

**SECTION 23 73 13**  
**INDOOR CUSTOM AIR-HANDLING UNITS****PART 1 - GENERAL****1.1 DESCRIPTION**

- A. Air conditioning units including integral components specified herein.
- B. Definitions: Air Conditioning Unit (ACU): A custom factory fabricated and tested assembly of sections consisting of multiple plenum fans with direct driven motors , coils, filters, and other necessary equipment to perform one or more of the following functions of circulating, cleaning, heating, cooling, and dehumidifying of air. Design capacities of units shall be as scheduled on the drawings.

**1.2 RELATED WORK**

- A. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic restraints for equipment.
- B. Section 23 05 11, COMMON WORK RESULTS FOR HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.
- C. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT: Sound and vibration requirements.
- D. Section 23 07 11, HVAC INSULATION: Piping and duct insulation.
- E. Section 23 21 13, HYDRONIC PIPING; Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING; and Section 23 23 00, REFRIGERANT PIPING: Piping and valves.
- F. Section 23 82 16, AIR COILS: Heating and cooling coils and pressure requirements.
- G. Section 23 34 00, HVAC FANS: Exhaust fans.
- H. Section 23 31 00, HVAC DUCTS and CASINGS: Requirements for flexible duct connectors and air leakage.
- I. Section 23 40 00, HVAC AIR CLEANING DEVICES: Air filters and filters' efficiency.
- J. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: HVAC controls.
- K. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC: Testing, adjusting and balancing of air and water flows.
- L. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT: Types of motors.
- M. Section 26 29 11, MOTOR CONTROLLERS: Types of motor starters.
- N. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS: General Commissioning.
- O. Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS: HVAC Commissioning.

- P. Section 23 73 23, AIR-COOLED CONDENSING UNITS: Air-cooled condensing unit to serve refrigerant coil in Air Handling Unit.

### 1.3 QUALITY ASSURANCE

- A. Refer to Article, Quality Assurance, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- B. Air Handling Units Certification
1. Air Handling Units with Plenum Fans:
    - a. Air handling Units with Multiple Plenum Fans shall be tested and rated in accordance with AHRI 430 and AHRI 260.
- C. Heating, Cooling, and Air Handling Capacity and Performance Standards: AHRI 430, AHRI 410, ASHRAE 51, and AMCA 210.
- D. Performance Criteria:
1. The fan BHP shall include all system effects for all fans.
  2. The fan motor shall be selected within the rated nameplate capacity, without relying upon NEMA Standard Service Factor.
  3. Select the fan operating point as follows:
    - a. Air Foil, Backward Inclined, Including Plenum Fans: At or near the peak static efficiency but at an appropriate distance from the stall line.
  4. Operating Limits: AMCA 99 and Manufacturer's Recommendations.
- E. Units shall be factory-fabricated, assembled, and tested by a manufacturer, in business of manufacturing similar air-handling units for at least ten (10) years.
- F. Provide tags and decals to aid in service or to indicate caution areas.
- G. Units shall comply with the requirements of UL 1995 and NFPA 90.

### 1.4. SUBMITTALS:

- A. The contractor shall, in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, furnish a complete submission for all air handling units covered in the project. The submission shall include all information listed below. Partial and incomplete submissions shall be rejected without reviews.
- B. Manufacturer's Literature and Data:
1. Submittals for AHUs shall include fans, motors, coils, filter housings, and all other related accessories. The contractor shall provide custom drawings showing plans and elevations of the total air handling unit assembly including dimensions, operating weight, access sections, flexible connections, door swings, controls penetrations, electrical disconnect, lights, duplex receptacles, switches, wiring, utility connection points, unit support system, vibration isolators, drain pan, pressure drops through each component (filter, coil etc).

