SECTION 15810 - SEMI-CUSTOM AND PRE-ENGINEERED AIR HANDLING UNITS

1.0 GENERAL

1.1 DESCRIPTION:

A. This section of the work includes the design, fabrication, testing, cleaning and packaging, shipment and final assembly of semi-custom and pre-engineered air handling units. The unit manufacturer shall build units in complete accordance with the following specification.

B. The details outlined and component manufacturers named in this specification may not be deviated from in the air handling unit manufacturer's preparation of the bid, even where techniques are required which are not considered standard by the manufacturer. The construction as described in this specification is considered essential, and any deviation from this specification must be specifically identified and bid as a Voluntary Alternate (add or deduct), but only after complying with the specification defined as the Base Bid. Any anticipated deviations must also be submitted in writing to the Directors of Central Utilities and the respective Operation and Maintenance Group and the consulting engineer for review and acceptance a minimum of twenty days prior to the bid date. The engineer shall communicate to all bidders acceptance or rejection of any proposed deviations in writing.

C. Due to the physical space constraints and associated performance expectations for the air handling units, the contractor accepts full responsibility for any deviations to this specification. Any cost associated with accepting alternate manufacturers or specifications or performance deviations shall be borne by the contractor.

D. The air handling units are based on and designed around Air Enterprise, Pace, or Rochester Custom Metal. Units by alternative manufactures are also acceptable if they meet all aspects of the following specification and the performance requirements outlined on the schedule. Special attention to the preferred material of construction and any coatings should be noted. The units are to be constructed of steel materials unless noted otherwise.

1.2 QUALITY ASSURANCE:

A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified or as denoted on the drawings and schedule.

B. Equipment furnished under this specification shall be in accordance with the following industry, association and government codes and standards, as applicable to their design, fabrication, assembly and testing.

1. AMCA 99 Standards
2. ARI 430 Central Station Air Handling Units
3. NFPA 70 National Electric Code
4. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating System

C. Fans shall be rated in accordance with AMCA Standard 210 for performance and AMCA Standard 301 for sound and shall bear the AMCA seal.

Motor shall meet requirements of NEMA, IEEE, ANSI, and NEC standard.

Coils shall be rated in accordance with ARI Standard 410 and bear the ARI seal.

D. Equipment within unit shall be UL listed where applicable.
1.3 SUBMITTALS:

A. DRAWINGS FOR APPROVAL: Provide the following detailed information on the equipment for approval:
   1. Information requested in the RFP, including equipment data sheets, schedules and sketches.
   2. Equipment drawings showing dimensions, configuration, major component locations, access door locations, duct connection sizes and locations, and shipping split locations.
   3. Equipment operating and shipping weights.
   4. Fan manufacturer and performance curves with the operating points clearly indicated.
   5. Motor sizes and types.
   6. Coil selections, including flow rates, temperatures, pressure drops, connection sizes, face velocities, fin spacing, and number of rows.
   7. Proposed filters indicating size, efficiency, and pressure drop.
   8. Materials of construction for housing and major components.
   9. Airborne and transmitted sound power levels by octave band.
   10. Electrical data, wiring diagrams, and accessory panel layouts. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
   11. Factory and required test procedures for review and acceptance.

Unit manufacturer shall itemize all deviations from the specified requirements. If not so indicated, unit manufacturer will be required to furnish all items in total compliance with the drawings and the specification.

B. AFTER RECEIPT OF APPROVED DRAWINGS: Submit manuals with detailed description of installation, operation, and maintenance, including the following:
   1. All approved “Certified for Construction” drawings.
   2. Written recommendations for field storage, both indoors and outdoors.
   3. Installation requirements including assembly instructions, lifting requirements and adjustments.
   4. Manufacturer’s literature describing each piece of equipment furnished including operation instructions including step by step preparation of starting, shutdown, and draining and maintenance instructions including lubrication.
   5. Factory test results.

