SPECIAL SPECIFICATION

SECTION 15721-S

MAKE-UP AIR HANDLING UNITS FOR MICROFAB

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Section Includes:

1. Make-up Air Handling Units to supply clean conditioned air to MicroFab cleanrooms and Recirculation Air Handlers.

2. Units shall be installed inside the building for MAH–1,2,3 and outside the building for MAH-5.

1.02 REFERENCES/PROJECT REQUIREMENTS

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

B. Requirements of the following publications apply to this section:

1. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
3. AMCA 99 - Standards Handbook.
4. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
5. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
6. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
7. AMCA 500 - Test Methods for Louver, Dampers, and Shutters.
8. ARI 410 – Forced-Circulation Air-Cooling and Air-Heating Coils.
9. ARI 430 - Central-Station Air-Handling Units.
10. ARI 435 - Application of Central-Station Air-Handling Units.
11. ARI 610 - Central System Humidifiers.
12. NEMA MG1 - Motors and Generators.
13. NFPA 70 - National Electrical Code.
14. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
15. UL 900 - Test Performance of Air Filter Units.

C. Additional project requirements:

1. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience, who issues complete catalog data on total product.

1.03 DEFINITIONS

Not Used

1.04 SYSTEM DESCRIPTION

A. Design Criteria:

1. Seismic: PER IBC 2000, SITE CLASS D, STIFF SOIL. IMPORTANCE FACTOR, I=1.5 FOR PC2

   Site specific parameters: Sms=0.795, Sds=0.53, Sml=0.374, Sdl=0.75 Seismic design category D. Allowable 1/3 stress increase for seismic loading. Allowable soil bearing pressure = 2000psf.

2. All units will provide clean conditioned air according to the design conditions specified on the Mechanical Equipment Schedule.

B. Units Included:

1. The following units are to be included under this specification:
   a. MAH-1
   b. MAH-2
   c. MAH-3
   d. MAH-5

1.05 SUBMITTALS

A. Submit the following in accordance with Conditions of Contract and Standard in Specification Division 1:

1. Required with the bid:
   a. Identify all exceptions to the specifications and areas of noncompliance. Submit data and information regarding alternates, revisions and exceptions.
   b. Dimensioned assembly and outline drawings with operating weights.
   c. Fan performance curves with operating condition indicated.
   d. Performance data on coils and filters.
   e. Make-up Air Handler sound power level data at design operating point and at 50 percent capacity. Rating shall be based on AMCA Bulletin 300.
   f. Vibration isolator data sheets.

2. Required for review within 30 days of award of Contract:

   a. Detailed information on structural, mechanical, electrical, instrumentation and controls, or other changes and modifications necessary to adapt the materials to the arrangement shown. Changes shall not differ from the performance criteria specified.

   b. Final data for fans including full speed and half speed performance curves showing shaft power performance versus air quantity handled.

   c. Complete test performance data (ARI-certified) at design conditions for all coils. All coil dimension data.

   d. Data for each filter type: complete certified performance data at design conditions including airflow rate versus pressure drop performance curves.

   e. Light fixture data and light switches (120 volt).

   f. Motor data: Test results verifying guaranteed premium efficiency and power factor rated load and rated voltage, motor dimensions and weights, features, motor bearings and bearings/ shaft grounding details and type.

   g. Vibration isolation data.

   h. Wiring diagrams for units exactly as supplied.

   i. Flush mounted magnahelics data.

   j. Mounting details for all pressure, temperature, humidity, monitoring and control devices supplied and installed by Controls Contractor. Provide details for thermal break construction for devices located in cold sections.

   k. Cleaning, packaging and shipping procedures.

   l. Manufacturer's recommended installation procedures.

   m. Contractor's move-in path identified.

   n. Filter particle count test procedure.

