

SECTION 23 00 01

MAKE-UP AIR UNITS
08/18

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE 62.1 (2013) Ventilation for Acceptable Indoor
Air Quality

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2017) Standard Specification for Zinc
(Hot-Dip Galvanized) Coatings on Iron and
Steel Products

ASTM B766 (1986; R 2015) Standard Specification for
Electrodeposited Coatings of Cadmium

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2016; SUPP 2016) Motors and Generators

NEMA MG 10 (2017) Energy Management Guide for
Selection and Use of Fixed Frequency
Medium AC Squirrel-Cage Polyphase
Induction Motors

NEMA MG 11 (1977; R 2012) Energy Management Guide for
Selection and Use of Single Phase Motors

UNDERWRITERS LABORATORIES (UL)

UL 6 (2007; Reprint Nov 2014) Electrical Rigid
Metal Conduit-Steel

UL Bld Mat Dir (updated continuously online) Building
Materials Directory

1.2 SYSTEM DESCRIPTION

Furnish ductwork, piping offsets, fittings, and accessories as required to provide a complete installation. Coordinate the work of the different trades to avoid interference between piping, equipment, structural, and electrical work. Provide complete, in place, all necessary offsets in piping and ductwork, and all fittings, and other components, required to install the work as indicated and specified.

1.2.1 Mechanical Equipment Identification

Provide labels for all equipment

1.2.2 Service Labeling

Label equipment, including fans, air handlers, terminal units, etc. with labels made of self-sticking, plastic film designed for permanent installation. Provide labels in accordance with the typical examples below:

SERVICE	LABEL AND TAG DESIGNATION
Make-up Air Unit	MAU - 1, 2, 3
Gas Make-up Air Unit	GMAU -1

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data

Make-Up Air Units; G

SD-06 Test Reports

Performance Tests; G

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions; G

Operation and Maintenance Training

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

Make-Up Air Units; G

1.4 QUALITY ASSURANCE

Except as otherwise specified, approval of materials and equipment is based on manufacturer's published data.

- a. Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories, the label of or listing with reexamination in UL Bld Mat Dir, and UL 6 is acceptable as sufficient evidence that the items conform to Underwriters Laboratories requirements. In lieu of such label or listing, submit a written

certificate from any nationally recognized testing agency, adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the specified requirements. Outline methods of testing used by the specified agencies.

- b. Where materials or equipment are specified to be constructed or tested, or both, in accordance with the standards of the ASTM International (ASTM), the ASME International (ASME), or other standards, a manufacturer's certificate of compliance of each item is acceptable as proof of compliance.
- c. Conformance to such agency requirements does not relieve the item from compliance with other requirements of these specifications.

1.4.1 Prevention of Corrosion

Protect metallic materials against corrosion. Provide rust-inhibiting treatment and standard finish for the equipment enclosures. Do not use aluminum in contact with earth, and where connected to dissimilar metal. Protect aluminum by approved fittings, barrier material, or treatment. Provide hot-dip galvanized ferrous parts such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials in accordance with ASTM A123/A123M for exterior locations and cadmium-plated in conformance with ASTM B766 for interior locations.

1.4.2 Asbestos Prohibition

Do not use asbestos and asbestos-containing products.

1.4.3 Detail Drawings

Submit detail drawings showing equipment layout, including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications. Include any information required to demonstrate that the system has been coordinated and functions properly as a unit on the drawings and show equipment relationship to other parts of the work, including clearances required for operation and maintenance. Submit drawings showing bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Submit function designation of the equipment and any other requirements specified throughout this Section with the shop drawings.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect stored equipment at the jobsite from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, cap or plug all pipes until installed.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide components and equipment that are "standard products" of a

manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. "Standard products" is defined as being in satisfactory commercial or industrial use for 2 years before bid opening, including applications of components and equipment under similar circumstances and of similar size, satisfactorily completed by a product that is sold on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record are acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Provide equipment items that are supported by a service organization.

