

SECTION 235100 - BREECHING, CHIMNEYS, AND STACKS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type B double wall gas vents.
2. Double wall metal stacks.
3. Condensing Boilers Stacks

B. Related Sections:

1. Section 230529 - Hangers and Supports: Product requirements for hangers and supports for placement by this section.
2. Section 230700 - Mechanical Insulation: Execution requirements for insulation specified by this section.
3. Section 235234 - Boilers: Boilers using breeching, chimneys, and stacks.
4. Section 230503 - Wiring Connections: Execution requirements for electrical connections specified by this section.

1.2 REFERENCES

- A. American National Standards Institute:
- B. ASTM International:
- C. National Fire Protection Association:
- D. Sheet Metal and Air Conditioning Contractors:
- E. Underwriters Laboratories Inc.:

1.3 DEFINITIONS

- A. Breeching: Vent Connector.
- B. Chimney: Primarily vertical shaft enclosing at least one vent for conducting flue gases outdoors.
- C. Smoke Pipe: Round, single wall vent connector.
- D. Vent: Portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.
- E. Vent Connector: Part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate general construction, dimensions, weights, support and layout of breeching. Submit layout drawings indicating plan view and elevations where factory built unit is used.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.6 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 TYPE B DOUBLE WALL GAS VENTS

- A. Manufacturers:
1. Selkirk.
  2. Metal Fab.
  3. Van-Packer
- B. Fabrication: Inner pipe of sheet aluminum, and outer pipe of galvanized sheet steel, tested in compliance with UL 441.

2.2 DOUBLE WALL METAL STACKS

- A. Manufacturers:
1. Selkirk.
  2. Metal Fab.
  3. Van-Packer
- B. Furnish double wall metal stacks for use with building heating equipment, in compliance with NFPA 211.
- C. Fabricate with 1 inch (25 mm) minimum air space between walls. Air space shall have 1” fiberglass insulation. Construct inner jacket of 20 gage (0.9 mm) ASTM A167 Type 316 stainless steel. Construct outer jacket of aluminum coated steel 24 gage (0.6 mm) for sizes 10 inches to 24 inches (250 mm to 600 mm) and 20 gage (0.9 mm) for sizes 28 inches to 48 inches (700 mm to 1200 mm).
- D. Accessories, UL labeled:

1. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers and storm collar.
  2. Exit Cone: Consists of inner cone, and outer jacket, to increase stack exit velocity 1.5 times.
  3. Stack Cap: Consists of conical rain-shield with inverted cone for partial rain protection with low flow resistance.
- E. Where exposed to weather, the outer closure band shall be sealed to prevent rainwater from entering the space between inner and outer walls. Aluminized surfaces shall be protected by a minimum of one base coat of primer and one finish coat of corrosion resistant paint suitable for outer jacket skin temperature of the given application. All primer and paint to be supplied by the installing contractor and shall be equivalent to series 4100 or 9400 as manufactured by Rust-Oleum. Final finish paint shall be of color selected by architect.

### 2.3 POSITIVE PRESSURE VENT FOR CONDENSING BOILERS

- A. Manufacturer:
1. Selkirk
  2. Metal-Fab
  3. Van-Packer
- B. The vent shall be of the double-wall, factory-built type for use on condensing appliances or pressurized venting systems serving Category II, III or IV appliances or as specified by the equipment manufacturer.
- C. Maximum temperature shall not exceed 550°F (288°C).
- D. Vent shall be listed for an internal static pressure of 6" w.g. and tested to 15" w.g.
- E. Vent shall be constructed with an inner and outer wall, with a 1" annular insulating air space.
1. The inner wall (vent) shall be constructed of AL29-4C® superferritic stainless steel, .015 thickness for 6"-12" diameters and .024 thickness for 14"-24" diameters.
  2. The outer wall (casing) shall be constructed of aluminized steel, .018 thickness for 6"-12" diameters and .024 thickness for 14"-24" diameters.
  3. Inner and outer walls shall be connected by means of spacer clips that maintain the concentricity of the annular space and allow unobstructed differential thermal expansion of the inner and outer walls.
- F. All Parts exposed to the weather shall be protected by one (1) coat of corrosion and heat resistant base primer and one (1) coat of heat resistant paint.
- G. All support, roof or wall penetrations, terminations, appliance connectors and drain fittings, required to install the vent systems shall be included.
- H. Roof penetration pieces shall be UL listed and provided by the vent manufacturer. Roof curbs shall be required on roofs greater than 12:12 pitch.

- I. All inner vent connections shall be secured by means of profiled connector bands with gear clamp tighteners. Joints shall be sealed with P077 Sealant.
- J. Where exposed to weather, the outer closure band shall be sealed to prevent rainwater from entering the space between inner and outer walls. Aluminized surfaces shall be protected by a minimum of one base coat of primer and one finish coat of corrosion resistant paint suitable for outer jacket skin temperature of the given application. All primer and paint to be supplied by the installing contractor and shall be equivalent to series 4100 or 9400 as manufactured by Rust-Oleum. Final finish paint shall be of color selected by architect.
- K. Vent shall terminate in accordance with installation instruction and local codes.

### PART 3 EXECUTION

#### 3.1 PREPARATION

- A. Install concrete inserts for support of breeching, chimneys, and stacks in coordination with formwork.

#### 3.2 INSTALLATION

- A. Install in accordance with NFPA 54.
- B. Install breeching with minimum of joints. Align accurately at connections, with internal surfaces smooth.
- C. Insulate breeching in accordance with Section 230700.
- D. For Type B double wall gas vents, maintain UL listed minimum clearances from combustibles. Assemble pipe and accessories for complete installation.
- E. Assemble and install stack sections in accordance with NFPA 82, industry practices, and in compliance with UL listing. Join sections with acid-resistant joint cement. Connect base section to foundation using anchor lugs.
- F. Level and plumb chimney and stacks.
- G. Clean breeching, chimneys, and stacks during installation, removing dust and debris.
- H. Install slip joints allowing removal of appliances without removal or dismantling of breeching, breeching insulation, chimneys, or stacks.
- I. Outdoor flues shall be painted with color to be selected by architect. See manufacturer recommendation for flue preparation prior to painting.

END OF SECTION 235100

SECTION 235234 - BOILERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Boilers.
2. Boiler controls.
3. Boiler trim.
4. Natural gas fired burner.

B. Related Sections:

1. Section 230100 – Basic Mechanical Requirements.
2. Section 230513 - Motors: Product requirements for electric motors for placement by this section.
3. Section 230548 - Mechanical Sound, Vibration, and Seismic Control: Product requirements for Vibration Isolators for placement by this section.
4. Section 221100 - Domestic Water Piping: Execution requirements for cold water piping connections to boilers specified in this section.
5. Section 232113 – Hydronic Piping: Execution requirements for hot water piping connections to boilers specified in this section.
6. Section 221523 - Gas Piping: Execution requirements for gas piping connections to boilers specified in this section.
7. Section 235100 - Breeching, Chimneys, and Stacks: Execution requirements for breeching, chimney, and stack connections to boilers specified in this section.
8. Section 260503 - Wiring Connections: Execution requirements for electric connections to boilers specified in this section.