1.06 SPECIAL REQUIREMENTS

A. Do not operate for any purpose, temporary or permanent, until ductwork is clean, filters are installed, bearings lubricated, and fans have been checked for rotation and tested under observation.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect Make-Up Air Handling Units from damage due to normal handling during shipment and storage. Protection shall be applied to open ends to prevent dirt and moisture from entering. All units shall be cleaned and completely dry prior to shipment. Units suitable for indoor installation shall be plastic shrink wrapped per shipping section.

B. Consignee must inspect shipment upon delivery and note any and all damages and discrepancies on bill of lading and notify manufacturer.

C. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

D. Make-Up Air Handling Units shall not be stored in an area where they will have a chance to be damaged from traffic or debris. Where possible, store inside and protect from dirt and debris. When necessary to store outside, store above grade and enclose with waterproof wrapping to protect from water, dirt and debris. Handle carefully to avoid damage to components, enclosures, and finishes.

1.08 CONFLICTING REQUIREMENTS

A. The seller/manufacturer shall call to the buyer's attention any discrepancies found in this Specification. No deviations shall be made from the cutsheets at the end of this section and specifications without prior written authorization from the Sandia Delegated Representative (SDR).

1.09 WARRANTY

A. Copy of Warranty required with bid shall include:

1. Manufacturer shall provide written guarantee and warranty covering defects in material and workmanship for the equipment. This guarantee and warranty shall be for five years from the date of final acceptance from the owner. Date of acceptance shall be defined as the date the owner assumes operation of the equipment.

2. The warranty shall cover the construction, materials, parts, labor, and operation.

3. Painted surfaces shall be guaranteed for two years against failure including but not limited to fading, rusting, or chipping.

4. Metal surfaces shall be guaranteed for two years against rusting.

5. All equipment or material found to be defective in the warranty period shall be replaced to new condition at no material or labor cost to the owner.

6. Manufacturer shall provide to owner, specifics for necessary maintenance to keep the warranty in effect.

7. Manufacturer shall provide six copies of the warranty and guarantee to the Owner at the time of bid.

1.10 FACTORY INSPECTIONS

A. Sandia National Laboratories or their representative shall maintain the right to tour the manufacturer's plants at any time that fabrication is being performed on components intended for this Project.

B. The manufacturer shall notify the SDR seven days prior to when production is finished on the first component of each type. Any time after that date, the SDR may exercise the option, without advance notice to tour the plant and inspect for component assembly, painting, cleaning, or packaging to ensure that quality control is being maintained.

1.11 MAINTENANCE

A. Manufacturer shall provide six full copies in loose-leaf binders of complete operating and maintenance manuals containing all documents of furnished equipment. These manuals are required before the start-up and acceptance testing.

B. Include as a minimum: fan vibration nomograph, instruction for lubrication, filter replacement, motor and drive replacement, spare parts list, controls diagram, electrical wiring diagram, safety procedures, installation and check-out procedures, trouble-shooting procedures, Manufacturer's cut sheets for all equipment and instruments provided.

C. The manuals shall be identified and indexed with plastic tabs with a complete table of contents. Include names, addresses and phone numbers of factory and local representatives in the appropriate sections. Use three ring binders only with project name, building and project number on outside cover and binder strip.

D. The manuals are a minimum. Manufacturer shall include all drawings and specifications that are considered useful for installation and operation of equipment.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Haakon

B. Pace

C. Engineered Air

D. M&I

E. HuntAir

F. Miller-Picking

2.02 GENERAL

A. Provide internally isolated, draw-through unit as shown on the drawings and described in this section. Units include, but are not limited to, the following components:

1. Inlet and discharge opposed blade isolation dampers suitable for installation of damper operator by Controls Contractor

2. 30% pre-filters

3. Minipleat 85% final filters

4. Hot water pre-heat coil

5. Atomizing evaporative cooler/ humidifier

6. Medium temperature cooling coil (except MAH-5)

7. Low temperature cooling coil

8. Plug fan or fans

9. Hot water re-heat coil (except MAH-5)

10. Carbon filter rack (except MAH-5) (actual carbon filter is future)

11. 99.99% final HEPA filter

12. Drain pans

13. Internal piping and accessories

14. Service plenum sections with access doors and glazing

15. Lights per section with two 3-way switches per unit

16. Motors with pigtail

B. Make-up Air Handling Units (MAH 1,2,3) shall be suitable for installation indoors in a conditioned space. MAH-5 shall be suitable for outdoor installation.