1.4 PRODUCT CLEANING, DELIVERY, STORAGE, AND HANDLING:

A. Thoroughly clean equipment, components and subassemblies of water, dirt, debris, weld splatter, grease, oil and other foreign matter prior to shipment.

B. Seal and protect all openings in unit casings, housings and enclosures with thin gauge sheet metal closure sheets. Seal closures, caps and plugs dust-tight and moisture-tight.
   Protect pipe flanges with plywood coverings. Protect pipe threads with plastic end caps or plugs.
   Protect machined surfaces with suitable, easily removable rust preventive.
   Provide full charge of proper lubricant for grease lubricated bearings.
   Provide desiccant bags or vapor phase inhibitors where required to keep components dry.

C. Units delivered with scratched, dented, or dirty surfaces or damage of any type shall be restored to “as new” condition as directed by the Architect/Engineer/Owner at no cost to Owner.

D. If equipment is to be stored before use, the shipping protection provided by the unit manufacturer shall remain on the unit until the unit is installed. In addition, manufacturer shall submit written recommendations for field storage, both indoor and outdoor.
E. Provide non-corrosive nameplate permanently attached to each piece of equipment containing the following information at a minimum:

1. Manufacturer’s project number
2. Plant name and location
3. Equipment number
4. Date of manufacture

1.5 WARRANTY:

A. The unit manufacturer shall warrant the following for the period listed from the date of Owner acceptance:

1. Unit casing and structural base against corrosion or failure under normal operating conditions for a period of ten (10) years.
2. Parts and labor for all equipment, materials and workmanship for a period of one (1) year.

B. During the warranty period, at no additional cost to the Owner, any equipment, material, or workmanship in which defects may develop shall be repaired or replaced. This warranty obligation for parts and labor is to be coordinated between the installing contractor and the unit manufacturer.

2.0 MATERIALS

2.1 MANUFACTURERS:

A. Subject to compliance with requirements, provide air handling units as manufactured by:

1. Air Enterprise
2. PACE
3. Rochester Custom Metal

B. Alternate pricing based on pre-approved manufacturers will be considered if the specified performance requirements and construction techniques are adhered to in all respects. Any substitutions shall be approved by the Architect/Engineer/Owner in writing ten (10) days prior to bid.

C. The unit manufacturer shall have been manufacturing air handling units for a minimum of five (5) years.

2.2 SEMI-CUSTOM AND PRE-ENGINEERED AIR HANDLING UNITS:

A. Air handling units shall be of the configuration, capacity and style as indicated on the drawings and equipment schedule and as specified herein. Through properly designed access; ease of maintenance, removability of components, and unit serviceability shall be assured.

B. The units shall be constructed for indoor or outdoor installation as indicated.

C. The units shall consist of: inlet mixing box with return air and outside air dampers, filter section with combination 35% and 85% filters, heating coil section, humidifier section, cooling coil section, and supply fan section.

D. Units shall be provided with a complete lighting system with switches and receptacles, damper operators furnished and installed on all dampers, and motor wiring to safety disconnect switches.
E. Provide safing between internal components and unit casing to prevent air bypass. All seams or voids between safing, components and unit casing shall be caulked and sealed airtight.

F. Provide hygienic unit design with interior suitable for washing down. Unit insulation must be completely encapsulated.

G. The unit sizes shown on drawings are established based on unit performance, structural, and access requirements and are not to be altered.

2.3 UNIT BASE:

A. The unit shall be constructed on an all aluminum or 304 stainless steel structural base. The base shall be designed to distribute loads properly to a suitable mounting surface and be braced to support internal components without sagging, pulsating or oil canning.

B. The entire unit base shall be fully welded and guaranteed waterproof; cooling coil condensate and outside air intake areas shall have a minimum 3” deep sump between structural members to serve as a drain pan to prevent building water damage from the unit. Sump to be double-sloped towards units drains to positively remove condensate from the unit.