2. Submittal drawings of section or component only will not be acceptable. Contractor shall also submit performance data including performance test results, charts, curves or certified computer selection data; data sheets; fabrication and insulation details. If the unit cannot be shipped in one piece, the contractor shall indicate the number of pieces that each unit will have to be broken into to meet shipping and job site rigging requirements. This data shall be submitted in hard copies and in electronic version compatible to AutoCAD version 2014.
  3. Submit sound power levels in each octave band for the inlet and discharge of the fan and at entrance and discharge of AHUs at scheduled conditions. In absence of sound power ratings refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
  4. Provide fan curves showing Liters/Second (cubic feet per minute), static pressure, efficiency, and horsepower for design point of operation and at maximum design Liters/Second (cubic feet per minute).
  5. Submit total fan static pressure, external static pressure, for AHU including total, inlet and discharge pressures, and itemized specified internal losses and unspecified internal losses. Refer to air handling unit schedule on drawings.
  6. Ladder-type schematic drawing of power and auxiliary utility field hook-up requirements, indicating all items that are furnished by the manufacturer.
  7. Calculations required for base rail heights to satisfy condensate trap requirements of cooling coil.
  8. Rated load amp draw.
  9. Approximate shipping weight.
  10. Operation and maintenance materials for Operating and Maintenance Manual.
- C. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS. Include instructions for lubrication, filter replacement, motor and drive replacement, spare part lists, and wiring diagrams.
- D. Submit written test procedures two weeks prior to factory testing. Submit written results of factory tests for approval prior to shipping.
- E. Submit shipping information that clearly indicates how the units will be shipped in compliance with the descriptions below.



F. Military Specifications (Mil. Spec.):

MIL-P-21035B-2003.....Paint, High Zinc Dust Content, Galvanizing  
Repair (Metric)

G. National Fire Protection Association (NFPA):

NFPA 90A-12.....Standard for Installation of Air Conditioning  
and Ventilating Systems, 2009

H. Energy Policy Act of 2005 (P.L.109-58)

**PART 2 - PRODUCTS**

**2.1 AIR CONDITIONING UNITS**

A. General:

1. ACUs shall be fabricated from insulated, solid double-wall galvanized steel without any perforations in draw-through configuration. Casing shall be fabricated as specified in section 2.1.C.2. Galvanizing shall be hot dipped conforming to ASTM A525 and shall provide a minimum of 0.275 kg of zinc per square meter (0.90 oz. of zinc per square foot) (G90). Aluminum constructed units, subject to VA approval, may be used in place of galvanized steel. The unit manufacturer shall provide published documentation confirming that the structural rigidity of aluminum air-handling units is equal or greater than the specified galvanized steel.
2. The contractor and the AHU manufacturer shall be responsible for ensuring that the unit will not exceed the allocated space shown on the drawings, including required clearances for service and future overhaul or removal of unit components. All structural, piping, wiring, and ductwork alterations of units, which are dimensionally different than those specified, shall be the responsibility of the contractor at no additional cost to the Government.
3. ACUs shall be fully assembled by the manufacturer in the factory in accordance with the arrangement shown on the drawings. The unit shall be assembled into the largest sections possible subject to shipping and rigging restrictions. The correct fit of all components and casing sections shall be verified in the factory for all units prior to shipment. All units shall be fully assembled, tested, and then split to accommodate shipment and job site rigging. On units not shipped fully assembled, the manufacturer shall tag each section and include air flow direction to facilitate assembly at the job site. Field reassembly shall be with factory-supplied gasketing material, not caulk. Lifting lugs or shipping skids shall be provided for each section to allow for field rigging and final placement of unit.

4. The ACU manufacturer shall provide the necessary gasketing, caulking, and all screws, nuts, and bolts required for assembly. The manufacturer shall provide a factory-trained and qualified local representative at the job site to supervise the assembly and to assure that the units are assembled to meet manufacturer's recommendations and requirements noted on the drawings. Provide documentation to the Contracting Officer's Representative (COR) that the local representative has provided services of similar magnitude and complexity on jobs of comparable size. If a local representative cannot be provided, the manufacturer shall provide a factory representative.
5. Gaskets: All door and casing and panel gaskets and gaskets between air handling unit components, if joined in the field, shall be high quality which seal air tight and retain their structural integrity and sealing capability after repeated assembly and disassembly of bolted panels and opening and closing of hinged components. Bolted sections may use a more permanent gasketing method provided they are not disassembled.
6. Structural Rigidity: Provide structural reinforcement when required by span or loading so that the deflection of the assembled structure shall not exceed 1/200 of the span based on a differential static pressure of 2986 PA (12 inch WG) or higher.