C. Provide all electrical, controls, and piping entry sleeves.

D. Unit performance data shall be as specified in Mechanical Equipment Schedule.

E. Fan rating shall be based upon tests performed in strict accordance with the AMCA-66 standard for air moving devices and 410-72 for coils. Each fan shall carry, near the manufacturer's nameplate, the seal authorized by ARI indicating that ratings are certified. Fans not bearing this seal will not be acceptable.

F. Coils shall be rated, tested and certified in accordance with ARI standards.

G. All electrical assemblies shall be UL listed, FM approved and comply with NEC requirements.

H. Fans shall operate at speeds less than 80 percent of their true critical speed.

I. Make-up Air Handler Maximum Sound Power – Provide data for an eight-octave band analysis, as well as an A-weighted db(A) rating. Noise Criteria in the cleanroom to be NC-55 with all air handlers operating.

J. Air velocity through all unit sections shall not exceed 450 fpm.

K. MAH-1-3 shall have a minimum of 760 cfm/kW. MAH-5 shall have a minimum of 1100 cfm/kW.

2.03 MOTORS AND CONTROLS

A. Material and Equipment:

1. Provide motors and equipment that is standard products of a reputable manufacturer regularly engaged in the manufacture thereof. Multiple motors shall be of the same manufacturer unless specified otherwise.

2. Install motors in accordance with equipment and motor manufacturer's recommendations.

3. Protect motors from damage which may be caused by theft, weather, and building operations. Failure to protect motors and equipment adequately shall be sufficient cause for rejection of any damaged motor or equipment.

B. Electric Motors:

1. Conform to Special Specification Division 15, Section "Motors." Fan motors with VFC's shall be premium efficiency, inverter duty motors.

~~C.Motor Starters:~~

~~1.Variable Frequency Controllers shall serve as starters. See Division 16. Variable Frequency Controllers shall be matched to motor and duty. Variable Frequency Controllers shall be supplied and installed by the electrical contractor.~~

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D. Drives:

1. Make-up Air Handling Unit fans shall be direct drive.

2. Tachometer access shall be provided for each rotating axle.

2.04 CONSTRUCTION

A. Unit Casing:

1. Casing shall be fabricated from 16-guage galvanized steel, mounted and braced on a minimum 8" tall structural steel welded frame. All interior surfaces shall be insulated with 4-inch thick, 3 pound density fiberglass insulation encapsulated with a minimum of 2-mil polyethylene bag or Mylar facing protected with minimum 18-guage perforated 316L stainless steel liner for flow frequency noise control. Insulation shall have a minimum thermal conductivity K factor of 0.23 (Btu / in. hr. sq. ft °F) (@75°F mean) (R value = 17.4). Cooling coil and humidifier sections shall have solid 316L stainless steel lining in lieu of perforated lining.

2. The cabinet shall be designed and constructed in accordance with AMCA Class C standards for maximum 1% leakage and maximum L/200 deflection at negative and positive 10-inch static pressures.

3. All hardware (hinges, screws, etc) shall be stainless steel.

4. All panels (wall and roof) shall be coated with Polyurethane primer and Polyester-Hybrid semi-gloss topcoat of the manufacturer's standard color. Paint system shall pass a minimum of 1000 hr. salt spray test per ASTM B-117 and 1000 hr. humidity test per ASTM D-2247. Paint shall have equal or superior off-gassing properties as powder-coat finish. Test documentation shall be made available upon request.

5. Wall and roof panels shall include internal stiffeners for long spans. Wall bases shall provide 2 inch of insulation separation from solid floor panels.

6. Deflection on floor and roof surfaces shall not exceed ¼ inch per 4 foot span. Provide floor and roof for weight of manufacturer equipment plus 50 psf. Floor shall be fabricated from 16 gauge galvanized steel painted with 4 mil enamel.