2.2 IDENTIFICATION PLATES

In addition to standard manufacturer's identification plates, provide engraved laminated phenolic identification plates for each piece of mechanical equipment. Identification plates are to designate the function of the equipment. Submit designation with the shop drawings. Provide identification plates that are layers, black-white-black, engraved to show white letters on black background. Letters must be upper case. Identification plates that are 1-1/2-inches high and smaller must be 1/16-inch thick, with engraved lettering 1/8-inch high; identification plates larger than 1-1/2-inches high must be 1/8-inch thick, with engraved lettering of suitable height. Identification plates 1-1/2-inches high and larger must have beveled edges. Install identification plates using a compatible adhesive.

2.3 EQUIPMENT GUARDS AND ACCESS

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact according to OSHA requirements. Properly guard or cover with insulation of a type specified, high temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard.

2.4 ELECTRICAL WORK

- a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown. For packaged equipment, include manufacturer provided controllers with the required monitors and timed restart.
- b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11. Provide premium efficiency type integral size motors in accordance with NEMA MG 1.
- c. For polyphase motors, provide squirrel-cage medium induction motors, including motors that are part of a system, and that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Select premium efficiency polyphase motors in accordance with NEMA MG 10.
- d. Provide motors in accordance with NEMA MG 1 and of sufficient size to

drive the load at the specified capacity without exceeding the nameplate rating of the motor. Provide motors rated for continuous duty with the enclosure specified. Provide motor duty that allows for maximum frequency start-stop operation and minimum encountered interval between start and stop. Provide motor torque capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Fit motor bearings with grease supply fittings and grease relief to outside of the enclosure.

2.5 ANCHOR BOLTS

Provide anchor bolts for equipment placed on concrete equipment pads or on concrete slabs. Bolts to be of the size and number recommended by the equipment manufacturer and located by means of suitable templates. Installation of anchor bolts must not degrade the surrounding concrete.

2.6 PAINTING

Paint equipment units in accordance with approved equipment manufacturer's standards unless specified otherwise. Field retouch only if approved. Otherwise, return equipment to the factory for refinishing.

2.7 INDOOR AIR QUALITY

Provide equipment and components that comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

2.8 AIR SYSTEMS EQUIPMENT

2.8.1 Make-up Air Units (MAU-1, MAU-2)

MAU-1 and MAU-2 shall meet the following requirements: centrifugal fan, all aluminum double wall construction, mounted on a unitary base complete with drive, drive guard and motor. Provide filter frames of stainless steel construction with pre-filters and final filters. Drainable, stationary louvers of painted aluminum (Kynar) complete with rear birdscreen. Insulated aluminum painted panels for tongue and groove construction. Four access doors, fan discharge flexible connection, framed roof opening for field installation (sheet metal contractor to install along with counter flashing to make sure it is water tight). Internal stiffeners so that the enclosure meets the 1.75 factor construction. Base channel and corner flashing, all aluminum. Insulation, stainless steel self-tapping screws, and caulking to assemble kit. A set of pre-filters per unit for installation after start-up and commissioning.

Basis of design by Thermal Systems Group, (850-944-0013).

Provide certifications for fan and filters.

2.8.2 Make-up Air Units (MAU-3, GMAU-1)

The units shall meet the following requirements

Unit Construction bases and floors: Base shall be constructed from aluminum channels around the perimeter and welded structural aluminum cross members. Floor shall be constructed from Aluminum. The floor shall be double paneled. The floor surface shall be welded and all spaces and joints

completely sealed with dams around all bottom penetrations. All drain pans shall have a rigid 12" wide safety tread plate walk bridge stretched across the unit width. Insulation that meets a minimum R-value of 17 shall be provided underneath the entire unit floor. Insulation shall be closed-cell foam to prevent wicking of moisture.

Walls: Wall assemblies shall be 3" double 18 gage aluminum solid exterior and 18 gage aluminum interior. A thermal break shall be provided throughout the entire wall assembly that ensures no member on the exterior of the unit, including fasteners, has through metal contact with any member on the interior of the unit, including fasteners. Insulation that meets a minimum R-value of 17 shall be provided throughout all unit wall assemblies. Insulation shall be injected foam. Foam shall be closed cell to prevent wicking of moisture. Removable wall access panels shall be provided in coil and fan sections for service removal of components. A thermal break shall be provided throughout all removal wall access panels that ensures no member on the exterior of the unit, including fasteners, has through metal contact with any member on the interior of the unit, including fasteners.

