filled with roofers pitch.

4. Where groups of conduit pass through masonry walls, the Contractor is to furnish and install suitable lintels approved by the Architect over the openings required for such groups.

5. The Contractor is to be responsible for locating sleeves and lintels for conduits passing through exterior masonry walls, above grade, waterproof walls, between floors and through roofs.

6. Sleeves to be furnished and properly installed and securely cemented in place by the Contractor.
FIREPROOFING

1. Work must be done so that it will not interfere with the existing fireproofing of the structure.

2. Where conduits, boxes or equipment of any type pass through new or existing fire barrier or smoke barrier stops, fire rated ceilings, floors and walls, the Contractor is to thoroughly seal such openings with high temperature fire resisting materials. O.Z./Gedney Fire-Seal fittings or approved equal, is to be used at openings. The Contractor is to be responsible for providing necessary fire resistant materials and covers, where fire rated portions of the building structure are penetrated under this Contract, in accordance with the requirements of NFPA, and other applicable codes.

3. Holes, voids and sleeves created or installed to extend electrical systems through walls or ceilings to be sealed by the Contractor with an intrumescent material capable of expanding up to 8 to 10 times when exposed to temperatures beginning at 250°F. It is to be U.L. classified and have appropriate code approved ratings for three (3) hours per A.S.T.M. E-814.

4. Acceptable materials are to be 3M Brand Fire Barrier Penetration Sealing Systems caulk, putty, strip and sheet forms or approved equal. Method of application is to be in accordance with manufacturer's latest recommendations which are to be furnished as part of the "Shop Drawings".

5. Generally, blocking materials are to be metal; however, should wood blocking be utilized at any location, the blocking must be made fire-resistant.

PROJECT RECORD DOCUMENTS

1. During the progress of the work, the Contractor, assigned Sub-Contractors and major Sub-Contractors employed by them, are to maintain a current (daily) record set of Contract Drawings (Prints) and Specifications, indicating thereon work installed at variance with such Contract Documents, including work covered by supplemental contracts, addenda, change orders or other bona fide sources. All variances to the original Contract Documents are to be indicated in red.

2. At the completion of the construction work and prior to acceptance of the project, the Contractor is to furnish to the Engineer these marked-up documents to be used by the Owner as a record of exact locations of installed systems. The marked-up Drawings may be utilized by the Engineer to prepare “As-Constructed” AutoCAD Drawings.

ELECTRICAL REQUIREMENTS FOR EQUIPMENT INSTALLATION

1. Conduit and power wiring of required size and voltage from a panelboard or similar source are to be furnished and installed by the Contractor, to the equipment furnished by the Heating Contractor, Plumbing Contractor, or General Contractor. A junction box or means of disconnect (as required) is to be furnished and installed at the equipment by the Contractor furnishing the equipment.
2. Unless otherwise specified or noted on the Drawings, a full complement of control components, required for the intended use and/or operation of equipment, including line starters, contactors, magnetic controllers, start-stop switches, multi-speed switches, step controllers and/or other control devices required whether integral or remote, is to be furnished and installed by the Contractor furnishing the equipment. The power wiring (where required) through these devices is to be furnished and installed by the Contractor.

3. Furnishing and installing of control wiring for control devices and proper functioning of equipment is to be the responsibility of this Contractor furnishing the equipment.

4. The Contractor is to be responsible for power connections to equipment and for proper rotation of motors.

5. The approximate location of motors and control equipment is indicated on the Drawings. The Contractor is to make allowance for relocations that may develop at the time of installation. The exact location of the equipment will be determined at the site by the Architect, the Contractor whose equipment is being installed and the Contractor.

WORK IN EXISTING BUILDING

1. The Contractor is to visit the site and thoroughly familiarize himself with the existing conditions before submitting his Proposal as he will be held responsible for the removal and/or relocation of certain existing equipment.

2. The Contractor is to thoroughly familiarize himself with the Specifications and Construction Drawings to determine the extend of work and coordinate the work of the Prime Contractor and other trades to perform in accordance with the Specifications, and the Schedule of Work as required by the Engineer and Owner.

3. The Contractor is to disconnect and render dead wiring to equipment that is to be removed by the Prime HVAC Contractor. The Contractor is to remove exposed conduit and wiring to same. Unused openings for this electrical work are to be repaired and finished by the Contractor to match adjacent surfaces. Painting and finishing of disturbed areas are to be performed by the Prime Contractor unless otherwise indicated.