B. Base:

1. Provide a heavy duty steel base for supporting all major ACU components. Bases shall be constructed of wide-flange steel I-beams, channels, or minimum 200 mm (8 inch) high 3.5 mm (10 Gauge) steel base rails. Welded or bolted cross members shall be provided as required for lateral stability. Contractor shall provide supplemental steel supports as required to obtain proper operation heights for cooling coil condensate drain trap and steam coil condensate return trap as shown on drawings.
2. ACUs shall be completely self supporting for installation on concrete housekeeping pad.
3. The ACU bases not constructed of galvanized steel shall be cleaned, primed with a rust inhibiting primer, and finished with rust inhibiting exterior enamel.

C. Casing (including wall, floor and roof):

1. General: ACU casing shall be constructed water tight and air tight as solid double wall, galvanized steel insulated panels without any perforations, integral of or attached to a structural frame. The

thickness of insulation, mode of application and thermal breaks shall be such that there is no visible condensation on the exterior panels of the AHU located in the non-conditioned spaces.

2. Casing Construction:

Table 2.1.C.2

Outer Panel	1.5 mm (16 Gage) Minimum
Inner Panel	1.0 mm (20 Gage) Minimum
Insulation	Foam
Thickness	50 mm (2 inch) Minimum
Density	48 kg/m <sup>3</sup> (3.0 lb/ft <sup>3</sup> ) Minimum
Total R Value	2.3 m <sup>2</sup> .K/W (13.0 ft <sup>2</sup> .°F.hr/Btu) Minimum

3. Casing Construction (Contractor's Option):

Table 2.1.C.3

Outer Panel	1.5 mm (16 Gage) Minimum
Inner Panel	1.0 mm (20 Gage) Minimum
Insulation	Fiberglass
Thickness	50 mm (2 inch) Minimum
Density	24 kg/m <sup>3</sup> (1.5 lb/ft <sup>3</sup> ) Minimum
Total R Value	1.4 m <sup>2</sup> .K/W (8.0 ft <sup>2</sup> .°F.hr/Btu) Minimum

4. Blank-Off: Provide blank-offs as required to prevent air bypass between the AHU sections, around coils, and filters.
5. Casing panels shall be secured to the support structure with stainless steel or zinc-chromate plated screws and gaskets installed around the panel perimeter. Panels shall be completely removable to allow removal of fan, coils, and other internal components for future maintenance, repair, or modifications without removing the roof. Welded exterior panels are not acceptable. Panels shall be joined with 7.9 mm (5/16-inch) bolts that can be removed and refastened. Fasteners shall not penetrate the air tunnel.
6. Access Doors: Provide in each access section and where shown on drawings and incorporate a thermal break design. Show single-sided and double-sided access doors with door swings on the floor plans. Doors shall be a minimum of 50 mm (2 inch) thick with same double

wall construction as the unit casing. Doors shall be a minimum of 600 mm (18 inches) wide, unless shown of different size on drawings, and shall be the full casing height up to a maximum of 1850 mm (6 feet). Doors shall be gasketed, hinged, and latched to provide an airtight seal. The access doors shall include a minimum 150 mm x 150 mm (6 inch x 6 inch) double thickness, with air space between the glass panes tightly sealed, reinforced glass or Plexiglas window in a gasketed frame.