1.2 REFERENCES

- A. American National Standards Institute:
- B. American Society of Mechanical Engineers:
- C. Hydronics Institute:
- D. National Fire Protection Association:

1.3 SUBMITTALS

- A. Product Data: Submit capacities and accessories included with boiler. Include general layout, dimensions, size and location of water, fuel, electric and vent connections, electrical characteristics, weight and mounting loads.
- B. Test Reports: Indicate boilers meet or exceed specified performance and efficiency. Submit results of combustion test.
- C. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

1.5 QUALITY ASSURANCE

- A. Conform to ASME and ANSI Code for construction of boilers. Provide boilers registered with National Board of Boiler and Pressure Vessel Inspectors.
- B. Gas Train and Safety Controls: Conform to requirements of Factory Mutual (FM)
- C. Unit Certification: CSA or UL certified.
- D. Conform to applicable code for internal wiring of factory wired equipment.
- E. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for purpose specified and indicated.
- F. Perform Work in accordance with State Municipality standard.
- G. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience, and with service facilities within 100 miles of project.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept boilers and accessories on site in factory shipping packaging. Inspect for damage.
- B. Protect boilers from damage by leaving packing in place until installation.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.9 WARRANTY

- A. Boilers shall be supplied with a written 3 year warranty covering all parts and labor in accordance to the manufacturer's warranty. Warranty shall be performed by the local certified factory representative but backed by the manufacturer in writing.
- B. The manufacturer shall cover the heat exchanger for 10 years. The heat exchanger warranty may NOT be prorated.

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of boilers during warranty period.
- B. Provide emergency call back service at all hours for this maintenance period.
- C. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.
- D. Perform maintenance work using qualified personnel under supervision and in direct employ of boiler manufacturer's representative.

PART 2 PRODUCTS

2.1 HOT WATER BOILERS (NON - CONDENSING)

- A. Manufacturers:
  - 1. RBI Futura
  - 2. Patterson-Kelley Mudufire
  - 3. Lochinvar-Power Fin
- B. Boilers:
  - 1. Each boiler shall be designed to operate on natural gas or propane and shall have an AGA-certified rating indicated on drawing. Each boiler shall have a certified AGA thermal efficiency of 85% and shall be of the non-condensing type.
- C. Required Firing System and Trim
  - 1. Boiler must be fully modulating with minimum 3:1 proportionate firing rate.
  - 2. Ignition system must be interrupted spark (glow coils are not acceptable). Pilot shall be independent of the combustion system and configured with separate air and gas adjustments. Pilot assembly shall be easily removable from the boiler for cleaning and alignment similar to the RBI Turbo Pilot system.

3. Flame safeguard control shall be a non proprietary HONEYWELL RM7800 series, commercial grade with full diagnostic control screen on one boiler per boiler room. (Manufacturers utilizing light commercial or third party relay systems as a flame safeguard control will NOT be accepted).
4. Boiler must be vertically down fired using the 360 degree flame pattern concept. Horizontal exchangers will not be considered.

D. Construction:

1. Boiler shall be supplied with all stainless steel jackets.
2. All wiring must terminate to a numbered and labeled terminal strip easily accessed through a latched and piano hinged control cabinet door.
3. Heat Exchanger shall be constructed with ample tubing and passes to provide a 25F to 35F delta tee. Velocity within the heat exchanger may not exceed 13 FPS.

E. Controls and Building Management:

1. Boilers must be provided with a Heat Net control panel capable of communicating with all the boilers in the plant using a master/member set up.
2. The master boiler shall monitor and control the firing rate of all the boilers (networked as a single system via simple CAT V cable).
3. HeatNet shall have the ability to operate as a stand alone boiler plant energy management system, or accept a set point temperature signal from the BMS (4-20ma or 0-10vdc).
4. Boiler shall communicate to the building management system via Modbus (standard) and shall be capable of communicating through LonWorks or BacNet as required (see control specification).
5. Control system firmware must be upgradable using a USB/RS485 network configuration allowing the owner to update the system as they become available. Updates shall be available and downloadable at no charge from an accessible web site.

F. Gas Burner and performance criteria:

1. Metal fiber mat premix burner shall fire to provide equal distribution of heat throughout the entire heat exchanger.
2. Burner composition shall be Fecralloy™.
3. The burner shall be easily removed for maintenance without the disruption of any other major component of the boiler.
4. The burner shall be capable of 88.3% efficiency without exceeding a Nox reading above 20ppm.
5. The boiler shall be capable of operating at rated capacity with natural gas pressures as low as 42" W.C. at the inlet to the burner pressure regulator.

2.2 BOILER TRIM AND CONTROLS

A. PROVIDE THE FOLLOWING STANDARD TRIM:



1. Low Air Pressure Switch
2. Blocked Flue Detection Switch
3. Flow Switch (Factory Mounted and wired)
4. Modulation Control
5. Temperature/Pressure Gauge
6. Manual Reset High Limit
7. Air inlet filter
8. Inlet/Outlet Temperature Display
9. Full Digital Text Display for all Boiler Series of Operation and Failures
10. Variable Frequency Drive and Combustion Air Fan

**B. PROVIDE THE FOLLOWING JOB SPECIFIC TRIM AND FEATURES**

1. Air Inlet hood (side wall termination of air intake pipe). (shipped loose)
2. Vent termination Hood (side wall termination of vent pipe). (shipped loose)
3. FM or IRI controls and Gas Train.
4. Each boiler must be provided with a freeze protection damper on the air inlet.
5. Damper shall be prewired and shipped loose with a pigtail.
6. Manufacturer shall supply a thermostatic mixing valve at each boiler to insure a 140F return temperature to the copper heat exchanger.
7. Thermostatic tempering valve shall be non-electric without the need for external control.

**C. Control Panel:**

1. The control panel shall be mounted and wired on the boiler and conveniently located for the operator. It shall be a NEMA-1 design and shall contain the flame safeguard relay, motor starter, and all necessary relays. All wiring shall be number coded for ease of tracing and shall terminate on a terminal strip.
2. The front of the panel shall contain a 10-point diagnostic control system with power on switch and indicating lights for power, heat, ignition, pilot, main flame, low water, low gas pressure, low air flow, and high temperature. The flame safeguard relay shall be a Honeywell 7800 Series, microprocessor, computerized, solid-state control with digital readouts and annunciation.
3. Air inlet damper control panel to be shipped loose and to be installed and interlocked with boiler by mechanical contractor. Damper will open on a "call for heat" and drive closed when the firing cycle is completed to prevent any potential damage from sub-freezing out-door temperatures.
4. The entire control panel shall be pre-wired and require only a 120/1/60 power supply with a 9-amp circuit.

**D. BAS Lead-Lag Control System:**

1. The boiler manufacturer shall make provisions in his control panel to easily connect into the temperature control building automation system. Provide all relays to transmit alarm to the BAS. Boilers shall be rotated in operation as first on first off.