7. Manufacturer shall provide insulation, vapor barrier, and 316L stainless steel skin under floors and condensate drain pans to prevent floor noise transmission and condensation. Insulation shall have a minimum thermal conductivity K factor of 0.14 (Btu / in. hr. sq. ft °F) (@75°F mean) (R=14.3).

8. Manufacturer shall provide epoxy painted removable lifting lugs located at each corner of all unit sections.

9. Stainless steel piano type hinged and gasketed double wall access doors with 90° latching (Ventlock 310 or equal) handles shall be provided for access to fans, coils, piping and accessories, filters, and dampers. Hinges shall be provided at full length of access doors. Doors shall open out for negative sections of the unit and open in for positive sections of the unit. Provide full height (thru 72 inch tall doors), minimum 20 inch wide, minimum 2 inch thick, double wall, insulated, access doors.

10. Provide minimum 10 inch by 10 inch, tempered glass viewing window in each access door.

11. Manufacturer shall provide and install pre-manufactured 4 inch deep condensate drain pans in floor of humidifier and cooling coil sections, including 316L stainless steel liner. If drain pans require multiple drains, manufacturer shall header drains together inside the unit and provide a single point of connection for each drain pan exterior to the unit casing. Drain connections are to be to the side of the unit. Floor penetrations are not acceptable. Intermediate drain pans on stacked coils shall also be fabricated of 316L stainless steel with copper downspouts.

12. Service incandescent vapor proof pendant lights with guards shall be installed inside unit in all accessible sections. Lights will be tied together and operated

by two 3-way switches. Switches shall be installed on exterior of unit wall sections on handle side of access doors at each end of each unit. Electrical source for lights shall feed from the line side of the disconnect to the fan motor. Factory wire each motor in the fan section to a single point electrical connection in box recessed in the unit casing wall.

13. Install a 5kW electric Unit heater and thermostat in MAH-5 pipe chase vestibule.

14. Manufacturer shall provide all penetrations through the exterior walls and/or roof of the unit. All penetrations shall be sleeved and sealed. Manufacturer shall coordinate locations of all penetrations with controls contractor. All control devices shall be supplied and installed by the controls contractor, unless specifically included elsewhere in this specification.

15. All construction joints shall be sealed to prevent air and particle bypass. Sealant shall be approved for cleanroom use. Use non-outgasing silicone sealant approved by owner.

16. Unit shall have full thermal break construction from the entrance to the low temperature coil section to the discharge of the unit.

B. Plug Fan Section:

1. Fan shall be Arrangement 4, plug type, direct drive with single inlet bell. The fans shall be centrifugal type with airfoil blades having non-overloading horsepower characteristics. MAH-1,2,3 fans shall be Class III construction and MAH-5 fans shall be Class I, consisting of steel or aluminum with structural supports.

2. Fan wheels shall be all welded construction using high-strength steel or aluminum. Blades are to be welded to the spun wheel flange and back-plate.

3. Fan wheel shall be secured to shaft with a key-way and two set-screws.

4. Motor bearings shall be high temperature permanently sealed with minimum L-10 life of 200,000 hours. Bearings shall be double row spherical roller type in a housing.

5. The fan, motor and direct drive assembly shall be mounted on a powder coated structural steel frame with 4-inch minimum deflection open-type spring isolation. The spring shall be rigidly mounted to the spring baseplate and compression plate. The spring shall have 50 percent overload capacity. Powder coat shall be minimum 2 mils, high gloss, white polyester-epoxy paint and baked at 400°F. Fan assembly paint system shall be acceptable for clean room applications.