Access Doors: Access doors shall be provided for service. Access doors shall be double wall construction.

Roofs: Roof assemblies shall be double wall aluminum construction. Exterior roof panels and interior ceiling panels shall be of the same construction as the exterior and interior wall panels. Insulation that meets a minimum R-value of 17 shall be provided throughout all roof assemblies. Insulation shall be injected foam. Foam shall be closed cell to prevent wicking of moisture. Outdoor unit roofs shall incorporate a standing seam on the exterior to ensure a rigid roof construction. Outdoor roofs shall be sloped, not less than 1/8" per foot for water drainage. Where outdoor units are shipped in multiple sections, provide standing-seam joiners at each split with adhesive, hardware, and cover strips for field joining by the installing contractor. On outdoor units, rain gutters shall be provided over all doors to direct rain away from the door assembly.

Weather hoods: Outside and exhaust air weather hoods shall be fabricated from the same material as the unit exterior. Hoods shall extend past the perimeter of the unit casing opening to ensure the hood does not obstruct the airflow path. Hoods shall be furnished with drain gutters and wire mesh bird screen. Hoods shall be painted with the same paint requirements identified for the external casing herein. Inlet hoods shall be sized for less than 750 fpm inlet velocity. Inlet hoods shall be provided with a moisture eliminator that ensures no entrainment of water into the unit for the velocity at which the hood is selected.

Louvers: Louver frames and blade material shall be constructed of aluminum. Louvers shall have a minimum of 50% free area. Louvers shall be flush mounted to the exterior wall of the unit casing.

Air Filters: All filters shall be nominal sizes to minimize the number of sizes required to be stocked by the Owner. Filters of other nominal sizes will not be acceptable.

Medium Efficiency Pleated Media Filter: Pleated media filters 2" deep shall be provided. The MERV rating shall be 8 when tested in accordance with ANSI/ASHRAE 52.2. Filter media shall be of non-woven fibers with metal grid support. Filters shall be UL Class 2 when tested in accordance with UL Standard 900. Filters shall be provided with front-loading frames. Filter holding frames shall be constructed of aluminum and equipped with foam

gaskets to seal filters against filter frames. Frame seams shall be sealed to eliminate air bypass. Front-loading frames shall be equipped with filter fasteners of the same material as the filter frame. Filter fasteners shall be capable of being installed without the use of special tools, bolts or nuts. Filter holding frames shall be of a universal type to accommodate standard filters of the same nominal size as well as appropriate fasteners.

High Efficiency Pleated Media Filters: Rigid cartridge filters 12" deep shall be provided as indicated on the schedule and drawings. The MERV rating shall be minimum of 13 when tested in accordance with ANSI/ASHRAE 52.2. Filters shall consist of high density glass fiber media enclosed in stainless steel frames with diagonal supports on both the entering and leaving sides. Filters shall be provided with an anti-microbial coating. Filters shall be UL Class 1 when tested in accordance with UL Standard 900. Filters shall be provided with side or front-loading frames. Filter holding frames shall be constructed of stainless steel and equipped with foam gaskets to seal filters against filter frames. Frame seams shall be sealed to eliminate air bypass. Front-loading frames shall be equipped with filter fasteners of the same material as the filter frame. Filter fasteners shall be capable of being installed without the use of special tools, bolts or nuts. Filter holding frames shall be of a universal type to accommodate standard filters of the same nominal size as well as appropriate fasteners.

Cooling Coil (applies to MAU-3): Coil performance shall be provided as indicated on the schedule and drawings. Coil capacities, pressure drops and selection procedures shall be certified to AHRI Standard 410. Coils shall have same-end header connections. Water coils shall have non-ferrous headers. Water coils shall have vent and drain taps and MPT connections. Connection locations (handing) shall be as indicated on the drawings. Grommets shall be provided at coil casing penetrations around the coil piping. Grommets shall be designed to seal the opening under positive and negative pressure.