4. Where existing fixtures, outlets, conduits, etc., interfere with the new work in remodeled areas, the Contractor is to remove the equipment as required. New conduit, conductors, junction boxes, etc., are to be installed for the circuits affected in the area. Where fixtures, switches or other devices are removed and unused openings remain, the Contractor is to remove the box and repair and finish the opening to match the adjacent surfaces.

5. The Contractor is to reuse existing concealed conduit and boxes wherever possible to supply or control new branch circuits in the existing building. If existing boxes do not comply with the current NEC "cubic inch capacity" requirements, the Contractor is to modify or replace existing box as required to comply with the current edition of the National Electrical Code.

6. The existing exposed conduit and wiring not required as part of the remodeling is to be removed.
7. Existing concealed wiring not required as part of the remodeling is to be disconnected and rendered "dead", abandon in place.

8. The Contractor is to maintain continuity of existing branch circuits that are to remain but altered to accomplish the remodeling.

9. The Contractor is to arrange his work so as not to interfere with the normal operation of the building. Work in the existing portion of the building is to be performed with the full consent of the Owner regarding the location, time, etc.

10. Uninterrupted electrical service is to be maintained during the entire time required for the complete installation of the work contemplated under these Specifications and the Drawings.

11. The Contractor is to arrange his work to proceed in such a manner as will least interfere with the normal use of the building and existing facilities. Temporary equipment, cable and whatever else is necessary is to be provided as required to maintain electrical service. Temporary service facilities, if required are to, remain in place until new services are placed in proper operation.

12. If any service or system must be interrupted, the Contractor is to request permission in writing, stating the time and date the service or system will be interrupted and the areas affected. This request is to be made in sufficient time for proper arrangements to be made. Written permission is to be obtained from the Owner before interrupting the electrical service.

13. The Contractor is to do cutting and patching in a manner to cause the least dust, dirt and noise. Existing walls, floors, furniture, etc., are to be properly protected by the use of coverings, drop cloths or barriers as required.

14. The interior and exterior premises of the existing building are to be kept as clean as possible during the entire construction.

15. At no time is the Contractor to interfere with the normal operation of the building by allowing debris, excess material, excess earth, etc., to remain on the premises. Dust and dirt are to be removed in the existing building areas by the use of an industrial type vacuum cleaner."

- End of Section -
ELECTRICAL CONSTRUCTION DETAIL SPECIFICATION

SECTION 262000 – WIRING SYSTEMS AND DEVICES

WIRING METHODS

1. Furnish and install a complete feeder, branch circuit and control circuit distribution system as indicated on the Drawings. The entire system is to be installed in accordance with the requirements of the National Electrical Code and local codes and requirements of any other agency having jurisdiction.

2. Each branch circuit indicated or specified to be in conduit or raceway is to be provided with a separate conduit or raceway except single pole work on branch circuits.

3. Single pole branch circuits may be grouped in conduit or raceway using a common neutral as permitted by the National Electrical Code, except that the maximum allowable capacity may not be reduced.

4. The feeder and branch circuit runs indicated on the Drawings are diagrammatic. The Contractor is to determine the exact locations of circuits, raceways and circuit runs at the site.

5. Wiring in finished areas is to be installed concealed unless noted otherwise. Wiring is to be installed in rigid galvanized steel conduit, intermediate metal conduit, electrical metallic tubing or flexible metallic conduit. The various types of raceways are to be run as hereinafter specified. Aluminum conduit will not be permitted.

A. Rigid Steel Conduit: Wiring in the following locations is to be run in rigid steel galvanized steel conduit.

   1) Branch circuits below or in concrete slabs on earth or stone fill.
   2) Branch circuits in poured concrete walls or masonry walls below grade.
   3) Branch circuits exterior of the building.
   4) In damp locations.
   5) Branch circuits exposed to physical damage.

B. Intermediate Metal Conduits: (Contractor's Option) Wiring in the following locations is to be run in intermediate metal conduit.

   1) Branch circuits below or in concrete slabs on earth or stone fill.
   2) Branch circuits in poured concrete walls or masonry walls below grade.
   3) Branch circuits exterior of the building.
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Gateway Building
Second and Third Floor HVAC Upgrades

4) In damp locations.

5) Branch circuits exposed to physical damage.

C. Rigid Non-Metallic Conduit: Wiring in the following locations is to be run in rigid non-metallic conduit.

1) Branch circuits below or in concrete slabs on earth or stone fill.

2) Underground exterior of the building.

D. Electrical Metallic Tubing: Wiring in the following locations is to be run in electrical metallic tubing:

1) Branch or feeder circuits concealed above ceilings or concealed in walls or partitions, except where rigid conduit or intermediate conduit is permitted as herein specified.