6. Isolators shall be individually selected from each load bearing location to maintain equal deflection.

7. Provide magnahelic across fan section. Magnehelic shall be recessed mounted on outside of unit casing.

8. Fans shall be supplied with a factory mounted air flow measuring station and shall consist of total and static pressure pick-ups at various positions around the fan inlet cone throat and intake wall. The flow measuring station shall not obstruct the inlet to the fan and shall not have any effect on fan performance (flow or static pressure) or fan sound power levels. Traverse type velocity probes in the air-handling unit measuring the full inside height and width of the unit is an acceptable alternate. Traverse probes located in the fan inlet will not be acceptable due to increased noise levels and decreased fan efficiency. Provide a CFM gage on the external side of the fan section that indicates flow (CFM) through the fan and is calibrated for correct elevation. Provide a factory installed velocity transmitter for airflow measuring station connection to FCS. Transmitter shall be a Dwyer 604A-2, 4-20mA output signal.

9. Plenum fans shall be supplied complete with a shutoff device for twin fan arrangements. Device shall be capable of 100% shutoff and have factory mounted and tested electric actuator. The variable cone shaped disk shall be supported in the center of the fan with a non-rotating, solid chrome plated, 1045 cold drawn steel shaft and a bronze bushing. The disk and fan assembly shall be vibration free through the entire operating range. As an alternate, isolation dampers, equal to Ruskin CD-80AF4, can be provided one fan diameter upstream of the fan intake. Dampers shall be sized no smaller than 1500 feet per minute and supplied with a factory mounted electric actuator. The static pressure drop of the dampers at 100% design CFM shall be added to the internal static pressure drop of the unit. The shutoff device shall be completely independent of the fan assembly, such that removal of the fan assembly can be done without disturbing the device. The operating linkage shall be maintenance free and accessible for routine inspection. The shutoff device shall be installed by the air handling unit manufacturer.

10. The Air Handling Unit manufacturer shall include a fan removal and replacement system in the fan section of each unit. The system shall be capable of allowing no more than two (2) workers to remove and replace all fan wheels

and electric motors present in the fan section in a maximum of two (2) hours time. If any special tools are required from the manufacturer for this system to be complete, one (1) set of these tools shall be provided with the air handling units.

11. Provide a separate power connection for each fan in twin fan arrangements.

C. Pre-filter:

1. Pre-filter shall be 4-inch deep pleated cartridge type and shall include face load frame and filter assembly.

2. Provide access door for access to face load filters.

3. Frame shall be 16 gauge 316L stainless minimum with continuous solid bulb type gasket sealer and holding clips.

4. Filters shall be universal 24 inch by 24 inch and/or 12 inch by 24 inch. AAF AmAir 300 HT Extended Surface Pleated Panel Filters, ASHRAE 25-30% average efficiency. UL Standard 900 Class 1.

5. Provide and install a pressure differential magnehelic gauge with a range of zero to one inch WC. Magnehelic shall be recessed mounted on outside of unit casing.

6. Provide 3 full sets of filters, one set for during construction, one set for start-up, and one set for first change out.

D. Minipleat Final filter:

1. Final filter shall be 12-inch deep pleated cartridge type and shall include face load frame and filter assembly.

2. Provide access door for access to face load filters.

3. Frame shall be 16 gauge 316L stainless minimum with continuous solid bulb type gasket sealer and holding clips.

4. Filters shall be universal 24 inch by 24 inch and/or 12 inch by 24 inch. AAF VariCel XL Series Extended Surface Supported Pleat with Intersept Antimicrobial, ASHRAE 80-85% efficient. UL Class 1.

5. Provide and install a pressure differential magnehelic gauge with a range of zero to 2-inch WC. Magnehelic shall be recessed mounted on outside of unit casing.

6. Provide 3 full sets of filters, one set for during construction, one set for start-up, and one set for first change out.

E. Carbon Filter

1. Provide housing and racks only for future installation of Carbon Filters.

2. Provide access door and section as required for filters installation.

3. Frame shall be 16 gauge 316L stainless minimum with continuous solid bulb type gasket sealer and holding clips.

4. Filters will be 24 inch by 24 inch by 24 inch. Slide-in trays of carbon. Farr CF Glidepack with 30% prefilter.

F. Final HEPA filter:

1. Final filter shall be 12-inch deep cartridge type and shall include gel seal face load frame and filter assembly.

2. Provide access door for access to face load filters.

3. Frame shall be 16 gauge 316L stainless minimum with gel seal system.
4. Filters shall be universal 24 inch by 24 inch and/or 12 inch by 24 inch. Metal frame. UL Class 1, and UL 586. HEPA 99.99% efficient at 0.3 microns. Aluminum separators. Silicone bond.