Chilled Water Coils (applies to MAU-3): Chilled water coils shall be provided as indicated on the schedule and drawings. Chilled water coils shall have 0.0075" thick aluminum fins. Fins shall be mechanically bonded to 5/8" OD seamless copper tubes with 0.024" thick walls. Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion. Coils shall be circuited for counter-flow heat transfer. Coil casings shall be constructed of stainless steel. Chilled water coils shall be proof and leak tested under water. Proof test shall be at 300 psig and leak test shall be at 200 psig. Coil shall have a flexible epoxy polymer coating uniformly applied to all coil surface areas. Coating process shall ensure complete coil encapsulation with a uniform dry film thickness from 0.8 - 1.2 mil on all surfaces including fin edges. Coating shall have superior hardness characteristics of 2H per ASTM D3363-92A, cross-hatch adhesion of 4B-5B per ASTM B3359-93, and impact resistance up to 160 in/lb per ASTM D2794-93. Humidity and water immersion resistance shall be up to a minimum 1000 and 260 hours respectively (ASTM D2247-92 and ASTM D870-02). Corrosion durability shall be confirmed through testing to no less than 5,000 hours salt spray per ASTM B117-90 using scribed aluminum test coupons.

Primary Drain Pans (applies to MAU-3): Primary condensate drain pans shall be provided in cooling coil sections. Drain pans in cooling coil sections shall be stainless steel. Primary drain pans shall extend under each entire coil bank, including headers and return bends. Primary drain pans shall extend downstream of the coil bank for a minimum distance as indicated in the drawings. Primary drain pans shall be sloped a minimum of 1/8" per foot, shall be a minimum of 2" deep, and shall be double-sloped (sloped in

2 planes) to positively drain. Drain connections shall be of the same material as the primary drain pan and shall extend a minimum of 1-1/2" beyond the base to ensure adequate room for field piping of condensate drain traps. Any coil support member located inside a primary drain pan shall be of the same material as the drain pan.

Fans: All fans, including those as part of a fan array, shall be tested, rated and certified in accordance with ANSI/AMCA Standard 210 for air delivery and in accordance with AMCA Standard 300 for sound power levels and shall bear the AMCA seal. The fan balancing process, including vibration limits and documentation, shall be performed in accordance with ANSI/AMCA Standard 204. Each fan/motor assembly as a part of a fan array shall be dynamically balanced to meet AMCA standard 204-96, category BV-3, to meet or exceed Grade 6.3 residual unbalance. Fan and motor performance requirements shall be as shown on the schedule and drawings. Maximum rated speed of the fans shall not exceed 75% of the first critical speed.

Fan Arrays: Fan arrays shall be provided. Each fan in the array shall operate in parallel to each other fan in the array. Each Fan shall be supplied with a backdraft damper. Fans in the array shall be SWSI plenum type with high efficient AF blades. Fans shall be direct driven. The Hp characteristic of the fans shall be non-overloading. Fans shall be furnished with discharge and inlet screens to ensure protection from moving fan parts. Fans shall be furnished with inlet collars. Fan arrays shall be controlled using a common control signal, such as the duct static control signal, to modulate the fan speed. There shall be a VFD per fan.

Fan Motors: All motors shall conform to ANSI/NEMA MG 1 as well as all applicable requirements of NEC and shall be UL Listed. Motors shall be inverter ready, ODP and of the voltage, phase, frequency, and Hp indicated on the schedule and drawings. Motors shall be premium efficient, exceeding the EPAct efficiency requirements. Nameplate motor horsepower for all fans, including dual fans and fan arrays, shall be at least 10% greater than design brake horsepower of each fan. Motors for fan arrays shall each have an independent overload and an independent ground connection. Motors shall be NEMA Design B, with Class B insulation.