E. Flexible Metallic Conduit: Wiring in the following locations is to be run in flexible metallic conduit:

1) To motors in dry locations. Flexible connections are not to exceed 1'-6" in length.

2) To recessed lighting fixtures wired in electrical metallic tubing. Flexible connections are not to exceed 6' in length.

3) To wiring devices in tables and other fixed cabinetry where flexible conduit can be concealed. Conduits are to be supported with clamps or other such means over 12".

F. Flexible Liquid-Tight Metallic Conduits: Wiring in the following locations is to be run in flexible liquid-tight metallic conduit.

1) To motors and other equipment subject to vibration or in damp locations.

G. Type “MC” Metal Clad Cable: May be used for branch circuits. In finished spaces cable must be concealed above ceilings, in walls or partitions. Verify limits of use with local inspection agency or department.

6. Conduit Installation: The word "conduit" as used in this section of the Specifications is to include the complete raceway system including electrical metallic tubing and flexible conduit, etc., as hereinbefore specified.

7. Exposed conduit is to be assembled by use of cast, zinc or cadmium plated steel fittings as manufactured by Appleton or Crouse Hinds.

8. Conduit and fittings are to bear the Underwriters' Laboratories and manufacturer's labels.

9. Ends of conduits are to be cut square with the use of hacksaw. Burrs and sharp edges are to be removed by reaming. Pipe cutter will not be permitted.
10. Field threaded conduit is to have the same effective length and threaded dimensions as factory cut conduit threads.

11. Right angle or greater bends in conduit 1-1/4" and larger is to be made with factory made fittings, junction boxes and pull boxes as required.

12. Off-sets and changes in direction bends less than 90° and bends in 1" and smaller conduit may be made with hickey or power benders. Bends and off-sets are to be free from dents or flattening.

13. Minimum conduit size is to be 1/2" unless noted otherwise.

14. Exposed conduit runs are to be parallel or at right angles to the building lines.

15. Concealed conduit runs are to be straight and true in as direct a line as possible.

16. No more than the equivalent of four quarter bends are to be used in any conduit run. Runs are to be continuous from point of service to outlet. Terminals are to be furnished with locknut and bushings. Ends of conduit are to be equipped with O.Z. Electrical Manufacturing Company Type "B" or Type "SBT" insulated bushings. Grounding type bushings where required be .O.Z. Electrical Manufacturing Company Type "BLG".

17. Conduit runs are to be cleaned of foreign matter and moisture before pulling wire or cable.

18. A separation of not less than six (6) inches is to be maintained between conduits and steam, hot water or other hot lines or heat producing equipment. When conduits are closer than six (6) inches to hot lines or heat producing equipment, it is to be provided with 3/4" thick fiberglass insulation with factory applied four (4) ounce canvas jacket applied in accordance with the manufacturer's recommendations.

19. Conduit expansion fittings are to be installed at building expansion points. Fittings are to be O.Z./Gedney Electrical Manufacturing Company Type "EX". Install Type "EJ" bonding jumper at each expansion joint.

20. Conduits 1-1/4" and larger installed under floors on grade are to be encased in concrete below floor slab. This is to be accomplished by placing conduit in a shallow trench before concrete floor is poured. This Contractor is to make arrangements with the General Contractor for encasement of conduit beneath slabs on grade and pay costs for encasement.

21. After roughing-in conduit and up to the time of wire being pulled, conduits terminated with open ends up or in a horizontal position are to be protected from entry of foreign material with plastic caps, bushings or pushpennies or other effective covering specifically made to stay on and fit each size of conduit being protected.

22. Attention is directed to exposed block construction. Risers and vertical conduits in a block wall are to be installed as the wall is erected. Cutting and restoration necessitated by the Electrical Sub-Contractor's failure to keep pace will be done at the Electrical Sub-Contractor's expense. Any area affected is to be restored to its original appearance satisfactory to the Architect.

23. Under no circumstances will horizontal runs of conduit or tubing be permitted in walls or partitions.
RIGID CONDUIT

1. Conduit is to be heavy wall, rigid steel, manufactured of mild steel tube of uniform thickness and smooth circular bore approved for use as an electrical raceway and conform to the Federal Specifications WW-C-581, and be zinc-coated, galvanized or sheradized inside and outside. Factory threaded conduit is to be furnished with protective coated threads. Conduit is to be H.K. Porter Company, Youngstown Sheet and Tube Company or Triangle Conduit and Cable Company.

2. Conduits are to be assembled with galvanized heavy wall threaded couplings and fittings.

RIGID NON-METALLIC CONDUIT

1. Conduit is to be PVC Type 40 conduit for application in underground and enclosed applications in accordance with the National Electrical Code (Article 347).

