

SECTION 15850 – PACKAGED DEDICATED OUTDOOR-AIR UNITS

SPECIFIER:

CSI MasterFormat 2004 number: 23 74 33

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. 15960 – Variable Frequency Drives.

1.2 SUMMARY

- A. Section includes factory-packaged units capable of supplying up to 100 percent outdoor air and providing cooling and heating.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Prepare the following by or under the supervision of a qualified professional engineer:
 - a. Mounting Details: For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
 - b. Include diagrams for power, signal and control wiring.
- C. Submit wind load calculations and connection details for the rooftop package unit, framework, casing support and foundations, signed and sealed by a Florida registered engineer, demonstrating compliance with the Florida Building Code (FBC) - American Society of Civil Engineers (ASCE) 7.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof-curb mounting details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Size and location of unit-mounted rails and anchor points and methods for anchoring units to roof curb.
 - 2. Required roof penetrations for ducts, pipes and electrical raceways, including size and location of each penetration.

B. Startup service reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For units to include in emergency, operation and maintenance manuals.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

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

1. AAON.
2. Addison.
3. Munters Corporation, Dehumidification Division; Des Champs Products.
4. Greenheck.
5. Lennox.
6. Petra.

2.2 PERFORMANCE REQUIREMENTS

A. General Fabrication Requirements: Comply with requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."

B. Delegated Design: Engage a Professional Engineer registered in the State of Florida to design wind restraints.

C. Wind-Restraint Performance: Roof mounted equipment shall be restrained against overturning and uplift forces in accordance with ASCE 7. Design requirements and factors shall be as per FBC and SREF requirements.

D. Cabinet Thermal Performance:

1. Maximum Overall U-Value: 0.08 Btu/h per sq. ft. per deg F (nominal R=13).
2. Include effects of metal-to-metal contact and thermal bridges in the calculations.

E. Cabinet Surface Condensation:

1. Cabinet shall have additional insulation and vapor seals if required to prevent condensation on the interior and exterior of the cabinet.

2. Portions of cabinet located downstream from the cooling coil shall have a thermal break at each thermal bridge between the exterior and interior casing to prevent condensation from occurring on the interior and exterior surfaces. The thermal break shall not compromise the structural integrity of the cabinet.
- F. Maximum Cabinet Leakage: 0.5 percent of the total supply-air flow at a pressure rating equal to the fan shut-off pressure.
- G. Cabinet Deflection Performance:
1. Walls and roof deflection shall be within 1/240 of the span at the design working pressure equal to the fan shut-off pressure. Deflection limits shall be measured at any point on the surface.
 2. Floor deflections shall be within 1/360 of the span considering the worst-case condition caused by the following:
 - a. Service personnel.
 - b. Internal components.
 - c. Design working pressure defined for the walls and roof.
- H. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Capacities and Characteristics shall be as scheduled on drawings.

2.3 CABINET

- A. Construction: double wall.
- B. Exterior Casing Material: Galvanized steel with paint finish.
- C. Interior Casing Material: Galvanized steel.
- D. Lifting and Handling Provisions: Factory-installed shipping skids and lifting lugs.
- E. Base Rails: Galvanized steel rails for mounting on roof curb or mounting on grade as indicated.
- F. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
1. Service Doors: Hinged access doors with gaskets. Material and construction of doors shall match material and construction of cabinet in which doors are installed.
- G. Roof: Standing seam or membrane; sloped to drain water.
- H. Floor: Reinforced, metal surface; reinforced to limit deflection when walked on by service personnel. Insulation shall be below metal walking surface.
- I. Cabinet Insulation:

1. Type: Closed cell foam insulation.
2. Thickness: 2 inches.
3. Insulation Adhesive: Comply with ASTM C 916, Type I.
4. Mechanical Fasteners: Suitable for adhesive, mechanical, or welding attachment to casing without damaging liner and without causing air leakage or thermal bridging when applied as recommended by manufacturer.
5. Insulation shall not be in contact with air stream.