- a. Hinges: Manufacturers standard, designed for door size, weight and pressure classifications. Hinges shall hold door completely rigid with minimum 45 kg (100 lb) weight hung on latch side of door.
  - b. Latches: Non-corrosive alloy construction, with operating levers for positive cam action, operable from either inside or outside. Doors that do not open against unit operating pressure shall allow the door to ajar and then require approximately 0.785 radian (45 degrees) further movement of the handle for complete opening. Latch shall be capable of restraining explosive opening of door with a force not less than 1991 Pa (8 inch WG).
  - c. Gaskets: Replaceable extruded EPDM sponge rubber gasket, continuous around door, positioned for direct compression with no sliding action between the door and gasket. Secure with high quality mastic to eliminate possibility of gasket slipping or coming loose.
7. Provide sealed sleeves, metal or plastic escutcheons or grommets for penetrations through casing for power and temperature control wiring and pneumatic tubing. Coordinate with electrical and temperature control subcontractors for number and location of penetrations. Coordinate lights, switches, and duplex receptacles and disconnect switch location and mounting. All penetrations and equipment mounting may be provided in the factory or in the field. All field penetrations shall be performed neatly by drilling or saw cutting. No cutting by torches will be allowed. Neatly seal all openings airtight.

E. Floor:

1. Unit floor shall be level without offset space or gap and designed to support a minimum of 488 kg/square meter (100 lbs per square foot) distributed load without permanent deformation or crushing of internal insulation. Provide adequate structural base members beneath floor in service access sections to support typical service foot traffic and to prevent damage to unit floor or internal insulation

and to deflect no more than 1/200 of span under operating conditions. Unit floors in casing sections, which may contain water or condensate, shall be watertight with drain pan.

2. Floor sheets shall be isolated from the base assembly from the base assembly with EPDM thermal break gasket.

F. Condensate Drain Pan: Drain pan shall be designed to extend entire length of cooling coils including headers and return bends. Depth of drain pan shall be at least 43 mm (1.7 inches) and shall handle all condensate without overflowing. Drain pan shall be double-wall, double sloping type, and fabricated from stainless (304) with at least 50 mm (2 inch) thick insulation sandwiched between the inner and outer surfaces. Drain pan shall be continuous metal or welded watertight. No mastic sealing of joints exposed to water will be permitted. Drain pan shall be placed on top of casing floor or integrated into casing floor assembly. Drain pan shall be pitched in all directions to drain line.

1. An intermediate, stainless-steel (304) condensate drip pan with copper downspouts shall be provided on stacked cooling coils. Use of intermediate condensate drain channel on upper casing of lower coil is permissible provided it is readily cleanable. Design of intermediate condensate drain shall prevent upper coil condensate from flowing across face of lower coil.
2. Drain pan shall be piped to the exterior of the unit. Drain pan shall be readily cleanable.
3. Installation, including frame, shall be designed and sealed to prevent blow-by.

G. Plenum Fans -Multiple Fans in a Lead/Standby Arrangement:

1. General: Fans shall be Class II (minimum) construction with single inlet, aluminum wheel and stamped air-foil aluminum bladed. The fan wheel shall be mounted on the directly-driven motor shaft in AMCA Arrangement 4. Fans shall be dynamically balanced and internally isolated to minimize the vibrations. Provide a steel inlet cone for each wheel to match with the fan inlet. Locate fan in the air stream to assure proper flow. The fan performance shall be rated in accordance with AMCA 210 or ASHRAE 51.
2. Allowable vibration tolerances for fan shall not exceed a self-excited vibration maximum velocity of 0.005 m/s (0.20 inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. After field installation, compliance to this requirement shall be

- demonstrated with field test in accordance with Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT and Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC. Following fan assembly, the complete fan assembly balance shall be tested using an electronic balance analyzer with a 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).
3. Provide spring-type thrust restraints on all fans which will travel horizontally more than 6 mm (1/4-inch) when in operation.
    - a. Isolate each fan independently.
    - b. Provide inertia base where required for contractor to fill with concrete after units are set in place.
  4. Each plenum fan shall be driven by variable speed motor controller at full air flow capacity should one fan fail. Use of a drive with bypass is not permitted.
    - a. Provide shaft grounding ring.
    - b. Provide a separate variable speed motor controller for each fan.
    - c. Variable speed motor controllers shall be mounted on exterior of unit.
  5. Multiple fans shall be installed in a pre-engineered structural frame. All fans shall modulate, above or below the synchronous speed within the limits specified by the manufacturer, by a common control sequence. Staging of the fans is not permitted. Redundancy requirement shall be met by each fan capable of meeting the air flow and pressure requirement operating alone.
  6. Fan Accessories
    - a. Fan Isolation: Provide an automatic back draft damper to isolate the fan not in operation due to failure.
    - b. Fan Airflow Measurement:
      - 1) Provide a factory installed airflow measuring device piezo ring integral to the fan to measure air volume within +/- 5 percent accuracy.
      - 2) The probing device shall not be placed in the airflow path to stay clear of turbulence and avoid loss of performance.
      - 3) Provide the appropriate differential pressure transducer and transmitter to incorporate into the Building Automation System to transmit pressure signals to the direct digital controller.
      - 4) Provide relays and auxiliary devices as required to produce a complete functional system.