2. Conduit is to be 90° C, UL rated or equivalent. Material is to comply with NEMA Specification TC-2 (Conduit), TC-3 (Fittings - UL-514) and UL-651.

3. The conduit and fittings are to carry a UL label on each 10'-0" length of conduit and stamped or molded on every fittings.

4. Conduit and fittings are to be identified for type and manufacturer and be trackable to location of plant and date manufactured.

5. The conduit is to be made from polyvinyl chloride C-300 compound which includes inert modifiers to improve weatherability, heat distortion. Clean rework material, generated by the manufacturer's own conduit production, may be used by the same manufacturer, provided the end products meet the requirements of this Specification.

6. The conduit and fittings are to be homogeneous plastic material free from visible cracks, holes or foreign inclusions. The conduit bore is to be smooth and free of blisters, nicks or other imperfections which could mar conductors or cables.

7. Conduit, fittings and cement are to be produced by the same manufacturer to assure system integrity.

8. Conduit and fittings are to be tested in accordance with the testing requirements defined in NEMA TC-2, NEMA TC-3 and UL-651 and UL-514 (fittings). The acceptance criteria is to be as given in the same standards.

9. Conduit and fittings are to be solvent cemented in applications in accordance with instructions from the manufacturer.

10. Where conduit is run under floors and exterior of building, Contractor is to change to a metal conduit (as specified) underground and continue conduit run. Where conduits pass thru footer, or below grade wall, Contractor is to sleeve conduit with a sleeve twice the size of the conduit.

ELECTRICAL METALLIC TUBING
1. Electrical metallic tubing is to be made of cold rolled steel, oxyacetylene welded to form a perfectly true tube of uniform thickness. Tubing is to be pickled and cleaned to remove scale and foreign substances and then galvanized. Electrical metallic tubing is to conform to Federal Specifications WW-C-806A. Tubing is to be H.K. Porter Company, Youngstown Sheet and Tube Co. or Triangle Conduit and Cable Company.

2. Electrical metallic tubing is to be assembled by use of threaded or set-screw type connectors and couplings. Threadless type fittings are to be tightened with wrenches. Set screw type fittings are to have captive type screws. Couplings and fittings are to be as manufactured by Thomas and Betts Co., ETP Division of Burgo Industries, Steel City or Raco. Set screw fittings 1/4" and larger are to have dual set screws.

FLEXIBLE METALLIC CONDUIT

1. Flexible metallic conduit is to be hot dipped, galvanized steel construction with interlocking convulsions, conforming to Federal Specification WW-C-566.

2. Flexible conduit is to be attached to rigid conduit, fixtures or boxes with malleable iron, galvanized couplings.

GALVANIZED INTERMEDIATE METAL CONDUIT

1. Galvanized intermediate metal conduit is to be U.L. Standards 6 or 1242 with concrete tight compression type fittings. Maximum size permitted to be 4" diameter.

FLEXIBLE LIQUID-TIGHT METALLIC CONDUIT

1. Flexible conduit is to be constructed with galvanized steel core which has extruded polyvinyl chloride cover. Flexible conduit is to be assembled with fittings manufactured for use with flexible, liquid-tight conduit. Conduit is to be Anaconda "Sealtite" Type UA, with bonding conductor, Steel City or Raco.

2. Conduit is to be assembled by use of liquid-tight insulated connectors manufactured by Thomas and Betts Company, Raco or Steel City.

3. Conduit and fittings are to be Underwriters" Laboratories, Inc. approved.

METAL CLAD, TYPE 'MC' CABLE

1. Type 'MC' cable is to be constructed of galvanized steel armor jacket. Conductors are to be solid copper in sizes from 14 thru 8 and stranded copper in sizes from 6 thru 1. Conductors are to be insulated with THHN-90° C insulation. Each cable is to include an internal insulated copper equipment ground conductor made of copper. 600 voltage rated.
2. Cable fittings are to be Underwriters' Laboratories, Inc., approved.


4. Installation of Type 'MC' cable is to be in a workmanlike manner. "Spaghetti" type installation is not permitted.

5. 'MC' type cable connected to surface mounted panels are to be enclosed in suitable metal enclosures from panelboards to ceiling and from panelboards to floor. Enclosures are to be painted to match panelboard.

**CONDUIT SUPPORTS**

1. Exposed conduits are to be securely fastened in place on a maximum five (5) foot intervals. Hangers, supports or fastenings are to be provided at each elbow and at the end of each straight run terminating at a box or cabinet.

2. Horizontal and vertical runs are to be supported by one hole malleable straps, clamp-backs or other approved devices with suitable bolts, expansion shields (where needed) or beam clamps for mounting to building structure of special brackets.