C. The base floor shall be minimum 1/8 inch thick aluminum or 12 gage 304 stainless steel fully welded at all joints and to structural members. The base floor shall be designed for a minimum live load of 100 pounds per square foot throughout the unit. The base floor is to be supported with adequate stiffening members to prevent oil canning. Caulking, gaskets and mechanical fasteners to guarantee seals and water tightness of joints will not be acceptable.

D. The perimeter support members shall be a minimum of 6” structural member properly sized to support all major components and the housing during rigging, handling and operation of the unit.

E. The underneath side of the base pan and base perimeter shall be insulated with minimum 2” thick 1.5-pcf high density fiber insulation covered with a plastic sheet to form a vapor barrier. Vapor barrier material is to be continuous with no seams. Vapor barrier is then protected by an 0.040 inch thick aluminum or 20 gauge 304 stainless steel sheet attached to the bottom of the base.

F. Each section of the unit base shall contain a minimum 1” NPT drain to facilitate system washdown, maintenance and condensate removal. Areas in the base where potential standing water cannot be removed through drains or weep holes are not acceptable. Clean out drains shall be provided with removable caps constructed of non-corrosive material.

G. All equipment within air handling unit shall be provided with a minimum 2” high base to raise equipment off unit floor for housekeeping. Equipment mounted directly on unit floor is unacceptable.

H. Supply air floor openings to be framed with 3” high water dam continuously welded to the pan to allow proper duct connections and to prevent moisture from entering the openings. Framed floor openings shall be provided with removable aluminum or 304 stainless steel grating designed and fabricated for a live load of 100 pounds per square foot. Galvanized or painted steel grating will not be accepted.

I. All unit base service openings shall be framed with a minimum 3” high water dam continuously welded to the floor. All pipe and electric conduit chases with openings to building or elements shall be covered with thin gauge aluminum or 304 stainless steel. All field penetrations shall be sealed.
J. Fastening to floor plate or joining of unit sections to be accomplished by bolting through gasketed joints above the floor line or continuously welding. Fasteners which penetrate base floor plate are not acceptable.

2.4 UNIT CASING

A. Air handling unit casing shall be built up from the unit base with panels. The unit manufacturer shall be the manufacturer of the panel system. Panels shall be load bearing and capable of withstanding anticipated static and dynamic loads (snow, wind, anticipated static pressures, internal component loading, etc.).

B. All panels shall be double wall construction. Exterior skin shall be minimum 16-gauge aluminum. Interior skin shall be minimum 19-gauge aluminum. Interior finish to be smooth, mill finish; exterior finish to be a low reflective textured mill finish. Each panel shall contain an integral frame or be properly supported by a framing system to provide an air and vapor tight seal at the interior and exterior skins to completely encapsulate the insulation.

C. The minimum panel thickness shall be 2” thick with 3-pcf high density fiber insulation. The insulation shall be completely encapsulated to provide a complete air and vapor seal. Core material shall comply with NFPA 90A requirements.

D. Thickness of the panel skin, core density, rib spacing and mullion spacing shall be regulated to eliminate panel pulsation and restrict the maximum deflection to 1/200 of any span at design load of 1-1/2 times the design positive or negative pressure plus snow and wind loading.

E. Casing system shall be guaranteed to assure the owner that system capacity, performance, and cleanliness standards specified are not compromised. Leakage to be guaranteed at no more than 1% of the design volume at 1 and ½ times the design operating pressure.

F. All casing walls shall be of panel construction, including the fan discharge walls, mixing section walls and divider wall to the access corridor.

G. Any equipment flashing, internal partitions or other attachments to the casing shall be made in such a way as to ensure a permanent leak-tight connection. Attachments that are bolted, screwed, or welded to or through the casing creating air bypass, air leakage or rust propagation areas are not acceptable.