- 5) The transmitter shall have a span not exceeding three times the design flow rate.
- 6) The control unit shall receive the transmitter signal and shall provide an output to the fan volume control device to maintain a constant flow rate.
- 7) The control unit shall provide proportional plus integral (PI) (automatic reset) control mode and where required also inverse derivation mode. Overall system accuracy shall be plus or minus the equivalent of 2 Pascal (0.008 inch) velocity pressure as measured by the flow station.

c. Airflow Synchronization:

- 1) The control unit shall provide a complete functional system that will maintain a constant flow rate difference between supply and exhaust air to an accuracy of  $\pm 10\%$ .
- 2) The control unit shall track the exhaust air fan capacity in proportion to the supply air flow under all conditions.

7. Provide extended lubrication lines.

8. Provide inlet screens.

H. Fan Motor, Drive, and Mounting Assembly (Plenum Fans):

Fan Motor and Drive: Motors shall be premium energy efficient type, as mandated by the Energy Policy Act of 2005, with efficiencies as shown in the Specifications Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC EQUIPMENT, on drawings and suitable for use in variable speed motor controller applications. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC, for additional motor and drive specifications. Refer to Specification Section 26 29 11, MOTOR CONTROLLERS.

I. Damper blades shall be galvanized steel or aluminum type. Dampers shall have metal compressible jamb seals and extruded vinyl or metal blade edge seals. Dampers shall rotate on stainless steel bearings or bronze bushings. Leakage rate shall not exceed 2.5 cubic meters/minute/square meter (8 CFM per sq. foot) at 250 Pa (1 inch WG). Dampers and operators shall be furnished and factory installed by AHU manufacturer where indicated on the drawings. Damper operators shall be of the same manufacturer as controls furnished under Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.

1. See Drawings for dampers supplied by AHU manufacturer.

J. Filter Section: Refer to Section 23 40 00, HVAC AIR CLEANING DEVICES, for filter requirements.

1. Filters including one complete set for temporary use at site shall be provided independent of the AHU. The AHU manufacturer shall install

- filter housings and racks in filter section compatible with filters furnished. The AHU manufacturer shall be responsible for furnishing temporary filters (pre-filters, final filters and after-filters, as shown on drawings) required for AHU testing.
2. Factory-fabricated filter section shall be of the same construction and finish as the AHU casing including filter racks and hinged double wall access doors. Filter housings shall be constructed in accordance with side service housing requirements in Section 23 40 00, HVAC AIR CLEANING DEVICES.
- K. Coils: Coils shall be mounted on hot dipped galvanized steel supports to assure proper anchoring of coil and future maintenance. Coils shall be face or side removable for future replacement through the access doors or removable panels. Each coil shall be removable without disturbing adjacent coil. Cooling coils shall be designed and installed to insure no condensate carry over. Provide factory installed extended supply, return, drain, and vent piping connections. Coil connections shall extend through the section casing. Seal coil connection penetrations from both the interior and exterior surfaces of the panel to prevent leakage and condensation. Refer to Drawings and Section 23 82 16, AIR COILS for additional coil requirements.
1. Integral Face and Bypass Steam Coils: Provide integral vertical face and bypass dampers with multiple alternating heating and bypass sections. Electric damper operators shall be furnished and mounted by the AHU manufacturer at the factory. Damper operators shall be of same manufacturer as controls furnished under Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
  2. Unit shall have chilled water coil and refrigerant coil in series to serve as backup or when chilled water is not available.
  3. Refrigerant coil circuit shall be furnished with a red brass distributor with solder type connection and copper sweat suction connection.
- L. Heat Recovery Wheel: Refer to Section 23 72 00, AIR-TO-AIR ENERGY RECOVERY EQUIPMENT.
- M. Discharge Section: Provide aerodynamically designed framed discharge openings or spun bellmouth fittings to minimize pressure loss.
- N. Electrical, Lighting and Receptacles: Wiring and equipment specifications shall conform to Division 26, ELECTRICAL.
1. Vapor-proof lights using cast aluminum base style with glass globe and cast aluminum guard shall be installed in access sections for fan, plenums, and any section over 300 mm (12 inch) wide. A switch