3. Adjustable hangers may be used to suspend conduits two (2) inches and larger when separately located.

4. If adjustable trapeze hangers are used to support groups of parallel conduits, U-bolts or similar type clamps are to be used at the end of each elbow J-bolt or approved clamps are to be installed on each third intermediate trapeze hanger to fasten each conduit.

5. Hangers are to be made of durable metallic materials suitable for application and be corrosion protected suitable for this area.

6. The use of perforated iron straps for support will not be permitted regardless of conduit size.

7. Strength of the supporting equipment is to be of size and type to support two and one half (2-1/2) times the combined weight of the conduit hanger, cables, etc., being supported.

**BUSHINGS AND LOCKNUTS**

1. Bushings for conduits 1" and smaller may be Type A. Those for conduits 1-1/4" and larger are to be insulating malleable iron, Type B. Use O.Z., Steel city or equal.

2. Locknuts up to and including 2" size are to be the galvanized standard weight type. Locknuts 2-1/2" and larger are to be the heavy duty cast type. Use Steel City, Raco or equal.

3. Connectors are to insure positive ground continuity.
JUNCTION BOXES AND PULL BOXES

1. Furnish and install junction boxes and pull boxes as required. In general, pull boxes are to be installed in conduit and tubing runs exceeding 100 feet and wherever necessary to facilitate pulling or splicing of cable.

2. Boxes are to be sized in accordance with current edition of the herein specified codes. Junction or pull boxes 100 cubic inches or smaller are to be standard outlet boxes. Boxes over 150 cubic inches are to be constructed of galvanized code gauge sheet steel as required for panel cabinets and be complete with gasketed cover secured in place by screws or bolts.

3. Boxes are to be supported from the building structure independent of the entering conduit or tubing. There is not to be an unused opening left in the boxes at completion of the project.

4. Concealed outlet boxes are to be sheradized pressed steel of sufficient size and shape to suit building construction and to accommodate the wiring devices installed at the outlet.

5. Boxes are to have mounting lugs or ears for mounting receptacles and covers.

6. Outlet boxes in finished tile, masonry or hollow metal partition type wall, tile, terrazzo, concrete or other finished floor are to be special boxes designed for specific type of construction. Boxes are to be Steel City, Raco or Appleton.

7. Outlet boxes, switches and receptacles on exposed installations are to be enclosed in Appleton, Crouse Hinds cast conduit fittings.

8. The approximate locations of outlets are shown on the Drawings. Exact locations are to be determined at the building. The Architect reserves the right to change the location of any outlet a reasonable distance from location shown or indicated before outlet has been installed at no additional cost.

9. Any outlet installed out of proper relation as to wall centerline or the building details is to be relocated by the Contractor.

WIRE AND CABLE

1. Wire and cable for feeders, branch circuit, control, etc., are to be soft drawn copper conductors, 600 volt, heat resistant thermoplastic insulated, Type "THWN", "THHN", "THW" or "XHHW" conforming to the latest requirements of the herein specified codes.

   A. Aluminum conductors or copper-clad aluminum conductors will not be permitted.

   B. Shielded cable and other special conductors are to be used where shown on the Drawings, specified herein or otherwise required by the system or equipment manufacturers.

2. Every coil or reel of wire is to bear the manufacturer's name, the Underwriters" label, type, voltage, size length and manufacturing date and be delivered to the job in original containers for inspection.

3. Wire and cable are to be as manufactured by Narragansett, Circle, General Wire and Cable, Paranite, Rome or equal.
4. The minimum wire size for feeders is not to be less than indicated on the Drawings.

5. Unless noted otherwise on the Drawings, the minimum wire size for branch circuits is to be No. 12 AWG, except No. 10 AWG minimum size is to be used in runs where distance from the panelboard to first outlet exceeds 75 feet due to conduit routing.

6. Neutral conductors are to be installed for single phase and 3-phase circuits as required for single phase elements and control circuits.

7. Splices and connections on No. 8 AWG or larger are to be made with approved solderless type connectors.

8. Wire No. 8 AWG and larger is to be stranded. Wire No. 10 and smaller may be solid.

9. Branch circuit conductors are to be color-coded with a separate color for each phase and neutral used consistently throughout the entire installation.

10. No conductors are to be pulled in conduit or EMT system until work which may cause damage to the cable has been completed.

11. Wire and cable is to be installed in conduit in a manner not to damage the insulation. Only U.L. approved wire pulling compounds are to be used to decrease the friction when pulling in wires, such as "Wire Lube" by Ideal.