H. All ductwork penetrations through unit enclosure shall be provided with framed openings of size indicated on drawing. All piping and conduit penetrations shall be provided with sleeves sealed watertight to unit casing; pipe penetrations through the unit casings shall be by the unit manufacturer and be properly sealed prior to leaving the factory. Penetrations created by cutting through panels, compromising panel integrity, will not be acceptable.

I. Provide minimum 18” wide access doors for access to all internal components. Access doors shall be installed to open against the greatest pressure relative to air pressure on each side of access door.

1. Access doors shall be of the same construction as panels described above.

2. The access doors shall be guaranteed tight closing by the means of continuous separate gasket seals around the entire periphery of the door or panel to assure a tight compression fit. Gasket material shall be UV-resistant, closed cell neoprene; gaskets shall be attached by adhesive and not be mechanically held in place.

3. Each access door shall be mounted with corrosion-resistant, offset hinges and shall have least two- (2) non-corrosive handles operable from either side. Hinges and latches shall be
provided and installed in such a manor to guarantee that the door shall stay square within the framing to prevent door leakage and gasket tearing.

2.5 OUTDOOR UNITS (delete for indoor units):

A. ROOF SYSTEM

1. The entire roofing system shall be a polymer membrane permanently bonded to the unit roof with deck adhesive. Membrane to be minimum 0.20” thick. The roofing system shall be guaranteed for a minimum of 10 years including parts and labor. Standing seam-roofing system will not be acceptable.

2. Roofs exceeding 10 ft. in any direction are to be sloped a minimum of ¼” per foot to assure positive run-off.

3. Entire roof perimeter shall be provided with a minimum 2” wide and 2” deep continuous extruded aluminum or 304 stainless steel rain gutter system with downspouts to guide unit roof water runoff to the building roof. Units incorporating roof systems without controlled water run-off accommodations are not acceptable.

B. OUTSIDE AIR SECTION

1. Outside air shall be admitted through storm-proof, extruded aluminum or 304 stainless steel louvers, with aluminum or stainless steel birdscreen and aluminum or stainless steel weather hoods. Weatherhood exterior to match the finish of the unit casing.

2. Louver to be provided with a low-leakage outside air damper. Dampers shall be as specified and shall be furnished and installed by the unit manufacturer.

3. Outside air intake shall be sized for a maximum of 400 fpm.

C. SERVICE CORRIDORS / SERVICE CLOSETS:

1. Provide a vestibule/corridor to be 5 feet clear wide by full height and length of the unit.

2. Provide vestibule ventilation for removing heat of variable speed drives and other devices within the vestibule. Ventilation by means of outside air intake and exhausted through an exhaust fan.

3. The service corridor shall provide for supporting of field piping installations. The ceiling structure shall include a means for pipe hangers to be attached (bolted) to supporting members. The ceiling support members shall be three feet on center and sized to support a uniform piping load of 250 lb/ft.

4. Provide a 5KW 3/60/480V electric unit heater with wall mounted thermostat for maintaining a minimum of 50°F temperature during winter operation. Provide factory mounted and wired heater, disconnect switch and thermostat.

2.6 DAMPERS

A. Dampers shall be low leakage, opposed blade design capable of withstanding 8” wg differential pressure at 2,000 fpm approach velocity. Leakage rate not to exceed 6 CFM per ft.² at 4” wg differential pressure and 2,000 fpm approach velocity.
B. Damper frames shall be made of extruded aluminum. Damper blades shall be extruded aluminum airfoil shape to withstand high velocities and static pressures. Dampers shall be provided with stainless steel blade end seals and flexible synthetic blade edge seals. Damper blades shall be mounted in sealed ball bearing.

C. Damper actuators to be mounted by unit manufacturer. Provide a minimum of one pneumatic damper actuator per 16 ft.² damper area. Damper actuators shall not control more than 16 ft.². Damper actuator to be Johnson Controls - model D3153 or approved equal. Actuators for dampers with modulating control to be provided with pilot positioners.