2.3 SOURCE QUALITY CONTROL

- A. Test and inspect boilers according to the ASME Boiler and Pressure Vessel Code, Section IV. Boilers shall be test fired in the factory with a report attached permanently to the exterior cabinet of the boiler for field reference.
- B. Each boiler must be factory fire tested prior to leaving the manufacturing plant. Results of the factory fire test shall be recorded and provided to the owner.

2.4 DIRECT-VENT /SEALED COMBUSTION:

- A. Each boiler shall have an AGA-certified rating for direct vent/sealed combustion. No air from the mechanical room/building shall be utilized for combustion air or dilution air (barometric dampers or draft hoods are not acceptable).
- B. Each boiler shall be provided with a sealed air intake with direct duct to outside air.
- C. An interlocked airtight damper and control panel shall be provided with each boiler for each inlet duct.
- D. Materials for construction for the air intake and venting systems must comply with the boiler manufacturer's AGA certification.
- E. The flues from Heating Boilers (where required) shall be of the size shown on the drawings and shall be double wall construction with 316 stainless steel inner liner. Provide special sleeves, spacers, and install a weathertight flashing at the roof and terminate above the roof in a Belmont top. Fabricate with 1 inch minimum air space between walls. Air space shall include 1” fiberglass insulation
- F. Shop Tests:
  1. The boilers must be shop tested prior to shipping and a copy of this test report furnished to the owner. This test is in addition to the hydrostatic test required by ASME Code, and will include wiring checkout, water level settings, firing rate set, and piping inspection.
- G. Start-Up:
  1. After the installation is completed, the boiler manufacturer shall furnish the services of a factory-trained service engineer to start-up and train the boiler operator in the proper operation of the boilers. In addition, the boiler manufacturer shall furnish a one-year warranty on labor and five years for materials to replace or repair any parts that may fail during normal usage.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install boilers plumb and level, to plus or minus 1/16 inch (2 mm) over boiler base.
- B. Maintain manufacturer's recommended clearances around and over boilers.
- C. Install boiler on concrete housekeeping pad, minimum 6 inches (87 mm) high and 6 inches (150 mm) larger than boiler base on each side. Refer to Section 03300.
- D. Connect natural gas piping in accordance with NFPA 54.
- E. Connect natural gas piping to boiler, full size of boiler gas train inlet. Arrange piping with clearances for burner removal and service.
  - 1. Each boiler shall require a minimum gas pressure of 5.3" W.C. (FM gas train) at 2,000 scfh (full load rated capacity).
  - 2. Each boiler shall be provided with an individual supply gas regulator for proper gas regulation with a 2" NPT connection.
- F. Connect hot water piping to supply and return boiler connections.
- G. Contractor shall install the following piping accessories. Refer to Section 232116.
  - 1. On supply:
    - a. Thermometer well for temperature controller.
    - b. Thermometer well and thermometer.
    - c. Well for control system temperature sensor.
    - d. Strainer.
    - e. Nipple and flow switch.
    - f. Pressure gage.
    - g. Shutoff valve.
  - 2. On return:
    - a. Thermometer well and thermometer.
    - b. Well for [control system] temperature sensor.
    - c. Pressure gage.
    - d. Shutoff valve.
    - e. Balancing valve.
- H. Install the following piping accessories on natural gas piping connections. Refer to Section 221123.
  - 1. Strainer.

2. Pressure gage.
  3. Shutoff valve.
  4. Check valve.
  5. Pressure reducing valve.
- I. Install discharge piping from relief valves and drain valves to nearest floor drain.
  - J. Install boiler trim and accessories furnished loose for field mounting.
  - K. Install electrical devices furnished loose for field mounting.
  - L. Install control wiring between boiler control panel and field mounted control devices.
  - M. Connect breeching to boiler outlet, full size of outlet. The boiler shall operate under positive (Category IV) or negative (Category II) stack pressure. Vent material must be listed AL29-4C Stainless Double Wall Stack for condensing appliances.
  - N. Provide all control wiring and interlocking wiring as required.

### 3.2 FIELD QUALITY CONTROL

- A. Perform combustion test including boiler firing rate, over fire draft, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide, percent oxygen, percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output. Perform test at minimum, mid-range, and high fire.
- B. Arrange with local authorities having jurisdiction for inspection of boiler, piping, and for certificate of operation.

### 3.3 COMMISSIONING

- A. Engage a factory-authorized service representative to provide startup service. Start up to be performed only after complete boiler room operation is field verified to offer a substantial load, and complete system circulation. One-year warranty service must be provided by a factory authorized and certified tech
- B. Adjust air dampers and gas valves

### 3.4 CLEANING

- A. Flush and clean boilers upon completion of installation, in accordance with manufacturer's start-up instructions.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:

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1. Operate boiler, including accessories and controls, to demonstrate compliance with requirements.
2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
3. Review data in the maintenance manuals. Refer to Division 1 Section "Contract Closeout."
4. Delete above or below depending on which Section is retained in Division 1.
5. Review data in the maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
6. Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION 235234

SECTION 237413 – PACKAGE ROOF TOP AIR CONDITIONING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Packaged Air Conditioning Units.
- B. Roof curbs.

1.2 RELATED SECTIONS

- A. Section 230516 - Expansion Compensation.
- B. Section 230516 – Motors & VFD.
- C. Section 230700 - Ductwork Insulation.
- D. Section 233100 - Ductwork.
- E. Section 233300 - Ductwork Accessories: Flexible duct connections.
- F. Section 260503 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.3 REFERENCES

- A. AMCA 99 - Standards Handbook.
- B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- C. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
- D. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
- E. AMCA 500 - Test Methods for Louver, Dampers, and Shutters.
- F. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
- G. ARI 430 - Central-Station Air-Handling Units.
- H. ARI 435 - Application of Central-Station Air-Handling Units.
- I. NFPA 90 A - Installation of air conditioning and ventilating systems.
- J. NFPA 70 - National Electrical Code.
- K. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- L. UL 900 - Test Performance of Air Filter Units.

1.4 WORK INCLUDED

- A. Package Roof Top units and components, as shown on product drawings and described in performance specifications.
- B. Motors, starters, and variable frequency drives as shown on product drawings and described in performance specifications.
- C. Factory packaged controls, as shown on product drawings and described in performance specifications.
- D. Product drawings, performance specifications, and other submittal documents show segments, components, options, and features furnished by Johnson Controls. Options listed in this specification will not necessarily be included.

1.5 SUBMITTALS

- A. Submit under provisions of Section 230100.
- B. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- C. Product Data:
  - 1. Provide literature: Indicates dimensions, weights, capacities, ratings, fan performance, gages and finishes of materials, and electrical characteristics and connection requirements.
  - 2. Provide data of filter media, filter performance data, filter assembly, and filter frames.
  - 3. Provide fan curves with specified operating point clearly plotted.
  - 4. Submit sound power level data for both fan outlet and casing radiation at rated capacity.
  - 5. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

1.6 RATINGS AND CERTIFICATIONS

- A. Unit will conform to AMCA 210 for fan performance ratings.
- B. Unit will conform to E.T.L. standards.
- C. Unit sound ratings will be reported in accordance with ARI 260 for inlet and discharge sound power levels.
- D. Unit casing radiated sound ratings will be reported in accordance with ISO 9614 parts 1&2 and ANSI S12.12.
- E. Unit will conform to ARI 410 for capacities, pressure drops, and selection procedures of air coils.
- F. Unit will conform to ARI 430 for all fabrication procedures of air handling units.