Vibration Isolation: All fan and motor assemblies, including those as part of a fan array, shall be mounted on vibration isolators which have a 2" deflection to isolate the assembly or array from the unit housing. The discharge of housed fan assemblies and the inlet of plenum fan assemblies or arrays shall be connected to the pressure-bulkhead panel (wall, floor, or roof) with flexible duct to prevent transmission of vibration to the unit casing. No metal to metal contact will be permitted between fixed and floating parts. Thrust restraints shall be provided as required to limit horizontal movement of fan assembly at design conditions. Fan bases shall be rigidly tied to the unit base during shipment to prevent damage from shipping vibrations. Shipping restraints shall be field removable with a common tool.

Gas Heat: Indirect-fired gas heat shall be provided as indicated on the schedule and drawings. Gas heat shall be supplied with FM- or IRI-approved components. Indirect fired gas heat shall have spark-ignited power burners capable of combustion of natural gas. Burner combustion shall be clean and odor-free throughout the entire operating range. Nitrogen oxide emissions levels shall not exceed 82 ppm. Gas heat exhaust shall be through induced powered means. Burners shall be provided with controls. Controls shall include flame safeguards, high temperature limit switches, draft proving switches, and fan cut-off devices. Turndown ratios shall be a minimum per

the schedule. Heat exchangers shall be drum and tube type with primary and secondary exchangers constructed of stainless steel. Heat exchanger design shall include suitable means for clean-out and inspection of heat exchanger. Burners shall be provided with FM- or IRI-approved pipe trains. Pipe trains shall consist of gas shut off valves, main and auxiliary fluid power valves, pilot pressure regulators and pilot controls.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

- a. Install materials and equipment in accordance with the requirements of the contract drawings and approved manufacturer's installation instructions. Accomplish installation by workers skilled in this type of work. Perform installation so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors.
- b. No installation is permitted to block or otherwise impede access to any existing machine or system. Install all hinged doors to swing open a minimum of 120 degrees. Provide an area in front of all access doors for service and repair. In front of all access doors to electrical circuits, clear the area the minimum distance to energized circuits as specified in OSHA Standards, part 1910.333 (Electrical-Safety Related work practices).
- c. Except as otherwise indicated, install emergency switches and alarms in conspicuous locations. Mount all indicators, to include gauges, meters, and alarms in order to be easily visible by people in the area.

3.2.1 Condensate Drain Lines

Provide water seals in the condensate drain from all units. Provide a depth of each seal of 2 inches plus the number of inches, measured in water gauge, of the total static pressure rating of the unit to which the drain is connected. Provide water seals that are constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Provide pipe cap or plug cleanouts where indicated. Connect drains indicated to connect to the sanitary waste system using an indirect waste fitting.

3.2.2 Equipment and Installation

Provide frames and supports for valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Floor mount or ceiling hang air handling units as indicated. Anchor and fasten as detailed. Set floor-mounted equipment on not less than 6 inch concrete pads or curbs doweled in place unless otherwise indicated. Make concrete foundations heavy enough to minimize the intensity of the vibrations transmitted to the piping, duct work and the surrounding structure, as recommended in writing by the equipment manufacturer. In lieu of a concrete pad foundation, build a concrete pedestal block with isolators placed between the pedestal block and the floor. Make the concrete foundation or concrete pedestal block a mass not less than three times the weight of the components to be supported. Provide the lines connected to

the pump mounted on pedestal blocks with flexible connectors.

3.2.3 Access Panels

Install access panels for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance of sufficient size, and locate them so that the concealed items are easily serviced and maintained or completely removed and replaced.

3.2.4 Flexible Duct

Install pre-insulated flexible duct in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Provide hangers, when required to suspend the duct, of the type recommended by the duct manufacturer and set at the intervals recommended.

3.3 EQUIPMENT PADS

Provide equipment pads to the dimensions shown or, if not shown, to conform to the shape of each piece of equipment served with a minimum 3-inch margin around the equipment and supports. Allow equipment bases and foundations, when constructed of concrete or grout, to cure a minimum of 14 calendar days before being loaded.