2.7 MIXING SECTION

A. Complete with framed openings with low-leakage outside and return air dampers. Dampers shall be as specified below and shall be furnished and installed by the unit manufacturer.

B. Outside air damper bank to be provided with an independent damper with independent control for minimum outside air applications. Minimum outside air provided by controlling outside air damper bank to a minimum position will not be acceptable.

C. Mixing section shall be designed for controlled mixing in that the proximity, relation, and air velocity for each respective damper shall be such that volume swings and stratification will be eliminated when operating on the full range of the economy cycle.

D. Conventional air mixing arrangements not incorporating positive destratification control of converging air patterns shall utilize air blenders to assure positive mixing and prevent stratification. Air blenders shall be furnished and installed by the unit manufacturer and shall be as specified below.

1. Air blenders to be fabricated from aluminum or 304 stainless steel.

2. Air blender shall be guaranteed to result in a total temperature deviation of 5 degrees or less measured across the discharge opening.

2.8 FILTER SECTIONS:

A. Provide all prefilters and final filters of number, size and capacity as required for air handling system indicated on drawings and as stated in these specifications.

B. Filters shall have nominal rating of 500 fpm. Each cell shall be 24” x 24”, or 12” x 24”. Initial pressure drop shall not exceed that indicated. Media shall be approved and listed as Underwriters Laboratories Class 2 when tested according to U.L. Standard 900 and as described below:

1. Prefilters: 2" thick 30% efficiency (per ASHRAE Test Standard 52-76), and 85% (per ASHRAE Test Standard 52-76), rigid disposable filters.

2. Final Filters: 12” bag type, 85% (per ASHRAE Test Standard 52-76), disposable filters.

C. Filters shall be upstream removable. Side access is not acceptable. Pre-filter sections shall be complete with holding frames capable of holding prefilters with high efficiency filters. Prefilters shall be capable of being removed and installed without affecting seal of the high efficiency filter.
D. Filter holding frames shall be installed and individually sealed to prevent leakage around frames. Filter banks shall be reinforced with vertical stiffeners to assure rigidity. Unit manufacturer shall provide flashing between filter banks and unit casings to prevent air leakage or bypass around the frames. Installation techniques, sealing methods and structural reinforcement shall be provided to eliminate unfiltered air bypass and to assure system cleanliness based on filter efficiencies specified.

E. Unit manufacturer shall provide and install a Dwyer series 2000 magnehelic gauge complete with static pressure tips accessories for indicating the operating pressure drop of each filter bank. Indicating range of gauge shall be selected at two times the final resistance of the filter bank.

F. Unit manufacturer shall provide two (2) sets of prefilter media and two (2) sets of final filter media with the unit for installation by others.

G. Acceptable filter frame and filter manufacturers: Viladon or approved equal.

2.9 PRE-HEATING COIL SECTION (STEAM) – Reference Air Coils Design Standard 238216

2.10 SUPPLY FAN SECTION

A. Provide fans, motors and drives of number, size and capacity as required for air handling system indicated on drawings and as stated in these specifications. As a general policy, fans shall be selected to minimize the fan RPM. The fan RPM shall be limited to 1800 RPM or less. Fan to be placed in a blow-through position relative to the cooling coil.

B. Supply fan sections shall be complete with DWDI, arrangement 3, direct drive plug fans as per the following:

1. Fan housing shall be heavy gauge, continuously welded construction with spun inlet cones. Bearing supports shall be rigid and shall provide a firm foundation for the shaft and bearings. Bearings supported from the fan housing will not be acceptable.

2. Fan wheels shall be non-overloading, airfoil type. Impellers shall be statically and dynamically balanced. Hubs shall be straight bored, keyed and set screwed to the shaft. Shafts are to be solid steel sized for first critical speed of at least 1.35 times the maximum speed for the class.