J. Condensate Drain Pans:

1. Shape: Rectangular, with 2 percent slope in at least two planes to direct water toward drain connection.
2. Size: Large enough to collect condensate from cooling coils including coil piping connections, coil headers, and return bends.
 - a. Length: Extend drain pan downstream from leaving face 8 inches.
 - b. Depth: A minimum of 2 inches deep.
3. Configuration: Double wall, with space between walls filled with foam insulation and moisture-tight seal.
4. Material: Stainless-steel sheet.
5. Drain Connection:
 - a. Located at lowest point of pan.
 - b. Terminated with threaded nipple.
 - c. Minimum Connection Size: as indicated on drawings.
6. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

K. Surfaces in Contact with Airstream: Comply with requirements in ASHRAE 62.1 for resistance to mold and erosion.

L. Roof Curb: Full-perimeter curb of sheet metal, height shall be as required to provide a minimum of 12 inches above the roofing membrane. Roof curb shall meet the structural performance requirements specified herein.

2.4 FANS

A. Forward-Curved or Backward Inclined Fan Type: Centrifugal; statically and dynamically balanced.

1. Fan Wheel Material: Galvanized steel, mounted on solid-steel shaft.
2. Bearings: Pillow-block bearings rated L₅₀ for 200,000 hours and having external grease fittings.

B. Service Factor for Belt Drive Applications: Multiple V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly with minimum 1.5 service factor.

C. Motors:

1. Suitable for variable speed service, complying with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 15051 - "Mechanical Support Devices."
2. Enclosure: Totally enclosed.
3. Enclosure Materials: Cast iron.
4. Motor Bearings: Ball bearing type.
5. Efficiency: Premium efficient.
6. NEMA Design: NEMA "B".
7. Service Factor: 1.15.

D. Mounting: Fan wheel, motor, and drives shall be mounted to fan casing with spring isolators.

E. Provide variable frequency drives.

2.5 COOLING COILS

A. Capacity Ratings: Comply with ASHRAE 33 and ARI 410 and coil bearing the ARI label.

B. Coil Casing Material: Galvanized steel.

C. Tube Material: Copper.

D. Tube Header Material: Copper.

E. Fin Material: Aluminum.

F. Fin and Tube Joints: Mechanical bond.

G. Leak Test: Coils shall be leak tested at 300 psig with air underwater.

H. Refrigerant Coil Capacity Reduction: Circuit coils for row interleaved control.

I. Refrigerant Coil Suction and Distributor Header Materials: Seamless copper tube with brazed joints.

J. Coating: Phenolic epoxy corrosion-protection coating after assembly.

2.6 REFRIGERATION SYSTEM

A. Comply with requirements in ASHRAE 15, "Safety Standard for Refrigeration Systems."

B. Refrigerant Charge: Factory charged with refrigerant and filled with oil.

C. Compressors: Reciprocating or scroll compressors with integral vibration isolators, internal overcurrent and over-temperature protection, internal pressure relief and crankcase heater.

D. Refrigerant: R-134a, R-410A HFC refrigerant.

1. Classified as Safety Group A1 according to ASHRAE 34.

2. Provide unit with operating charge of refrigerant.
- E. Refrigeration System Specialties:
1. Expansion valve with replaceable thermostatic element.
 2. Refrigerant dryer.
 3. High-pressure switch.
 4. Low-pressure switch.
 5. Thermostat for coil freeze-up protection during low ambient temperature operation or loss of air.
 6. Brass service valves installed in discharge and liquid lines.
- F. Capacity Control:
1. Capacity control with continuous dehumidification on a single compressor. (Evaporator coil shall be continuously active for dehumidification).
 2. Single compressor with evaporator and condenser coil within the air handling unit cooling section to provide cooling and to reheat for humidity control.
 3. Units 6 Tons capacity and above shall be provided with multiple compressors. Units 6 to 20 Tons capacity will be capable of 100% 75% 50% 25% and 0% capacity steps. Units 21 to 50 Tons capacity will be capable of operating 100%, 87.5%, 75%, 67.5% 50%, 37.5%, 25%, 0% capacity steps. Capacity reduction maybe accomplished by shutting down compressors, unloading cylinders, varying speed, hot gas bypass, or a combination of the above. Evaporator coils shall be intertwined, split by rows and maintain a full energized face at all times. Coils split by face are not acceptable.
- G. Condenser, evaporator and reheat coils:
1. Capacity Ratings: Complying with ASHRAE 33 and ARI 410 and coil bearing the ARI label.
 2. Tube Material: Copper.
 3. Fin Material: Aluminum.
 4. Fin and Tube Joint: Mechanical bond.
 5. Leak Test: Coils shall be leak tested with air underwater.
 6. Coating: Phenolic epoxy corrosion-protection coating after assembly.
 7. Louvered hail guard shall be provided over condenser coil surfaces.
- H. Condenser Fan Assembly:
1. Fans: Direct-drive propeller type with statically and dynamically balanced fan blades.
 2. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 15051 "Mechanical Support Devices."
 - b. Motor Enclosure: Totally enclosed non-ventilating (TENV) or totally enclosed air over (TEAO) enclosure.
 - c. Enclosure Materials: Cast iron.
 - d. Motor Bearings: Permanently lubricated bearings.
 - e. Unusual Service Conditions: Ambient Temperature: 40 deg C.
 - f. Built-in overcurrent and thermal-overload protection.