- G. Motors covered by the Federal Energy Policy Act (EPACT) will meet EPACT requirements.
- H. Damper performance will comply with AMCA 500.
- I. Airflow Monitoring Stations will be rated in accordance with AMCA 611-95 and bear a Certified Ratings Seal for Airflow Measurement Performance.
- J. Air-handling units will be ISO9001 certified.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 230100.
- B. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.8 QUALITY ASSURANCE

- A. Product of manufacturer regularly engaged in production of components who issues complete catalog data on total product offering.
- B. Variable Air Volume Units with Variable Speed Drive: Certify air volume, static pressure, fan speed, brake horsepower and selection procedures in accordance with ARI 430. Certify units with inlet vanes in wide-open position. If air handling units are not certified in accordance with ARI 430, contractor shall be responsible for expenses associated with testing of units after installation to verify performance of fan(s). Any costs incurred to adjust fans to meet scheduled capacities shall be the sole responsibility of the contractor.

1.9 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver, store, protect and handle products to site under provisions of General Conditions.
- B. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.
- C. Units shall ship fully assembled up to practical shipping and rigging limitations. Units not shipped fully assembled shall have tags and airflow arrows on each section to indicate location and orientation in direction of airflow. Each section shall have lifting lugs or shipping skid to allow for field rigging and final placement of section.
- D. Deliver units to site with fan motors, sheaves, and belts completely assembled and mounted in units. Mount motors as specified.
- E. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.
- F. Unpainted units will be wrapped prior to shipment.
- G. Openings will be protected against damage from shipping
- H. Loose-shipped items will be packed, protected and secured with units.



1.10 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.11 EXTRA MATERIALS

- A. Furnish under provisions of Section 230100.
- B. Provide one additional sets fan belts.
- C. Provide two additional sets for each unit pleated filters and pre-filters.

PART 2 PRODUCTS

2.1 MODULAR AIR HANDLING UNIT

- A. Manufacturers
  - 1. Aeon
  - 2. Carrier “39M”
  - 3. Trane “MCC”
  - 4. McQuay “CAH”
  - 5. Johnson Controls YORK Solution

2.2 ROOFTOP UNITS

- A. General Description
  - 1. Packaged rooftop unit shall include compressors, evaporator coils, filters, supply fans, dampers, air-cooled condenser coils, condenser fans, gas heaters, return fans, and BACnet unit controls.
  - 2. Unit shall be factory assembled and tested including leak testing of the coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the controls compartment’s literature pocket.
  - 3. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
  - 4. Unit components shall be labeled, including pipe stub outs, refrigeration system components and electrical and controls components.
  - 5. Estimated sound power levels (dB) shall be shown on the unit ratings sheet.
  - 6. Installation, Operation and Maintenance manual shall be supplied within the unit.
  - 7. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment’s access door.
  - 8. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment’s access door.

B. Construction

1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
2. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D-1929 for a minimum flash ignition temperature of 610°F.
3. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.
4. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Refrigerant piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.
5. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
6. Access to filters, dampers, cooling coils, reheat coil, heaters, exhaust fans, return fans, energy recovery wheels, compressors, water-cooled condensers, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.
7. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
8. Units with cooling coils shall include double sloped 304 stainless steel drain pans.
9. Unit shall be provided with base discharge and return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.
10. Unit shall include lifting lugs on the top of the unit.

C. Electrical

1. Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.
2. Unit shall be provided with factory installed and factory wired 115V, 13 amp GFI outlet with outlet disconnect switch in the unit control panel.

D. Supply Fans

1. Unit shall include direct drive, unhooded, backward curved, plenum supply fans.
2. Blowers and motors shall be dynamically balanced and mounted on rubber isolators.

3. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.
4. Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency.

E. Return Fans

1. Unit shall include direct drive, axial flow return fans. Blades shall be adjustable pitch.
2. Unit shall include barometric relief dampers.
3. Fans and motors shall be dynamically balanced.
4. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.
5. Access to return fans shall be through double wall, hinged access doors with quarter turn handles.
6. Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency.

F. Cooling Coils

1. Evaporator Coils
  - a. Coils shall be designed for use with R-410A refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.
  - b. Coils shall have interlaced circuitry and shall be 6 row high capacity.
  - c. Coils shall be helium leak tested.
  - d. Coils shall be furnished with a factory installed thermostatic expansion valves.

G. Refrigeration System

1. Unit shall be factory charged with R-410A refrigerant.
2. Compressors shall be scroll type with thermal overload protection, independently circuited, and carry a 5 year non-prorated warranty.
3. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam insulated panels to prevent the transmission of noise outside the cabinet.
4. Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.
5. Each refrigeration circuit shall be equipped with thermostatic expansion valve type refrigerant flow control.
6. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides, and factory installed liquid line filter driers.

7. Unit shall include a variable capacity scroll compressor on all refrigeration circuits which shall be capable of modulation from 10-100% of its capacity. Units not provided with variable capacity scroll compressors shall have a minimum Unit EER rating of 15.4 for Rtu-1, 16.1 for Rtu-2 and 13.4 for Rtu-3.
8. Each refrigeration circuit shall be equipped with a liquid line sight glass.
9. Each capacity stage shall be equipped with a 5 minute off, delay timer to prevent compressor short cycling.
10. Each capacity stage shall be equipped with an adjustable, 20 second delay timer to prevent multiple capacity stages from starting all at once.
11. Each refrigeration circuit shall include adjustable compressor lockouts.
12. First capacity stage shall be provided with on/off condenser fan cycling and adjustable compressor lockout to allow cooling operation down to 35°F.

H. Condensers

1. Air-Cooled Condenser
  - a. Condenser fans shall be vertical discharge, axial flow, direct drive fans.
  - b. Coils shall be designed for use with R-410A refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.
  - c. Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.
  - d. Coils shall be helium leak tested.
  - e. Condenser fans shall be high efficiency electrically commutated motor driven with multiple speeds which are controlled with a fan cycle switch based on head pressure and allow matching condenser airflow with cooling capacity steps.

I. Gas Heating

1. Unit shall include a natural gas furnace with 2 stages of capacity.
2. Aluminized steel heat exchanger furnace shall carry a 15 year non-prorated warranty.
3. Gas furnace shall consist of aluminized steel heat exchangers with multiple concavities, an induced draft blower and an electronic pressure switch to lockout the gas valve until the combustion chamber is purged and combustion airflow is established.
4. Furnace shall include a gas ignition system consisting of an electronic igniter to a pilot system, which will be continuous when the heater is operating, but will shut off the pilot when heating is not required.
5. Unit shall include a single gas connection and have gas supply piping entrances in the unit base for through-the-curb gas piping and in the outside cabinet wall for across the roof gas piping.

J. Filters

1. Unit shall include 2 inch thick throw away pre-filter and 4" pleated panel filters with an ASHRAE efficiency of 65% and MERV rating of 9, upstream of the cooling coil.
2. Unit shall include a clogged filter switch.