3. Bearings are to be heavy duty, grease lubricated, anti-friction ball or roller, self-aligning, pillow block type and selected for minimum average bearing life (AFBMA L-10) in excess of 200,000 hours at the maximum class RPM. All bearings shall be equipped with regreasable Zerk fittings. Lubrication lines shall not be extended.

4. Fan shall be provided with housing access door and scroll drain.

5. Fan shall be cleaned, prime coated and provided with two coats of enamel final coat.

6. Each fan shall be run fully assembled at the fan manufacturer’s factory, prior to shipment, at the maximum class RPM. The fan assembly shall be checked for balance and compared against acceptable “Good” levels on the Rathbone chart. Fan vibration shall not exceed 0.075 inches over the full operational range.

7. Acceptable fan manufacturers: New York Blower or pre-approved equal.

C. Motors shall be 1750 RPM, 460V/3ph/60Hz as per the following:

1. Motor shall be premium efficient, open drip-proof, inverter duty, with cast iron housing.
2. The motor service factor shall be 1.15.

3. Motor shall be designed for continuous duty operation, NEMA Design B with class F insulation.

4. The motor shall be suitable for operating with variable frequency drives without undue noise, vibration or deterioration of reliability and life.

5. Provide stainless steel nameplate indicating the following:
   a) NEMA efficiency index nominal efficient (MB1-12.53BO).
   b) AFBMA bearing numbers.
   c) Lubrication instructions.

6. Acceptable motor manufactures: Reliance or pre-approved equal.

D. The entire fan assembly shall be centered in the airstream (both vertically and horizontally) in order to assure proper airflow through system. The fan assembly shall be provided with a minimum of 24" clearance on all unattached sides for proper service access. Fan inlets to be provided with a minimum clearance distance equal to 75% of the wheel diameter.

E. The unit manufacturer shall provide flexible connection between fan, fan transition and fan wall or unit discharge wall. Flex connection material shall be flame retardant fabric suitable for intended use meeting the requirements of NFPA 90A.

F. The fan and motor shall be factory-mounted on a spring type vibration base. The base shall be mounted on stable free standing spring isolators.

   Springs shall be adjustable, open spring type isolators mounted with combination leveling bolt and equipment fastening bolt, with ¼” neoprene pad bonded to baseplate. Isolators shall have 3” maximum deflection rating. Spring efficiency to be not less than 98%.

G. Motor shall be mounted on an adjustable motor base affixed to the fan vibration base. The motor base shall automatically control belt tension in order to minimize belt servicing and extend belt life. The motor base shall be permanently aligned type so belts can be changed without having to realign the motor and V-belt drive. The base shall allow for belt changes with adjusting one bolt and without the use of a come along.

H. The V-belt drive shall be the constant speed type provided with a minimum of two (2) drive belts. Drives with two (2) belts shall have a minimum service factor of 2.0; all other drives shall have a service factor of 1.5. Additional sheaves, as required to balance the unit for the system, shall be provided by the contractor.

I. V-belt drive shall be enclosed in a perforated metal belt guard. The belt guard is to be a two-piece design split along shaft centerlines; fastened with two quick disconnect clasps so that access to the belts can be made without the use of any tools. Designs resulting in loose hardware will not be accepted. Beltguard shall have framed holes at the fan & motor shaft with coverplates to allow for tachometer measurements.

2.11 DUAL TEMPERATURE HEATING/COOLING COIL SECTION (CHILLED WATER) - Reference Air Coils Design Standard 238216

2.12 REHEATER (DRIER) COILS - Reference Air Coils Design Standard 238216

2.13 HUMIDIFIERS (delete when not a functional requirement of the space):
A. Provide steam dispersion humidifier of size, arrangement, and capacity as required for air handling system indicated on drawings and as stated in these specifications. Performance shall be based on 5# direct steam dispersion unless noted otherwise.