- g. Efficiency: Premium efficient.
- h. NEMA Design: NEMA "B".
- i. Service Factor: 1.15.

3. Fan Safety Guards: Steel with corrosion-resistant coating.

I. Safety Controls:

- 1. Compressor motor and condenser coil fan motor low ambient lockout.
- 2. Overcurrent protection for compressor motor.
- 3. Condensate overflow safety switch shall automatically shut down the system.

2.7 ELECTRIC-RESISTANCE HEATING COIL

A. UL Compliance: Comply with requirements in UL 1995, "Heating and Cooling Equipment."

B. Electric-Resistance Heating Elements:

- 1. Open-Coil Resistance Wire: 80 percent nickel and 20 percent chromium.
- 2. Supports and Insulation: Floating ceramic bushings recessed into casing openings; fastened to supporting brackets and mounted in galvanized-steel frame.
- 3. Heating Capacity: Low density 35 W per sq. in. factory wired for single-point wiring connection; with time delay for element staging and overcurrent- and overheat-protection devices.
- 4. Safety Controls:
 - a. Blower-motor interlock, air-pressure switch.
 - b. Quiet mercury contactors.
 - c. Time delay between steps.
 - d. Integral, non-fused power disconnect switch.

2.8 OUTDOOR-AIR INTAKE HOOD

A. Type: Manufacturer's standard hood or louver.

B. Materials: Match cabinet.

C. Bird Screen: Comply with requirements in ASHRAE 62.1.

D. Configuration: Designed to inhibit wind-driven rain from entering unit.

2.9 FILTERS

A. Extended-Surface, Disposable Panel Filters:

- 1. Comply with NFPA 90A.
- 2. Factory-fabricated, dry, extended-surface type.
- 3. Thickness: 2 inches.
- 4. Provide minimum filtration efficiency of MERV 6, in accordance with ASHRAE 52.2.
- 5. Media: Fiberglass free, formed into deep-V-shaped pleats with antimicrobial agent and held by self-supporting wire grid.

B. Mounting Frames:

1. Filters arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from both sides.
2. Galvanized or stainless steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.

2.10 ELECTRICAL POWER CONNECTIONS

- A. General Electrical Power Connection Requirements: Factory installed and wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.
- B. Enclosure: NEMA 250, Type 3R, mounted in unit with hinged access door in unit cabinet having a lock and key or padlock and key.
- C. Wiring: Numbered and color-coded to match wiring diagram.
- D. Wiring Location: Install factory wiring outside an enclosure in a raceway.
- E. Power Interface: Field power interface shall be to wire lugs.
- F. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:
 1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.
 2. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- G. Factory-Mounted, Overcurrent-Protection Service: For each motor.
- H. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus 20% spare capacity.
- I. Controls: Factory wire unit-mounted controls where indicated.
- J. Receptacle: Factory wire unit-mounted, ground fault interrupt (GFI) duplex receptacle.
- K. Control Relays: Auxiliary and adjustable time-delay relays.

SPECIFIER: In the following paragraph select the specification section applicable to the Scope of the Work.

2.11 CONTROLS

- A. Control equipment and sequence of operation are specified in Section [13810 - "Energy Management System"] [Section 15900 - "Controls and Instrumentation"].