K. Outside Air/Economizer

1. Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 15 CFM of leakage per sq. ft. of damper area when subjected to 2 inches w.g. air pressure differential across the damper. Damper assembly shall be controlled by spring return enthalpy activated fully modulating actuator. Unit shall include outside air opening bird screen, outside air hood with rain lip and barometric relief dampers.

L. Controls

1. Factory Installed and Factory Provided Controller
  - a. Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory factory tested.
  - b. Controller shall be capable of stand alone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.
  - c. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.
  - d. Controller shall include non-volatile memory to retain all programmed values, without the use of an external battery, in the event of a power failure.
  - e. With enthalpy activated fully modulating economizer option, an outdoor air humidity sensor shall be factory installed.
  - f. Variable Air Volume Controller
2. Unit shall be equipped with variable speed modulating compressors on the lead and lag refrigeration circuits to protect against evaporator frosting at low suction pressures and to prevent excessive compressor cycling.
3. Outside and return air temperature sensors shall be factory mounted and wired. Supply air temperature sensor and supply air duct static pressure sensor shall be furnished with the unit for field installation.
4. Control of supply air flow, for duct static pressure control, shall be with unit controller, factory installed variable frequency drive, and supply air duct static pressure sensor.
5. Unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling shall be accomplished with connection to interface module with LCD screen and input keypad, interface module with touch screen, or with connection to PC with free configuration software. Controller shall be capable of connection with other factory installed and factory provided unit controllers with individual unit configuration, setpoint adjustment, sensor status viewing, and occupancy scheduling available from a single unit. Connection between unit controllers shall be with a modular cable. Controller shall be capable of communicating and integrating with a BACnet network.

M. Accessories

1. Unit shall be provided with a terminal block for field installation of a smoke detector which shuts off the unit's control circuit.

2. Unit shall be provided with a firestat sensing the return and supply air of the unit, wire to shut off the unit's control circuit.

N. Curbs

1. Spring curbs shall to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting of the rooftop unit.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation, Operation and Maintenance manual shall be supplied with the unit.
- B. Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation and Maintenance manual instructions.
- C. Start up shall be performed by manufacturer's authorized technician. Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.
- D. Install in conformance with ARI 435.
- E. Install assembled unit on vibration isolation curb. Refer to Section 230548.
- F. Unit shall not operate during construction without a minimum of 2" throw away filters.
- G. Contractor shall clean energy recovery filters and coils prior to installation of permanent operation filters.

END OF SECTION 237413

SECTION 238216 - TERMINAL HEATING UNITS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes

1. Finned tube radiation,
2. Unit heaters,
3. Cabinet unit heaters,
4. Electric heat tracer (freeze protection)

B. Related Sections:

1. Section 230513 - Motors: Product requirements for motors for placement by this section.
2. Section 230700 Mechanical Insulation: Execution requirements for insulation specified by this section.
3. Section 232113 – Hydronic Piping: Execution requirements for piping fittings and drains piping specified by this section.
4. Section 260503 – Wiring Connections: Execution requirements for electric connection to units specified by this section.

1.2 REFERENCES

- A. ARI 410 (Air-Conditioning and Refrigeration Institute) - Forced-Circulation Air-Cooling and Air-Heating Coils.
- B. UL 1096 (ANSI/Underwriters Laboratories, Inc.) - Electric Central Air Heating Equipment.
- C. SMACNA (Sheet Metal Air Conditioning Contractors' National Association) - HVAC Duct Construction Standards, Metal and Flexible.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations. Indicate schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers
- B. Product Data: Submit coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions. Submit mechanical and electrical service locations, capacities and requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access to valves.

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- B. Operation and Maintenance Data: Submit manufacturers' descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

### 1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience.

### 1.6 PRE-INSTALLATION MEETING

- A. Convene minimum one week prior to commencing work of this section.

### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept units on site in factory packing. Inspect for damage. Store under roof.
- B. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors. Protect coils from entry of dirt and debris with pipe caps or plugs.

### 1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

### 1.9 WARRANTY

- A. Furnish one year manufacturer's warranty.

### 1.10 EXTRA MATERIALS

- A. Furnish two sets of filters.

## PART 2 PRODUCTS

### 2.1 FINNED TUBE RADIATION

- A. Manufacturers:
  - 1. Vulcan
  - 2. Trane
  - 3. Sterling
  - 4. Rittling
- B. Heating Elements: seamless copper tubing, mechanically expanded into evenly spaced aluminum fins, suitable for soldered fittings.
- C. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.



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- D. Enclosures: 0.0478 inch thick steel up to 18 inches in height, 0.598 inch steel over 18 inches in height [or aluminum as detailed], with easily jointed components for wall to wall installation. Support rigidly, on wall or floor mounted brackets [at least 3 feet on center maximum].
- E. Finish: Factory applied baked enamel of color as selected by architect.
- F. Damper: Where heating media is not thermostatically controlled, furnish knob-operated internal damper at enclosure air outlet.
- G. Access Doors: For otherwise inaccessible valves, furnish factory-made permanently hinged access doors, 6 x 7 inch minimum size, integral with cabinet.
- H. Capacity: As scheduled, based on 65 degrees F entering air temperature, 145 degrees F average water temperature.

### 2.2 CONVECTORS

- A. Manufacturers:
  - 1. Vulcan
  - 2. Sterling
  - 3. Rittling
  - 4. Trane
- B. Heating Elements: Seamless copper tubing mechanically expanded into evenly spaced aluminum fins and cast iron headers, steel side plates and supports, factory air pressure tested at 100 psi under water, with means of adjusting pitch of element.
- C. Cabinet 0.0598 inch thick steel front and top, 0.0478 inch steel back and ends; exposed corners rounded; easily secured removable front panels, adequately braced and reinforced for stiffness.
- D. Finish: Factory applied baked enamel of color as selected by architect.
- E. Damper: Where heating media is not thermostatically controlled, furnish knob-operated internal damper at enclosure air outlet.
- F. Access Doors: For otherwise inaccessible valves, furnish factory-made permanently hinged access doors, 6 x 7 inch minimum size, integral with cabinet.
- G. Capacity: As scheduled, based on 65 degrees F entering air temperature, 145 degrees F average water temperature.

### 2.3 UNIT HEATERS

- A. Manufacturers:
  - 1. Vulcan
  - 2. Sterling
  - 3. Rittling

4. Trane
- B. Coils: Seamless copper tubing, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.
- C. Casing: 0.0478-inch thick steel with threaded pipe connections for hanger rods.
- D. Finish: Factory applied baked enamel of color as selected by architect.
- E. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.
- F. Air Outlet: Adjustable pattern diffuser on projection models and two-way louvers on horizontal throw models.
- G. Motor: Permanently lubricated sleeve bearings on horizontal models, grease lubricated ball bearings on vertical models.
- H. Control: Local multi-speed disconnect switch.
- I. Capacity: As scheduled, based on 65 degrees F entering air temperature, 135 degrees F average water temperature.
- J. Electrical Characteristics: See drawings
  1. Refer to Section 260503.