12. The installation of wire and cable is to be done in such a manner to provide a minimum insulation resistance between conductors and between conductors and ground as required by the National Electrical Code.

13. Where open cable is installed in return air plenum above ceilings, fire rated cable is to be used.

**SPLICES AND TERMINATIONS**

1. Splices and terminations in Wires No. 6 and larger are to be made with mechanical splicing devices and lugs. Splicing devices and lugs for wires No. 2 and larger are to be a type in which the contact pressure in the wire is obtained by two or more screws or bolts and so designed that the failure of any one screw, bolt or nut will not result in a total loss of contact pressure. Mechanical splicing devices are to have insulating covers whenever obtainable and those without covers are to be insulated with Scotchfil electrical insulation putty and Scotch No. 88 all-weather vinyl elastic electrical tape.

2. Splices in conductors sizes No. 8 and smaller are to be self insulated screw-on wire nuts.

3. The terminations of No. 8 and smaller wires are to be made by forming the wires about the terminal screws in the case of solid wires. Stranded wires are to be provided with space lugs attached to the wires by a crimped sleeve.
4. Splices and terminations within wireways are to be made with "Keytap" combination cable connector and terminal blocks and manufactured by Keystone Columbia, Inc., or equal.

5. Materials and devices used for making joints and splices are to be approved by sample, catalog designation or Shop Drawing.

6. For exterior connections subject to moisture, 3M brand "Scotchcast" splicing and termination kits are to be used.

**WEATHERPROOF LOCATIONS**

1. Electrical apparatus installed outside of the building or in any manner exposed to the weather is to be of weatherproof construction.

2. Outlet boxes for weatherproof construction are to be of the cast condulet type, zinc or cadmium plated with matching gasket covers.

3. The ends of conduit are to be sealed with duct seal at terminal points in weatherproof locations.

**OPENINGS**

1. The Electrical Sub-Contractor is to provide required openings in demountable partitions for receptacles, wall switches, clocks, fire alarm system equipment, sound system equipment, etc., where indicated on the Drawings.

**SAFETY SWITCHES**

1. Safety switches are to be 240 or 600 volt, as required, single throw, fusible heavy duty with cover interlock, quick-make, quick-break, independent of handle, Type HD in NEMA Type I enclosure (interior) NEMA 3R (exterior) as manufactured by Square D, Cutler Hammer or General Electric Company or approved equal.

2. Fuses for safety switches are to be as specified under "Fuses".

**CIRCUIT BREAKERS**

1. Furnish and install, where shown on the drawings or specified, appropriate circuit breakers.

2. Single-pole breakers are to be arranged and connected to the main bus so that any adjacent two poles are of opposite potential.

3. A typewritten index of circuits is to be enclosed in an index holder on the back of each panelboard door. The index holder is to be provided with a transparent cover.
4. The panelboards, cabinets, circuit breakers, etc., are to be listed by the Underwriter's Laboratories and bear their label.

5. Circuit breakers are to have thermally operated inverse time limit tripping elements that will not trip the breaker on harmless momentary overload but insure adequate circuit protection. Rapid interruption of short circuit currents is to be accomplished with an instantaneous magnetic trip element.

6. The operating mechanism of breakers is to provide positive trip free operation of abnormal overloads or short circuit and provide quick-make and quick-break contact movement insuring full contact pressure to the time of opening under both manual and automatic operation.

7. The mechanism is to trip free from the handle so that contacts cannot be held closed against short circuit or abnormal overloads.

8. Both stationary and moving contacts are to be non-welding, silver-alloy and be adequately protected by the principle of arc dividing and cooling incorporated in the breakers.

9. Automatic tripping is to be clearly indicated by the handle automatically assuming a position between the manual "on" and "off" positions.

10. Circuit breakers are to be 1-pole, 2-pole or 3-pole with trip elements calibrated for 15 to 400 amperes in wire size capacities as indicated on the Drawings. Circuit breakers are to be of suitable voltage ratings for the circuit they serve.

11. Poles in multi-pole breakers are to be effectively barriered from one another. Multi-pole breakers are to be so designed that an overload on any one pole opens each pole of the breaker simultaneously.