shall control the lights in each compartment with pilot light mounted outside the respective compartment access door. Wiring between switches and lights shall be factory installed. All wiring shall run in neatly installed electrical conduits and terminate in a junction box for field connection to the building system. Provide single point 115 volt - one phase connection at junction box.

2. Install compatible 100 watt bulb in each light fixture.
  3. Lights shall be wired so they are functional whether the main power disconnect is in the ON or OFF position.
  4. Provide a convenience duplex GFCI receptacle next to the light switch.
  4. Disconnect switch and power wiring: Provide factory or field mounted disconnect switch. All wiring shall be factory installed to permit connection at a single point of connection. Coordinate with Division 26, ELECTRICAL.
- O. Ultraviolet Germicidal Irradiation Lamps
1. Ultraviolet germicidal irradiation (UVGI) lamps shall be provided. Lamps shall be installed such that the entire leaving face of the chilled water cooling coil(s) and the drain pan are exposed to the light in accordance with the GSA 2003 Facilities Standard, HVAC Systems and Components. Fixtures shall have been tested, Listed and labeled as UL/C-UL under Category Code ABQK (Accessories, Air Duct Mounted), UL Standards 153, 1598 & 1995, respectively.
  2. Each lamp shall contain no more than 8 milligrams of mercury, consistent with current environmental practices, while producing the specified output at 2.5 m/s (500 fpm) in temperatures of 13°C to 57°C (55°F to 135°F). Useful lamp life shall be 9,000 hours with no more than a 20% output loss at the end of one year of continuous use.
  3. Any windows with visual access to the light shall use protective UVC resistant glass. Access to any section with visual access to UVC light shall include automatic kill switches to de-energize the lamps.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install air handling unit in conformance with ARI 435.
- B. Assemble air handling unit components following manufacturer's instructions for handling, testing and operation. Repair damaged galvanized areas with paint in accordance with Military Spec. DOD-P-21035. Repair painted units by touch up of all scratches with finish paint material. Vacuum the interior of air handling units clean prior to operation.

- C. Leakage and test requirements for air handling units shall be the same as specified for ductwork in Specification Section 23 31 00, HVAC DUCTS AND CASINGS except leakage shall not exceed Leakage Class ( $C_L$ ) 12 listed in SMACNA HVAC Air Duct Leakage Test Manual when tested at 1.5 times the design static pressure. Repair casing air leaks that can be heard or felt during normal operation and to meet test requirements.
- D. Perform field mechanical (vibration) balancing in accordance with Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- E. Seal and/or fill all openings between the casing and AHU components and utility connections to prevent air leakage or bypass.
- F. Fill inertia base with concrete, if required.
- G. Coordinate field wiring with electrical contractor.
- H. Coordinate field controls with automatic controls contractor.

### 3.2 STARTUP SERVICES

- A. The air handling unit shall not be operated for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings are lubricated and fan has been test run under observation.
- B. After the air handling unit is installed and tested, provide startup and operating instructions to VA personnel.
- C. An authorized factory representative should start up, test and certify the final installation and application specific calibration of control components. Items to be verified include fan performance over entire operating range, noise and vibration testing, verification of proper alignment, overall inspection of the installation, Operator training, etc.
- D. Provide new set of filters at completion of start-up and test. Do not use Government's spare set.

### 3.3 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

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