- B. Control Valves as specified in Section [Section 13810 - "Energy Management System"][15900 – "Controls and Instrumentation"].
- C. Control Wiring: Factory wire connection for control and power supply.
- D. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, actuators, and valves shall be manufacturer's standard items to accomplish indicated control functions.
- E. Unit Mounted Status Panel: Capable of communicating with and connected to the school EMS system.
 - 1. Cooling/Off/Heating Controls: Control operational mode.
 - 2. Fan Speed: Indication of percentage of fan speed.
 - 3. Status Lights:
 - a. Filter dirty.
 - b. Fan operating.
 - c. Cooling operating.
 - d. Heating operating.
 - e. Smoke alarm.
 - f. General alarm.
 - 4. Digital Numeric Display:
 - a. Outdoor airflow.
 - b. Supply airflow.
 - c. Outdoor dry-bulb temperature.
 - d. Outdoor dew point temperature.
 - e. Space temperature.
 - f. Supply temperature.
 - g. Space relative humidity.
 - h. Space carbon dioxide level.
- F. Control Dampers:
 - 1. Damper Location: Factory installed in air inlet section and provided with ease of blade axle and bushing service.
 - 2. Damper Leakage: Comply with requirements in AMCA 500-D. Leakage shall not exceed 6.5 cfm per sq. ft. at a static-pressure differential of 4.0 inches water column when a torque of 5 inch-pounds per sq. ft. is applied to the damper jackshaft.
 - 3. Damper Rating: Rated for close-off pressure equal to the fan shutoff pressure.
 - 4. Damper Label: Bear the AMCA seal for both air leakage and performance.
 - 5. Blade Configuration: Unless otherwise indicated, use parallel blade configuration for two-position control and equipment isolation service. For other applications, use an opposed-blade configuration.
 - 6. Damper Frame Material: Galvanized steel.
 - 7. Blade Type: Single-thickness metal reinforced with multiple V-grooves.
 - 8. Blade Material: Galvanized steel.
 - 9. Maximum Blade Width: 6 inches.
 - 10. Maximum Blade Length: 48 inches.

11. Blade Seals: Replaceable, continuous perimeter vinyl seals and jambs with stainless steel compression-type seals.
12. Bearings: Thrust bearings for vertical blade axles.
13. Airflow Measurement:
 - a. Monitoring System: Complete and functioning system of outdoor airflow monitoring as an integral part of the damper assembly where indicated.
 - b. Remote Monitoring Signal: 0-10 volt or 4-20 mA scaled signal.
 - c. Accuracy of flow measurement: Within 5 percent of the actual flow rate between the range of the scheduled minimum and maximum airflow. For units with a large range between minimum and maximum airflow, configure the damper sections and flow measurement assembly as necessary to comply with accuracy.
 - d. Straightening Device: Integral to the flow measurement assembly if required to achieve the specified accuracy as installed.
 - e. Flow measuring device: Suitable for operation in untreated and unfiltered outdoor air. If necessary, include temperature and altitude compensation and correction to maintain the accuracy.

G. Damper Operators:

1. Factory-installed electric operator for each damper assembly with one operator for each damper assembly mounted to the damper frame.
2. Operator capable of shutoff against fan pressure and able to operate the damper with sufficient reserve power to achieve smooth modulating action and proper speed of response at the velocity and pressure conditions to which the damper is subjected.
3. Maximum Operating Time: Open or close damper 90 degrees in 60 seconds.
4. Adjustable Stops: For both maximum and minimum positions.
5. Position Indicator and Graduated Scale: Factory installed on each actuator with words "OPEN" and "CLOSED," or similar identification, at travel limits.
6. Spring-return operator to fail-safe; either closed or open as required by application.
7. Operator Type: Direct coupled, designed for minimum 60,000 full-stroke cycles at rated torque.
8. Position feedback Signal: For remote monitoring of damper position.
9. Coupling: V-bolt and V-shaped, toothed cradle.
10. Circuitry: Electronic overload or digital rotation-sensing circuitry.

H. Refrigeration System Controls:

1. Outdoor-air sensor de-energizes dehumidifier operation when outdoor air temperature is less than 60 deg F (15 deg C)
2. Relative humidity sensor energizes dehumidifier operation when relative humidity is more than 50 percent.

I. Electric-Resistance Heat Controls:

1. Wall-mounted, space-temperature sensor with adjustment on remote control panel to control space temperature.
2. Capacity Controls: On/off Multiple steps Modulating SCR.

J. Damper Controls: Two position.

- K. Space Pressure and CO₂ Control:
 - 1. Supply and exhaust Fan speed shall modulate air volumes to maintain the space CO₂ level setpoint, except that the minimum air volumes shall be as required to maintain the space at 0.10 in. wg. positive pressure with respect to an outdoor air reference.
- L. Integral Smoke Alarm: Smoke detector installed as per FBC, Mechanical. Detector shall be compatible with fire alarm system installed under Division 16.

SPECIFIER: In the following paragraph select the specification section applicable to the Scope of the Work.