12. Circuit breakers are to be of the "bolt-in" type.

13. Circuit breakers are to have no less than the following NEMA test procedures RMS symmetrical ampere interrupting ratings:

<table>
<thead>
<tr>
<th>FRAME SIZE</th>
<th>120 VOLT</th>
<th>240 VOLT</th>
<th>277 VOLT</th>
<th>480 VOLT</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 (Minimum)</td>
<td>10,000</td>
<td>10,000</td>
<td>14,000</td>
<td>14,000</td>
</tr>
<tr>
<td>100</td>
<td>10,000</td>
<td>10,000</td>
<td>14,000</td>
<td>14,000</td>
</tr>
<tr>
<td>225</td>
<td></td>
<td>22,000</td>
<td></td>
<td>22,000</td>
</tr>
<tr>
<td>400</td>
<td></td>
<td>42,000</td>
<td></td>
<td>30,000</td>
</tr>
</tbody>
</table>

14. Circuit breakers with frame sizes rated 225 amperes and higher are to have adjustable trips.

15. Circuit breakers with higher symmetrical ampere interrupting rating are to be installed where the above minimum ratings are not physically compatible in the panelboards scheduled on the Drawings or hereinafter specified. No circuit breakers are to have frames less than 50 amperes.

16. Circuit breakers for branch circuits supplying power to convenience receptacle located in the exterior walls are to be U.L. listed as a ground fault circuit interrupting type.

17. Circuit breakers are to be manufactured by the same manufacturer of the panel board they are installed.
IDENTIFICATION OF SWITCHES, PANELBOARDS AND CONTROLS

1. Furnish and install name tags as outlined herewithin these Specifications.

   A. Switches (Furnished under this contract mounted remote from equipment)

      1) Equipment Name

   B. Distribution Switchboard Switches

      1) Equipment Name

   C. Controls

      1) Equipment Name

2. Name tags are to be made of rigid black plastic laminate with 1/4" high white letters. Name tags are to be fastened to equipment by heavy duty double face tape.

   - End of Section -
SECONDARY SERVICE – MAIN BUILDING

1. The existing secondary service, 3Ø-4W-120/208 volts in the building is to remain and be reused.

SERVICE CHARGES, PERMITS AND INSPECTIONS

1. The Electrical Sub-Contractor is to coordinate permits and obtain inspections and approvals required for the system installation. Certification of Inspection is to be submitted at the completion of Contract.

FUSES

1. Fuses are to be of the ampere ratings indicated on the Drawings and have a voltage rating equal to or greater than the voltage at their point of application.

2. Fuses, for use in systems rated 600 volts or less are to be of the same manufacturer to facilitate positive selective coordination of the protective devices.

3. Fuses, as specified above, are to be stored in a moisture free location and be installed in the fuse holders immediately prior to energization of the circuit in which the fuse is applied. In no case are fuses to be installed and shipped with equipment to assure compliance with the requirement for moisture-free storage.

4. Furnish one (1) spare set of three (3) fuses for each specified size of fuses installed. These spare fuses are to be delivered to the Owner at the time of acceptance of the project, neatly encased in suitable containers or cabinets as approved by the Architect, for location near points of use.

5. Fuses for safety switches and distribution switches in distribution switchboard will be Class R with ampere ratings of 1/10 ampere to 600 amperes and be of a dual-element construction, incorporating a spring assisted thermal overload element using a 280°F melting point alloy to provide thermal protection for the fuse and fuseholder, and a separate short-circuit element. The design is to provide time-delay of not less than 10 seconds at 500 percent of ampere rating. The interrupting rating is to be aluminum of 200,000 amperes RMS symmetrical as listed by Underwriters' Laboratories. Peak let-thru current (Ip) and energy let-thru values (I²t) are not to exceed the values established by Underwriters' Laboratories Standard for Class K-5 fuses. Fuses are to be Bussman Manufacturing Division of McGraw Edison Company "Low Peak", Class K-5, Type "LPN-RKSP" 250 volt.
GROUNDING

1. The Contractor is to furnish and install the electrical grounding system as required and in compliance with the most recent issue of the National Electrical Code, Power Company policy and recommendations, applicable regulations, and in accordance with the Specifications and Contract Drawings.

2. Ground wiring is not necessarily shown on the Drawings and is the responsibility of the Electrical Sub-Contractor. It is essential and extremely important that the Contractor thoroughly familiarize himself with the applicable codes and regulations prior to installation of the grounding system.

3. Furnish and install necessary materials and accessories to solidly ground non-current carrying metal parts of the electrical system, including where applicable, but not limited to:

   Panelboards and switchboards, enclosures and structure
   Conduit systems, pullboxes, etc.
   Motor frames
   Disconnect switch enclosures

   A. The enclosures of motor starters and controllers, wireways, lighting and power distribution panels, and dry type transformers may utilize the connecting conduit as the equipment grounding conductor, unless a separate equipment grounding conductor is furnished with the main feeder (unless shown otherwise on the Drawings). Provide double lock nuts with grounding bushings and bonding jumpers at metal enclosures.