#### 2.4 CABINET UNIT HEATERS

- A. Manufacturers:
  1. Vulcan
  2. Sterling
  3. Rittling
  4. Trane
- B. Coils: Evenly spaced aluminum fins mechanically bonded to copper tubes, designed for 100 psi and 220 degrees F.
- C. Cabinet: 0.0598 inch thick steel with exposed corners and edges rounded, easily removed panels, glass fiber insulation and integral air outlet and or integral air outlet and inlet grilles.
- D. Finish: Factory applied baked enamel of color as selected by architect on visible surfaces of enclosure or cabinet.
- E. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.
- F. Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.

- G. Control: Multiple speed switch, factory wired, located in cabinet.
- H. Filter: Easily removed 1 inch thick glass fiber throw-away type, located to filter air before coil.
- I. Mixing Dampers: Where indicated, mixing sections with dampers. Refer to Section 230900 for operating sequence.
- J. Capacity: As Scheduled, based on 65 degrees F entering air temperature, 145 degrees F average water temperature.
- K. Electrical Characteristics: See drawings
  - 1. Refer to Section 260503.

## 2.5 ELECTRIC PROPELLER UNIT HEATER

- A. Manufacturer:
  - 1. Q-Mark
  - 2. Erincraft
  - 3. Markel
  - 4. Electromode
- B. Assembly : UL listed and labelled assembly with terminal box and cover and controls.
- C. Heating Elements: Fintube with continuous aluminum spiral fins brazed to metal sheath.
- D. Unit Casing: 18 gauge steel with horizontal adjustable discharge air louvers and service panel.
- E. Fan: Direct drive type 'Q' wheel propeller type, statically and dynamically balanced, with fan guard.
- F. Motor: Totally enclosed permanently lubricated, sleeve bearings for horizontal models, ball bearings for vertical models with inherent overload protection.
- G. Control: Factory wired, with built-in contactors. Provide thermal overload and high limit safety switch. Wall mounted thermostat wired by Temperature Control Contractor.
- H. Electrical Characteristics:
  - 1. As scheduled on drawings.
  - 2. Disconnect Switch: Factory mount disconnect switch.
  - 3. Refer to Section 260503 and Electrical drawings.

## 2.6 FREEZE PROTECTION - ELECTRIC HEAT TRACING

- A. Manufacturer:
  - 1. Thermom Corporation
  - 2. Raychem

3. Chromalox
- B. Electric heat tracing for the purpose of freeze protection shall be installed on the cooling tower water piping and cold water piping to cooling tower under insulation as indicated on the plans.
  - C. The heat tracing shall be capable of maintaining a minimum water temperature of 40 deg. F. at an ambient air temperature of -10 deg. F. (or specify desired minimum temperature).
  - D. The electric heat tracing shall be a self-regulating heater. Heater shall respond to varying localized temperature conditions along the pipe by self-regulating its heat output at each point along its length without reliance on thermostat controls. For energy conservation, provide factory set at 50 deg. F NEMA 4X enclosure ambient or pipe sensing thermostat.
  - E. Operating energy shall be conserved by the self-regulating feature of the heater materials that automatically controls heat output in proportion to the heat requirements. Operating safety shall be increased by the absolute heater temperature limit built into the self-regulating heater material without a reliance on thermostats. A constant wattage heater shall not be acceptable.
  - F. The heater shall have a self-regulating factor of at least 90 percent. The self-regulation factor is defined as the percentage reduction, without thermostatic control, of the heater output going from 40 deg. F. pipe temperature operation to 15 deg. F. pipe temperature operation.
  - G. The electrical heat tracing shall consist of flat, flexible, low-heat density electric heat tracing strip of parallel circuit construction, consisting of 16 AWG bus bars and a continuous inner core of self-regulating conductive material. This core shall be insulated with a radiation crosslined polyolefin jacket, tinned copper braid and outer protective polyolefin jacket. The heat tracing strip shall be capable of being cut to the desired length in the field. Thermon components shall be used for all power connection points, heat tracing tees and end seal terminations.
  - H. The self-regulating heater, in combination with the inter-connect components, shall have U.L. System Listing.
  - I. See electrical drawings for electrical characteristics.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify wall construction and ductwork are ready for installation.
- B. Verify concealed blocking and supports are in place and connections are correctly located.

#### 3.2 INSTALLATION

- A. Install Work in accordance with manufacturer's recommendation standards.
- B. Install coils in ducts and casings in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- C. Wire electric duct coils. Refer to Section 260503.

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- D. Install equipment exposed to finished areas after walls and ceilings are finished and painted. Avoid damage.
- E. Protection: Install finished cabinet units with protective covers during remainder of construction.
- F. Finned Tube Radiation: Locate on outside walls and run cover wall-to-wall unless otherwise indicated. Center elements under windows. Where multiple windows occur over units, divide element into equal segments centered under each window. Install wall angles where units butt against walls.
- G. Convectors: Install at locations as indicated on Drawings. Coordinate to assure correct recess size for recessed convectors.
- H. Unit Heaters: Hang from building structure, with pipe hangers anchored to building, not from piping. Mount as high as possible to maintain greatest headroom unless otherwise indicated.
- I. Cabinet Unit Heaters: Install at locations as indicated on Drawings. Coordinate to assure correct recess size for recessed units.
- J. Install electric heating equipment including devices furnished by manufacturer but not factory-mounted. Furnish copy of manufacturer's wiring diagram submittal. Install electrical wiring in accordance with manufacturer's submittals and Section 260503.
- K. Provide wall box extensions for CRUV and FC connections to outside wall louvers. Verify air tight connections.

### 3.3 CLEANING

- A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.
- C. Install new filters.

END OF SECTION 238216

SECTION 271343 – TELE/DATA PREMISE CABLE DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION

- A. Requirements in the "general conditions of contract", division 1 and section 16 of these specifications apply to all work in this section.
- B. The intent of this section is to have a complete cabling system meeting all required standards furnished, installed, tested and fully documented. the specifications, diagrams and plans establish the minimum acceptable standards. They are not intended to indicate exact equipment and rack layouts or all cables, equipment and components required. all work required for a completely installed and functioning system fully coordinated with the data network electronics and phone system being moved from previous office location.
- C. The design intent of this structured cable system is to provide flexibility of the installed wiring plant of this office area. this is to be accomplished by the use of cat6 rated cables running from the mdf to ports throughout the office area. these cat6 qualified drops shall be able to provide many different functions i.e. 10/100/1000 base-t data, and phone system lines. cross connecting these ports in the mdf shall use rj-45 jacks and cat6 quality patch cords and provide connection to any device being used. the pin-out termination of any special purpose equipment or service wiring will need to be verified by the cabling contractor. example is analog phone line pairs that run from phone system backboard to mdf patch panel ports, each pair would be terminated to center conductors of a patch panel rj45 jack. in this example of a special purpose run, cross connection of the analog phone pair rj45 jack to the rj45 cat6 runs via standard cat6 patch cords will provide proper pin-out to user ports as required where final equipment connection can be made.