- M. Temperature Control: Standalone control module for link between unit controls and temperature-control or EMS system. Control module shall be compatible with control or EMS system specified in Section [13810 – “Energy Management System”] [15900 - "Control and Instrumentation"]. Links shall include the following:
 - 1. Start/stop interface relay, and relay to notify the temperature-control system alarm condition.
 - 2. Hardware interface or additional sensors for the following:
 - a. Room temperature.
 - b. Discharge-air temperature.
 - c. Refrigeration system operating.
 - d. Variable-frequency-controller operation.
 - e. Cooling load.
 - f. Air-distribution static pressure and ventilation-air volumes.
 - g. Space CO₂ level.
- N. EMS Interface: Factory-installed hardware and software to enable the EMS to monitor, control, and display unit status and alarms.

SPECIFIER: In the following paragraph add the required alarm monitoring points after consulting with the M-DCPS Office of District Inspections, Operations and Energy Management

- 1. Hardwired Points:
 - a. Monitoring: On-off status, [common trouble alarm] <Insert monitoring point>.
 - b. Control: On-off operation, [space temperature set-point adjustment] [supply temperature set-point adjustment] [space humidity set-point adjustment] [space pressure set-point adjustment] <Insert control point>.
- 2. ASHRAE 135 (BACnet) or industry-accepted, open-protocol communication interface with the BAS shall enable the EMS operator to remotely control and monitor the unit from an operator workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the EMS.

2.12 ENERGY RECOVERY WHEEL

- A. Shall include drive system, energy transfer segments removable for cleaning and replacement. Wheel segments shall rotate between exhaust and outside air streams to transfer both sensible and latent heat. Intake and exhaust sections shall be separate and sealed to minimize air transfer between sections. Wheel drive motor shall have permanently lubricated bearings. Belt drive shall rotate wheel without slippage. Wheel surface shall be coated with a desiccant material to absorb and desorb moisture.

2.13 ACCESSORIES

- A. Duplex Receptacle: Factory mounted in unit supply-fan section, with 20 amp 120 V GFI duplex receptacle and weatherproof cover.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.
- C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.
- B. Curb Support: Install roof curb on roof structure as follows:
 - 1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction. Installation shall comply with FBC wind load design requirements.
 - 2. Coordinate size, installation and structural capacity of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7.
 - 3. Coordinate size, location and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.
- C. Equipment Mounted on Grade:
 - 1. Install air units on cast-in-place concrete equipment bases. Comply with concrete requirements for equipment bases and foundations specified in Division 3.
 - 2. Comply with requirements for vibration isolation devices specified in Section 15240, "Vibration Isolation."

- D. Install sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.
- E. Install separate devices furnished by manufacturer and not factory installed.
- F. Install new filters at completion of equipment installation and before testing, adjusting and balancing.
- G. Install drain pipes from unit drain pans to drain.

3.3 CONNECTIONS

- A. Where installing piping adjacent to units, allow space for service and maintenance.
- B. Duct Connections:
 - 1. Comply with requirements in Section 15890 "Ductwork."
 - 2. Drawings indicate the general arrangement of ducts.
 - 3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 15910 "Duct Accessories."
- C. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.
 - 1. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.4 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
 - 3. Start refrigeration system when outdoor-air temperature is within normal operating limits and measure and record the following:
 - a. Cooling coil leaving-air, dry and wet-bulb temperatures.
 - b. Cooling coil entering-air, dry and wet-bulb temperatures.
 - c. Condenser coil entering-air dry-bulb temperature.
 - d. Condenser coil leaving-air dry-bulb temperature.
 - 4. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.
 - b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.
 - 5. Inspect casing insulation for integrity, moisture content and adhesion.
 - 6. Verify that clearances have been provided for servicing.
 - 7. Verify that controls are connected and operable.

8. Verify that filters are installed.
9. Clean coils and inspect for construction debris.
10. Inspect and adjust vibration isolators.
11. Verify bearing lubrication.
12. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
13. Adjust fan belts to proper alignment and tension.
14. Start unit.
15. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
16. Operate unit for run-in period.
17. Calibrate controls.
18. Adjust and inspect high-temperature limits.
19. Inspect outdoor-air dampers for proper stroke.
20. Verify operational sequence of controls.
21. Measure and record the following airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Outdoor-air flow.

- B. After startup, change filters, verify bearing lubrication and adjust belt tension.
- C. Remove and replace components that do not properly operate, and repeat startup procedures as specified above.
- D. Prepare written report of the results of startup services.

3.5 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to four visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate and maintain units.

END OF SECTION