3.4 CUTTING AND PATCHING

Install work in such a manner and at such time that a minimum of cutting and patching of the building structure is required. Make holes in exposed locations, in or through existing floors, by drilling and smooth by sanding. Use of a jackhammer is permitted only where specifically approved. Make holes through masonry walls to accommodate sleeves with an iron pipe masonry core saw.

3.5 CLEANING

Thoroughly clean surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction before such surfaces are prepared for final finish painting or are enclosed within the building structure. Before final acceptance, clean mechanical equipment, including piping, ducting, and fixtures, and free from dirt, grease, and finger marks. When the work area is in an occupied space such as office, laboratory or warehouse protect all furniture and equipment from dirt and debris. Incorporate housekeeping for field construction work which leaves all furniture and equipment in the affected area free of construction generated dust and debris; and, all floor surfaces vacuum-swept clean.

3.6 FIELD PAINTING OF MECHANICAL EQUIPMENT

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except clean to bare metal on metal surfaces subject to temperatures in excess of 120 degrees F. Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Provide aluminum or light gray finish coat.

3.6.1 Temperatures less than 120 degrees F

Immediately after cleaning, apply one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat to metal surfaces subject to temperatures less than 120 degrees F.

3.6.2 Temperatures between 120 and 400 degrees F

Apply two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of two mils to metal surfaces subject to temperatures between 120 and 400 degrees F.

3.6.3 Temperatures greater than 400 degrees F

Apply two coats of 315 degrees C 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of two mils to metal surfaces subject to temperatures greater than 400 degrees F.

3.7 IDENTIFICATION SYSTEMS

Provide identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and item number on all valves and dampers. Provide tags that are 1-3/8 inch minimum diameter with stamped or engraved markings. Make indentations black for reading clarity. Attach tags to valves with No. 12 AWG 0.0808-inch diameter corrosion-resistant steel wire, copper wire, chrome-plated beaded chain or plastic straps designed for that purpose.

3.8 PERFORMANCE TESTS

After testing, adjusting, and balancing is complete as specified, test each system as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Record the testing during the applicable season. Make corrections and adjustments as necessary to produce the conditions indicated or specified. Conduct capacity tests and general operating tests by an experienced engineer. Provide tests that cover a period of not less than 2 days for each system and demonstrate that the entire system is functioning according to the specifications. Make coincidental chart recordings at points indicated on the drawings for the duration of the time period and record the temperature at space thermostats or space sensors, the humidity at space humidistats or space sensors and the ambient temperature and humidity in a shaded and weather protected area.

Submit test reports for the performance tests in booklet form, upon completion of testing. Document phases of tests performed including initial test summary, repairs/adjustments made, and final test results in the reports.

3.9 CLEANING AND ADJUSTING

Provide a temporary bypass for water coils to prevent flushing water from passing through coils. Wipe equipment clean, with no traces of oil, dust, dirt, or paint spots. Provide temporary filters prior to startup of all fans that are operated during construction, and provide new filters after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned.

Perform and document that proper "Indoor Air Quality During Construction" procedures have been followed; provide documentation showing that after construction ends, and prior to occupancy, new filters were provided and installed. Maintain system in this clean condition until final acceptance. Properly lubricate bearings with oil or grease as recommended by the manufacturer. Tighten belts to proper tension. Adjust control valves and other miscellaneous equipment requiring adjustment to setting indicated or directed. Adjust fans to the speed indicated by the manufacturer to meet specified conditions. Maintain all equipment installed under the contract until close out documentation is received, the project is completed and the building has been documented as beneficially occupied.

3.10 OPERATION AND MAINTENANCE

3.10.1 Operation and Maintenance Manuals

Submit six manuals at least 2 weeks prior to field training.

3.10.2 Operation And Maintenance Training

Conduct a training course for the members of the operating staff as designated by the Contracting Officer. Make the training period consist of a total of 8 hours of normal working time and start it after all work specified herein is functionally completed and the Performance Tests have been approved. Conduct field instruction that covers all of the items contained in the Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations. Submit the proposed On-site Training schedule concurrently with the Operation and Maintenance Manuals and at least 14 days prior to conducting the training course.

-- End of Section --