5. Factory leak tested - laser and static scan tested.

6. Provide and install a pressure differential magnehelic gauge with a range of zero to 2-inch WC. Magnehelic shall be recessed mounted on outside of unit casing.

7. Provide 3 full sets of filters, one set for during construction, one set for start-up, and one set for first change out.

G. Atomizing evaporative cooler/ humidifier

1. Cool Fog humidification system consisting of foggers, manifold bars, air regulating valves, water regulating valves, pressure switches, and control panel. System shall be capable of 40:1 turndown proportional control.

2. Foggers with Manifold bar: complete with air and water regulating valves, adjustable resonator tips, and compression fitting ends. All wetted parts suitable for service with 5 meg-ohm resistivity clean Reverse Osmosis water.

3. Control Panel: self contained, pre-wired and pre-piped, with NEMA-1 enclosure housing controls and fail-safe interlocked to provide proportional

control of humidity through 4-20 mA control signal. (Control signal by controls contractor.)

4. Provide drain pan in fog chamber.

H. Coils

1. Coils shall be fin and tube type constructed of seamless copper tube and aluminum fins mechanically bonded or soldered to tubes. Coil headers shall be red brass to prevent galvanic corrosion.

2. Casing and tube supports sheets shall be minimum 16 gauge 316L stainless steel.

3. Tubes shall be correctly sized and circuited for proper water flow velocity.

4. Coils shall be rated in accordance with ARI Standard 410 and shall meet specified performance on the Mechanical Equipment Schedule.

5. Coils shall be removable through the unit casing via bolted and gasketed panels for MAH 1,2,3. MAH-5 coils shall be aligned with the doors of the Vestibule piping chase for coil removal through the doors.

6. Tubes shall be secured against vibration by a channel- shaped retainer, permitting expansion and contraction.

7. Circuiting shall be serpentine, counter-flow and designed for full drainability without turbulators or baffles.

8. Coils shall be supported independently by 316 L stainless steel slide-out racks to allow removal of any one coil without requiring removal of any other coils.

I. Dampers: Maximum 5 percent low leakage opposed blade dampers shall have extruded aluminum airfoil blades, zinc plated tubular steel square or hexagon shafting, heavy duty nylon shaft bearings, santoprene rubber or extruded vinyl edge seals, stainless steel jamb seals, a 16-gauge stainless steel frame and includes linkage.

J. Provide a power connection with disconnect for the unit heater and lights, separate from the power connections for motors, to allow heater operation and prevent freezing during unit shutdown on MAH-5.

PART 3 - EXECUTION

3.01 TESTING

A. Factory pressure test coils prior to shipping unit. Balance and certify operation of fan prior to shipping unit. Test and balance unit on site during startup, see Special Specification in Division 15, Section, "Testing, Adjusting and Balancing."

B. Fan wheel shall be factory dynamically balanced and shall meet or exceed guidelines in AMCA 204-96 for Balance Quality and Vibration Levels for Fan Application Category BV-3. Following fan assembly, the complete spring isolated fan assembly shall be tested using an electronic balance analyzer with tunable filter and stroboscope. Vibration measurements shall be taken on each motor bearing housing in the vertical, horizontal, and axial planes (5 total measurements, 2 each motor bearing and 1 Axial). The maximum allowable velocity shall not exceed 0.040 inches per second peak amplitude (filter in) on any of 5 readings and shall not exceed 0.5 mils @ 1800 rpm, 0.7 mils @ 1200 rpm, or 0.9 mils. @ 900 rpm. A copy of the Vibration test report (Vibration Nomograph) shall be provided with the Operation and Maintenance Manual. The fan assembly shall also be vibration tested at design RPM with the spring isolators at the specified deflection, with the tunable filter utilized and frequencies from 500 cpm to 50,000 cpm shall be scanned to detect misalignment, bearing defects, mechanical looseness or foundation weakness.