   B. The frames of motors are to be grounded with a separate equipment grounding conductor run in the same conduit as the phase conductors and connected to the equipment ground bus or ground stud in case of small motor starters.

4. Furnish and install ground conductors and connections as follows:

   A. Ground conductors are to be copper and sized by the Electrical Sub-Contractor unless shown otherwise on the Drawings.

   B. Ground conductors are to be continuous in their length with a minimum of joints or splices installed in exposed rigid steel conduit and securely clamped at each end where the conductor enters and leaves the conduit.

   C. Connections are to be tight and solid, securely bolted to the equipment. Contact surfaces are to be thoroughly cleaned and bright before connections are made to insure good metal-to-metal contact.

   D. Connections are to be made accessible for visual inspection; particularly underground connections should not be covered until they have been inspected by the Owner's representatives.

   E. Use copper cable and clamps at underground mechanical joints of the cast iron water service line.
F. Ground conductors from protective devices such as lighting arrestors and grading rings are to be kept as straight and short as possible. Where bends are necessary, they are to be of large radii to minimize surge impedance. The entire distribution system is to be effectively and solidly grounded.

G. Copper ground bus bar is to be provided where shown or required.

H. Provide bonding jumpers across conduit where the grounding continuity may otherwise be broken, such as flexible and expansion joints.

I. Equipment grounding conductors installed in conduit with other insulated phase conductors are also to be insulated.

J. Grounding conductors are to be located and installed in such a manner to provide the shortest and most direct path between equipment and ground.

- End of Section -
FIRE ALARM SYSTEM

1. Description

A. This section of the specification includes the installation, connection and testing of the duct smoke detectors and wiring as shown on the drawings and specified herein.

B. Underwriters Laboratories Inc. (UL) - USA:

   No. 38 Manually Actuated Signaling Boxes
   No. 50 Cabinets and Boxes
   No. 268A Smoke Detectors for Duct Applications

C. The installing company shall employ NICET (minimum Level II Fire Alarm Technology) technicians on site to guide the final check-out and to ensure the systems integrity.

2. Scope

A. Basic Performance:

   1) Initiation Device Circuits (IDC) shall be wired Class B (NFPA Style B) or Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.
   2) All circuits shall be power-limited, per UL864 9th edition requirements.
   3) A single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm when wire NFPA Style 6/7.
   4) Alarm signals arriving at the main FACP shall not be lost following a primary power failure or outage of any kind until the alarm signal is processed and recorded.

3. Guarantee:

A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.
4. Applicable Standards and Specifications:

The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.

A. National Fire Protection Association (NFPA) - USA:

  No. 13 Sprinkler Systems
  No. 70 National Electric Code (NEC)
  No. 72 National Fire Alarm Code
  No. 101 Life Safety Code

B. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.

C. Local and State Building Codes.

D. All requirements of the Authority Having Jurisdiction (AHJ).

5. Approvals

A. The system shall have proper listing and/or approval from the following nationally recognized agencies:

  UL  Underwriters Laboratories Inc
  ULC Underwriters Laboratories Canada
  FM  Factory Mutual
  MEA  Material Equipment Acceptance (NYC)
  CSFM California State Fire Marshal

PRODUCTS

1. Conduit and Wire

A. Conduit:

  1) Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.

  2) Where required, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.

  3) Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760-55.
4) With the exception of telephone connections, wiring for 24-volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.

5) Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.

6) Conduit shall be 3/4-inch (19.1 mm) minimum.

B. Wire:

1) All fire alarm system wiring shall be new.

2) Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for Initiating Device Circuits and Signaling Line Circuits, and 14 AWG (1.63 mm) for Notification Appliance Circuits.

3) All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.

4) Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NEC 760 (e.g., FPLR).

5) Wiring used for the multiplex communication circuit (SLC) shall be twisted and support a minimum wiring distance of 10,000 feet. The design of the system shall permit use of IDC and NAC wiring in the same conduit with the SLC communication circuit. Shielded wire shall not be required.

6) All field wiring shall be electrically supervised for open circuit and ground fault.

7) The fire alarm control panel shall be capable of T-tapping Class B (NFPA Style 4) Signaling Line Circuits (SLCs). Systems which do not allow or have restrictions in, for example, the amount of T-taps, length of T-taps etc., are not acceptable.

C. Terminal Boxes, Junction Boxes and Cabinets:

1) All boxes and cabinets shall be UL listed for their use and purpose.

EXECUTION

1. Installation

A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.
Allegany College of Maryland
Gateway Building
Second and Third Floor HVAC Upgrades

B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

2. Test

The Duct Smoke Detectors shall be tested to ensure proper operation.

- End of Section -