B. Use ‘Ultra-Sorb’ type distribution device. Air handling manufacturer shall be responsible for proper absorption distance for steam between humidifier and downstream components. Absorption distance shall not exceed 20”.

C. ‘Ultrasorb’ dispersion panel to be provided with stainless steel casings.

D. Humidifier is to be provided with following accessories:
   1. F&T (or bucket) traps as required for manifolds and separator.
   2. Y-type strainer for steam supply line.
   3. pneumatic or electric operator with pilot positioner.
   4. interlocked temperature switch

A. Acceptable humidifier manufacturers: Dri-Steem or pre-approved equal.

2.14 ELECTRICAL

A. All electrical work shall be installed in full compliance with the National Electric Code, and all local codes and requirements. Where applicable, components shall be UL approved. All wiring and components inside air handling plenums shall be weatherproof and rated for such use. All equipment shall contain a grounding conductor.

   1. WIRING: 600 volt rated, type, #12 THHN copper (minimum size).

   2. CONDUIT: E.M.T. conduit, minimum ¾” dia. Utilizing compression type fittings.

       All conduit penetrations in the unit housing and penetrations across the cooling coil sections and humidifier sections shall be internally sealed with foam sealant to prevent the migration of water vapor in the conduit. Bulkhead type connections shall be supplied at all wall penetrations.

B. Unit manufacturer shall furnish, install and wire a complete lighting system to one (1) identified 120 volt feed location. Lighting system to include light fixtures, switches, and a GFCI receptacle per the following:

   1. LIGHT FIXTURES: vapor tight incandescent marine type guarded service light fixture, 100 watt (A-21) R.S. bulb.

       Each access section to be provided with minimum of one (1) light fixture. Fan sections and filter sections to be provided with minimum of two (2) light fixtures. Access corridors to have a minimum of three (3) light fixtures.

   2. LIGHT TIMERS: 20 AMP, specification grade, with 30 minute override, with stainless steel cover (indoor), or weatherproof cover (outdoor).

   3. GFCI CONVENIENCE OUTLETS: 20 AMP, specification grade, NEMA 5-20R, duplex receptacle in lug type device box with stainless steel cover (indoor), or weatherproof cover (outdoor). Unit to be provided with one (1) convenience outlet on unit exterior at the fan section.
C. Unit manufacturer shall furnish, install and wire a disconnect switch for each fan motor to one (1) identified 460 volt feed location.

Final connection to motors shall be made through Sealight flexible conduit.

1. **FAN MOTOR DISCONNECTS**: 3 pole, 600V, horsepower rated, heavy duty, visible blade, non-fused, NEMA 12, (NEMA 4 for outside/weatherproof use) safety switch with 2 pole control circuit interlock if used in conjunction with variable speed drive.

D. **VARIABLE SPEED DRIVE**

1. The standard Variable Frequency Drive (VFD) and all the optional modifications shall mount within a packaged NEMA 1 or NEMA 12 (1-60 HP @ 460 Volts, 1-25 HP @ 208 Volts) enclosure.

2. Motor and VFD shall be of the same manufacturer.

3. VFD shall be current rated at 8 kHz carrier frequency for VFD’s 1-150 HP. All HP ratings shall meet or exceed Table 430-150 of the NEC, 3 Phase Motor Full Load Currents. HP, Maximum Current, and Rated Voltage shall appear on the drive nameplate.

4. VFD shall not generate damaging transistor pulses at lead lengths up to 500 feet greater than limits set by NEMA MG1 section 31.40.4.2. Minimum rise time at 500 feet shall be .1 microseconds and peak voltage shall remain under 1600 volts per this standard. Motors shall also be designed to withstand this rise time and peak voltage level.

5. The VFD shall be a fully digital PWM using very large scale integration (VLSI) techniques as well as surface-mount technology for increased reliability. The VFD shall use two 32-bit microprocessors with 12-bit resolution to allow stepless motor control from 0.1% to 110% of motor base speed.