1.2 DESCRIPTION OF WORK INCLUDED

- A. Work in this section includes a complete structured cabling system for data communications meeting the requirements of eia/tia-568-b category.
- B. Work includes:
  - 1. Work Station Data Modular Jacks
  - 2. UTP Horizontal cables
  - 3. UTP patch panels
  - 4. UTP patch cords
  - 5. Equipment cabinets
  - 6. Grounding
  - 7. Testing and documentation
  - 8. Workstation wall boxes and floor ports to furniture.

1.3 STANDARDS

- A. Work shall comply with the applicable requirements in the latest version of:

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1. ANSI/TIA/EIA-568-b telecommunications cabling standard
2. ANSI/TIA/EIA -569-a pathway and spaces.
3. NFPA 70 national electrical code
4. ISO - 11801
5. Grounding
6. NEMA - 250
7. ANSI/TIA/EIA - 606

### 1.4 QUALITY ASSURANCE

- A. Category 6 data cabling shall be furnished as a complete system by one manufacturer that includes jacks, patch panels, patch cords, and approved cable tested as a system and certified and guaranteed by cable system manufacture for at least 25 years optimal category 6 performance..
- B. Category 6 cabling shall be third party etl verified to tia/eia 568b-5 cat 6 component and channel specifications.
- C. Contractor shall have an RCDD certified employee.

### 1.5 PERFORMANCE REQUIREMENTS

- A. The category 6 system shall provide the following minimum performance:
  1. Performance in excess of proposed TIA/EIA category 6 parameters.
  2. Support of applications from 10base-t through 1000base-t.
  3. Backwards compatibility with lower performing category products.

### 1.6 1.6 DOCUMENTATION

- A. Installation and testing shall be documented in accordance with ansi/tia/eia-606 standards and submitted to architect in a bound booklet..
  1. Provide as-built drawings showing routing and identification numbers of all cables and terminations.
  2. Provide a printed schedule and microsoft excel spreadsheet file for all cables listing each data port with room and jack designations. include length of each cable run.

### 1.7 SUBMITTALS

- A. Submit the following in accordance with requirements in section 16 and division 1 of the specifications. Provide as-built drawings showing routing and identification numbers of all cables and terminations
  1. Product data for each component specified, including detailed manufacturer's specifications documenting that components comply with specified standards.
  2. Samples of workstation outlet connectors, jacks, jack assemblies and face plates for color selection and demonstration of compatibility with system.

## PPNEO

3. Qualification data, certification copies for firms and persons installing the structured wiring system as well as structured cabling system manufacturer's contact information for verifying certification.
4. Installation and test documentation and as-built drawings.

### 1.8 WARRANTY

- A. Correct all faults that may occur and certify that the system as delivered to the owner is free of faults and will perform as specified.
- B. Provide draka/molex copper system gold performance based warranty by the cabling system manufacturer and contractor for period of at least 25 years on the horizontal cabling including patch panels, patch cables, terminations and labor, the remaining portions of the system shall be warranted for a period of one (1) year from date of substantial.

## PART 2 PRODUCTS

### 2.1 ACCEPTABLE SYSTEM MANUFACTURERS

- A. Category 6 system components and cabling shall be as manufactured or approved for their system use by Draka/molex cabling systems as a standard of bidding. Acceptable manufacturers include Blackbox and Allied wire and cable.
- B. Catalog numbers in the specifications or drawings are given for purpose of establishing functional requirements and minimum standard of design and quality. party numbers may change due to color requirement, mounting requirement, etc.
- C. All cables in ceiling spaces shall be plenum rated.

### 2.2 JACKS AND WALL PLATES

- A. Draka/molex datagate 6 jacks ksj-00013-xx shall be used..
- B. Specialized wall plate such as wall phone studded plates shall be approved for use by draka/molex for cat6 qualification and shall covered by cable system manufactures warrantee if their product line doesn't provide one.
- C. Wall plates shall be molex and coordinated with the architect as to style and color. Modular wall plate systems shall provide a consistent color of each part through out the installation.
- D. Jack mounting faceplates used in furniture shall be coordinated with furniture manufacture so they are suitable to mount draka/molex system jacks.

### 2.3 UTP HORIZONTAL CABLES

- A. Horizontal cable from workstation jack to patch panel shall be molex supercat 1000.
- B. Horizontal cable shall be terminated using the tia/eia-568-b pair assignments.

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## PPNEO

### 2.4 UTP PATCH PANELS

- A. Data patch panels shall be molex pid-00079, 24 port or pid-00080 48 port.
- B. Front 24 port patch panel cable management shall be molex 25.b013g above and below each 24 port patch panel.
- C. Front 48 port patch panel cable management shall be molex 25.b016g above each 48 port patch panel.
- D. Patch panels shall be 19" rack mounted sized to accommodate all homeruns from workstation outlets plus 20% spare capacity for future use.

### 2.5 LABELING OF PORTS

- A. Workstation data ports and distribution frame patch panel ports shall be labeled using a machine printed label.
- B. Labeling shall state room number, room port identifier, patch panel identifier and patch panel port identifier. Example of a port label is: a103-c-b-15 where a103 is room number on architectural drawing, c is the port identifier in the room (could run from a to z and on to aa, bb, etc.) b is the patch panel, and 15 is the port in the patch panel.

### 2.6 UTP PATCH CORDS

- A. All utp patch cables shall be molex pdc-000xx series cat 6 with length as required.
- B. Patch cords shall have eia/tia-568b pair assignment.
- C. Molex pdc-000xx series cat 6 patch cords shall be provided for each data workstation jack installed. coordinate length and color with architect.
- D. All cable dressing shall be done with velcro wire ties.

### 2.7 FLOOR MOUNTED RACKS AND CABINETS

- A. Structured cabling termination panels in the mdf shall be mounted in open racks manufactured by the Ritall corporation.
- B. At each equipment rack provide wire management panels for both horizontal and vertical wire management. front and rear cable stain relief devices shall be used.

### 2.8 GROUNDING

- A. A system grounding and bonding shall be provided meeting the requirements of ansi/tia/eia-607 grounding and bonding standard.
- B. A copper ground bus bar shall be provided at the lower left corner of each plywood backboard including service entrance board and boards at mdf. bus bar to be Square 'D' ground bar kit #pk23gta or equivalent.