3.02 TEST REPORTS

A. All testing shall comply with start-up and commissioning reports and procedures.

3.03 TEST NOTIFICATION

A. All involved parties shall be notified fourteen days prior to factory testing and field start-up and commissioning of Make-up Units.

3.04 FIELD SERVICES

A. Provide services of manufacturer's representative to supervise rigging, hoisting, and installation of Make-up Air Handling Units. Manufacturer's representative shall reconnect internal damper linkages, electrical and pneumatic connections across split points, and provide start-up of Make-up Air Handling Units and VFC's. Certify that units have been installed per manufacturer's recommendations and meet design requirements.

B. After installation of the units, but previous to start-up, the air handling unit manufacturer shall provide the services of a factory-trained technician for no less than two (2) days of training to the owner on the fan removal and replacement system alone. Manufacturer shall provide training to owner on balancing to factory spec's and all equipment required for balancing. The factory trained service technician shall provide no less than one (1) day training and demonstration after the units have been started, but previous to project completion. In each case, the factory trained service technician shall demonstrate that the fan removal system

meets the criteria specified. All training shall be videotaped for the owner' personnel.

3.05 EQUIPMENT SCHEDULE

A. See Mechanical Equipment Schedule.

3.06 INSTALLATION

A. Install in strict accordance with manufacturer's requirements, shop drawings, and contract documents.

B. Adjust unit in alignment on concrete foundations, sole plates, and sub-bases. Level, grout, and bolt in place per manufacturer's recommendations.

C. Arrange piping for easy dismantling to permit coil pull access.

D. Coordinate electrical installation with electrical contractor.

E. Coordinate controls with controls contractor.

F. Provide all appurtenances required ensuring a fully operational and functional unit.

3.07 FIELD QUALITY CONTROL

Conform to the following checklist as a minimum:

A. Unit Location:

1. Floor or foundation is prepared to support unit weight and is properly leveled.

2. Sufficient access is provided for unit size, clearances and maintenance access.

3. Foundation or mounting platform is sized for unit and accessories.

B. Mounting:

1. Vibration isolators are installed and fastened to floor/ steel structure.

2. Shipping angles and lifting lugs are removed.

3. Multi-section units are caulked and fully assembled.

4. Assembled units are mounted on and bolted to isolators.

5. Unit assembly is complete and fully functional according to design criteria.

6. Tension restraints are installed on high-pressure units.

7. Unit is level.

8. Manufacturer provided touch-up paint is applied to scratched surfaces.

C. Accessories:

1. Filters are installed and particle count has been performed.

2. All other accessories are installed per manufacturer's recommendations.

D. Fan Motor Assembly:

1. Fan has been balanced.

2. Vibration tests complete.

E. Dampers:

1. Linkages are properly mounted and adjusted.

2. Damper operators are properly installed and adjusted.

3. Dampers are tested for full range of motion.

4. Dampers are tested for fail mode.

F. Ductwork:

1. Ensure adequate ductwork supports are provided so that ductwork is not supported from unit.

G. Piping:

1. Condensate drain lines installed are trapped at exterior of unit and connected to manufacturer provided drain pans.

2. Provisions are made for properly draining and venting coils.

3. Supply and return coil connections are made and insulated.

4. Supply and return piping is flushed, cleaned, air vented and fully functional per design criteria.

H. Wiring:

1. Supply power is connected to fan motor.
2. Wiring between fan motor and disconnect is in a flexible conduit.
3. Field wiring in terminal box is complete.
4. Supply power is connected to humidifier section.
5. Fused disconnect switch is installed surface mounted to side of unit casing.
6. Motor overload protective devices are installed.
7. Proper lockout/ tag-out procedures are followed during installation.
8. All start-up and commissioning reports are followed and filled out.

END OF SECTION