6. All programmable settings shall be held in non-volatile memory and shall not be affected by power outages, brownouts, power dips, etc. The VFD shall have initial programmable settings intact from the factory without the need of battery backup. The VFD shall not need to be programmed at the job site prior to being able to run a motor, but shall be ready to run a motor as soon as power connections are made.

7. Programming at the job site to accommodate specific local applications requirements, such as frequency avoidance and preset speeds shall be available to the user.

8. VFD multiple motor operation shall not be acceptable. All high voltage components within the enclosure shall be isolated with steel or polycarbonate covers.

9. VFD and options shall be UL* 508 listed. NEMA 12 enclosed VFD shall be a UL a approved for mounting in conditioned air ducts and plenums (UL TM 1995). The drive and options shall comply with the applicable requirement of the latest standards of ANSI, NEMA, National Electric Code NEC, NEPU-70, IEEE 519-1992, FCC Part 15 Subpart J, CE 96. VFD manufacturer shall be ISO 9001 certified.

10. The manufacturer of the VFD described in this specification shall have a minimum of 20 years experience in the design, construction and application of adjustable frequency controls and motors.
3.0 EXECUTION

3.1 FACTORY UNIT TESTING:

A. Unit manufacturer shall provide tests at the factory to verify air flow, static pressure capability, casing leakage, system sound levels, fan assembly vibration levels, and control systems integrity.

1. The test for air flow shall verify design air flow at design static pressure. Test shall be performed by simulating design external static pressure (providing for dirty filters and wet coils) and measuring flow in a straight section of ductwork connected to the unit outlet/inlet. Flow shall be measured by performing a duct traverse at a distance not less than ten (10) duct diameters from the opening.

2. The casing leakage test shall verify that unit casing leakage is less than 1% of design air flow at 1-1/2 times the design static pressure. The duct openings in the pressure section shall be sealed. This section shall be connected to a fan developing the test pressure, and CFM of the fan shall be determined using a calibrated orifice plate. The test fan CFM shall be considered the casing leakage. The same procedure shall be repeated for the negative side of the AHU. The total casing leakage (positive plus negative) shall be considered the sum of the positive and negative leakage.

B. Factory testing shall assure the Owner and Engineer that any potential system performance concerns are addressed in the factory before unit shipment. Any unit modifications necessary as a result of factory testing not meeting specified performance levels shall be done by the unit manufacturer at no additional cost to the owner.

C. All tests shall be witnessed by the Owners representative. A formal written report including test results shall be submitted to the Engineer.

3.2 INSTALLATION:

A. The unit manufacturer shall coordinate unit shipping and installation schedule with contractor. Contractor shall be responsible for the rigging, hoisting and coordination of the entire air handling unit installation. Lifting and rigging instructions are to be provided by the unit manufacturer with the submittal drawings.

B. Electrical contractor shall provide connection of 460V/3Ph/60Hz power from motor control device to fan disconnect located on unit exterior. Electrical contractor shall also provide connection of 120V/1Ph/60Hz power from the building system to the lighting circuit provided with the unit.

D. The temperature controls contractor shall install temperature controls and panel, including, pneumatic tubing, control wiring, etc., required for a complete and operating control system. Electrical contractor shall make final connections to the temperature control panel after the unit is installed.

3.3 START-UP AND OWNER ORIENTATION:

A. Equipment start-up and owner maintenance orientation shall be the responsibility of the unit manufacturer in order to activate equipment warranty and assure that the Owner and his facility personnel are comfortable and familiar with equipment maintenance.

B. The air handling unit manufacturer shall be responsible for proper operation and shall be required to meet the scheduled capacities and specified performance for this equipment.
Basic Air Supply Unit Configuration

Dual Temperature Coil

Make Up Air

Mixed

Air

De-Stratifier

Filters

Fan

Dual Temperature

Coil

Reheater

Humidifier

Return Air

END OF SECTION 15855