## PPNEO

- C. Provide #6 awg stranded copper conductor from electrical service grounding electrode to bus bar at service entrance board to all other bus bars. run as a continuous conductor to last connection with intermediate bars connected with tap connection.
- D. Provide #6 awg stranded copper conductor back to last connection.
- E. Bond each equipment rack at mdf with #6 awg stranded copper conductor to bus bar at backboard
- F. Test ground system using a two-point test method. the ohmic value shall be less than 0.1 between the test points.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install system in accordance with eia/tia-568 specifications for category 6 wiring
- B. Termination of category 6 wiring shall be eia/tia-568b pair assignment on every end of every cat6 wire.
- C. Install components as indicated in accordance with standards and manufacturers' instructions. use techniques, methods and practices that are consistent with the designated standards that assure the specification performance from end to end to all wiring systems.
- D. Install cable in raised floor, concealed furniture raceway, and concealed conduits in finished rooms. Cable installation shall have cable management devices arranging the cable in a neat orderly manner. Exposed cable will not be allowed in finished room, cubicles, etc. secure and support cable at intervals not exceeding 48" and not more than 6" from frames, boxes, racks and equipment tie cable in bundles using velcro wire ties.
- E. Measure and record length of all cables. cable shall be one piece without splicing from patch panel to workstation outlet. cable must not exceed 90 meters in length. pull cables without exceeding manufacturer's recommended pulling tension. pull cables simultaneously when more than one is being installed in the same raceway. do not kink or bend cable in radius smaller than recommended by manufacturer or allowed by standards. keep cable free of damage. do not install against any surface or object that could cause damage.
- F. Identify all cables at each end with permanent machine marked coded labels. record all numbering and numbering system on as-built documents.

### 3.2 VERIFICATION AND TESTING

- A. Verify by testing and document that each pair utp cable satisfies the following:
  - 1. Proper numbering at each termination
  - 2. No AC voltage
  - 3. No DC voltage
  - 4. No opens
  - 5. No transpositions

PPNEO

6. No reversals
  7. No shorts
  8. No crosses
  9. Proper polarity
  10. Proper continuity
  11. Test all utp cable in accordance with tia/eta tsb-67 transmission performance specification for:
  12. Residual next
  13. Random noise floor
  14. Output signal balance
  15. Common mode reflection
  16. Dynamic accuracy
  17. Return loss
- B. Test all cable after installation for next and attenuation and plotted graphically at frequencies of 10, 50, and 100 mhz.
- C. An independent testing laboratory must conduct all tests.
- D. Contractor must engage an independent testing laboratory to conduct testing and verification that the structured wiring system meets or exceeds the standards identified in this section. Contractor shall include the costs of all testing and retesting that may be required until specified standards are met.

END OF SECTION

SECTION 337173 - ELECTRICAL SERVICES

PART 1 GENERAL

1.1 DESCRIPTION

A. Visit To Site

1. This Contractor shall visit the site of the work and familiarize himself with all conditions affecting this work and the submission of his proposal shall be construed as indicating such knowledge. No extra compensation will be allowed for work which could have been anticipated by making such site visit.

- B. Provide all labor, material, equipment, tools, and services necessary for, and incidental to, the proper installation of the incoming electrical service herein specified, and as shown on the drawings.

C. ELECTRICAL SERVICE

1. The building is supplied by means of two existing pad mounted transformer. The Utility shall tap the existing pad mounted transformer with secondary voltage at 480 volts, 3 phase, 4 wire for lighting and power, To upgrade service as required.
2. The new electric service shall consist of necessary conduit and incoming line and necessary conduit sleeves for incoming line. Conduit boxes, and all necessary backboards, and the entire system shall be coordinated directly with utility company and architect prior to rough-in. The new electrical service, voltage for the building shall be 480 volt, 3 phase, 4 wire.
  - a. Temporary electrical service wiring shall be provided by electrical contractor to OSHA requirements for the use of all trades during construction.

D. TELEPHONE SERVICE

1. The existing Telephone service is shall be upgraded as required. Contractor to provide new rough-in locations and backboards as required on contract documents.

PART 2 PRODUCTS

2.1 FABRICATION AND MANUFACTURE

- A. A pad mounted transformer installation will be provided by the local utility company, for the electrical requirements of this project.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The Power Company will furnish and install the pad mounted transformer. All work in connection with transformer will be provided by the Power Company, but this Contractor shall provide the secondary underground service conduits, duct banks, secondary service pull box, and meter base. This Contractor shall terminate all ducts and cables as directed by the Power Company.

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- B. This Contractor shall arrange conduits and conductors to accommodate the Power Company requirements in accordance with the Utility's accepted standards.
- C. This Contractor shall include in his bid proposal an allowance item of Twenty-Five Thousand Dollars (\$25,000.00) for the charges or costs made by the Power Company for new service. This allowance shall be used to compensate the Contractor for actual charges made by the Power Company. The balance, if any, shall be credited to the project.

### 3.2 CLEAN-UP:

- A. Oily waste rags or flammable materials must be removed from the building immediately after use. Keep floor areas covered and protected where conduit is cut and threaded. Conduit, outlet boxes, fittings, etc., must not be left scattered about. Keep floors, stairs and corridors free of construction materials, equipment and tools. Upon completion of installing any unit equipment, remove all excess materials, crates and debris from the job site. Keep covered and hazard-free all panels, equipment and temporary wiring. In general, maintain a safe, clean and orderly work area.

### 3.3 CUTTING AND PATCHING:

- A. Electrical Contractor shall plan and coordinate all his work ahead and place sleeves in walls, floors, and ceilings and anticipate during initial stages of construction, such openings as will be required to accommodate his equipment. Electrical Contractor shall coordinate his work closely with all Contractors to conceal his work in the finished portions of the building.
- B. Avoid cutting concrete, masonry, and other finished work by use of sleeves and inserts. Inform other trades of the locations of all sleeves and inserts required and deliver sleeves and inserts to the appropriate trade for installation.
- C. Perform cutting and patching required for installation of the electrical work. Methods and procedures shall be acceptable to the Architect.
- D. Cut holes through concrete, masonry and tiles, when necessary, by rotary core drilling. Hole locations shall have the approval of the Construction Manager. After installation of conduit, holes through fire-rated walls, floors, etc. shall be sealed to restore the fire rating.

### 3.4 EXCAVATION AND BACKFILLING:

- A. Excavation and backfill for all underground electrical and communication installations shall be included in the work of this Contractor unless indicated or specified otherwise. Excavation and backfill shall comply with applicable provisions of the General Trades portion of the specifications. The Electrical Contractor shall coordinate the routing of underground duct and conduits with the other trade contractors. Backfill shall include three (3) inches of screened sand below ducts and twelve (12) inches of screened sand above ducts. All backfill shall be compacted.
- B. Electrical Contractor shall provide concrete bases as required for exterior lighting. Concrete shall be 3000 pound minimum and shall conform to Concrete Section of Specifications.

3.5 COORDINATION:

- A. Plan and coordinate work to provide minimum interference with other trades. Coordinate all openings required in the building construction for installation of electrical work. Cutting and patching made necessary by failure to coordinate will be at this Contractor's expense.
- B. Before installing any of the work, verify that work does not interfere with clearances required for the erection and finish of beams, columns, pilasters, walls, or other structural or architectural members, as shown on the drawings. If any work is so installed and it later develops that the architectural design cannot be followed, the Contractor shall, at his own expense, make such changes in his work as the Architect may direct to permit the completion of the work in accordance with the Drawings and Specifications.
- C. Electrical Contractor shall report any interference between his work and that of any other Contractors to the Architect as soon as they are discovered. The Architect will determine which equipment shall be relocated regardless of which was first installed, and his decision shall be final.

3.6 GUARANTEE:

- A. Material, equipment and installation shall be guaranteed for a period of one year from the date of acceptance. Defects which appear during that time period shall be corrected by this contractor at his expense.

END OF SECTION 337173