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USACE / NAVFAC / AFCESA / NASA **UFGS-23 73 13 (November 2008)**

Preparing Activity: NASA **Superseding UFGS-23 73 13.00 40 (August 2008)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2009
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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

SECTION 23 73 13

MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

11/08

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SECTION 23 73 13

MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS
11/08

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NOTE: This guide specification covers the requirements for manufacturer's standard low-(AMCA Class A), medium- (AMCA Class B), and high-pressure (AMCA Class C), low- and high-velocity, factory fabricated and assembled, central station, air handling units.

Drawings or schedules must include configuration, all capacity conditions, coils, fans, filters, filter operating pressure range, access, drainage provisions, vibration isolation, piping, control diagrams, etc.

Identify air handling systems on the drawings, schedules, or herein by ah series numbering, location served, air flow (draw-through): cabinet type (multi-zone), and pressure and velocity class.

Supplement unit description with paragraphs which describe special requirements.

Include the following sections when applicable:

Section 23 05 15 COMMON PIPING FOR HVAC

Section 23 82 16 AIR COILS

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS

Section 23 05 48 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

Section 23 37 13 DIFFUSERS, REGISTERS, AND GRILLS

Section 23 41 13 PANEL FILTERS

Section 26 60 13.00 40 LOW-VOLTAGE MOTORS

Edit this guide specification for project specific requirements by adding, deleting, or revising text.

For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments and suggestions on this guide specification are welcome. Direct them to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Submit recommended changes to a UFGS as a Criteria Change Request (CCR).

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PART 1 GENERAL

1.1 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text are automatically deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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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.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 211	(2005) Certified Ratings Programme - Product Rating Manual for Air Fan Performance
AMCA 99	(2003) Standards Handbook

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 430	(1999) Standard for Central-Station Air-Handling Units

AHRI 880 (2008) Standard for Air Terminals

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

ASHRAE 51 (2008) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

ASHRAE 52.1 (1992; Interpretation 1 2007) Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter

ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653M (2009) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM B 117 (2009) Standing Practice for Operating Salt Spray (Fog) Apparatus

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 1940-1 (2003; Corrigendum 2005) Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance Tolerance - International Restrictions

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2007; Errata 2008) Standard for Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (2008; Errata 2009) Standard for the Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 900 (2004; Rev thru Nov 2007) Standard for Air Filter Units

1.2 GENERAL REQUIREMENTS

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NOTE: If Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS is not included in the project specification, insert applicable requirements there from and delete the following paragraph.
****

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS

applies to work specified in this section.

****

NOTE: Ensure fan and motor balance conform to ISO 1940-1 - (1986) Balance Quality Requirements of Rigid Rotors - Determination of Permissible Residual Unbalance unless otherwise noted. Ensure motor vibration levels conform to NEMA Specification MG-1, Motors and Generators, Part 7 unless otherwise noted.

****

Submit Equipment and Performance Data for air handling units in accordance with the specification. Provide data that consists of use life, total static pressure and coil face area classifications, and performance ratings.

Submit drawings and manuals that include a spare parts data sheet, with manufactures recommended stock levels.

1.3 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Keep submittals to the minimum required for adequate quality control.

A “G” following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a “G”. Only delete an existing “G” if the submittal item is not complex and can be reviewed through the Contractor’s Quality Control system. Only add a “G” if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, use a code of up to three characters within the submittal tags following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.][for information only. When used, a designation following the "G" designation identifies the office that reviews the submittal for the

Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit Installation Drawings for air handling units in accordance with paragraph entitled, "AHU Equipment Installation," of this section.

SD-03 Product Data

Submit Equipment and Performance Data for air handling units in accordance with paragraph entitled, "General Requirements," of this section.

Submit Manufacturer's catalog data for the following items:

Unit Cabinet
Fan
Drain Pans
Insulation
Plenums
Multizone AHU
Blow-Through AHU
Spare Parts

SD-07 Certificates

Submit Listing of Product Installations for air handling units in accordance with paragraph entitled, "AHU Equipment Installation," of this section.

Submit certificates for following items showing conformance with the referenced standards contained in this section.

Unit Cabinet
Fan
Drain Pans
Insulation
Plenums
Multizone AHU
Blow-Through AHU
Spare Parts

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals for air handling units in accordance with paragraph entitled, "Operation and Maintenance," of this section.

PART 2 PRODUCTS

2.1 AIR HANDLING UNIT (AHU)

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NOTE: Schedule packaged AHU "total AMCA fan outlet area" refers to AMCA 99 areas. It is the sum of outlet areas for the number of fans per unit and permits a variance to accommodate the manufacturer's

standard number per unit and fan type, where options are permitted, of plus or minus approximately 4 percent.

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NOTE: Balanced quality Grade G6,3 includes fans and pump impellers. Higher precision Grades G2,5 and G1,0 include turbines and precision machine spindles.

****

Provide central-station type, factory fabricated, and [sectionally] [fully] assembled air handling unit (AHU). Provide AHU that includes components and auxiliaries in accordance with AHRI 430. Balance AHU fan and motor to ISO 1940-1-2005.

Provide total static pressure and coil face area classification that conform to AMCA 99.

Fans with enlarged outlets are not permitted.

[Provide double-width, double-inlet, centrifugal scroll type AHU fan.]

2.2 UNIT CABINET

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NOTE:
Class A total static pressure to 3 inches water gauge.

Class B total static pressure of 3 to 5.5 inches water gauge.

Class C total static pressure over 5.5 inches water gauge.

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NOTE: Select the following paragraph for AMCA Class A and Class B cabinets.

****

Provide AHU cabinet that is suitable for pressure class shown and that has leaktight joints, closures, penetrations, and access provisions. Provide cabinet that does not expand or contract perceptibly during starting and stopping of fans and that does not pulsate during operation. Reinforce cabinet surfaces with deflections in excess of 0.004167 of unsupported span prior to acceptance. Stiffen pulsating panels, which produce low frequency noise due to diaphragming of unstable panel walls, to raise natural frequency to an easily attenuated level. Fabricate enclosure from continuous hot-dipped galvanized steel no lighter than 0.91 millimeter 20 gage thickness, to match industry standard. Provide mill-galvanized sheet metal that conforms to ASTM A 653/A 653M and that is coated with not less than 0.38 kilogram of zinc per square meter 1.25 ounces of zinc per square foot of two-sided surface. Provide mill-rolled structural steel that is hot-dip galvanized or primed and painted. Corrosion protect cut edges, burns, and scratches in galvanized surfaces. Provide primed and painted black carbon steel cabinet construction that complies with this specification.

Provide removable panels to access the interior of the unit cabinet. Provide seams that are welded, bolted or gasketed and sealed with a rubber-based mastic. Make entire floor as well as ceiling unit hot-dipped galvanized steel. Provide removable access doors on both sides of all access, filter, and fan sections for inspection and maintenance.

****

NOTE: Select the following paragraph for AMCA Class C cabinets.

****

Provide AHU cabinet suitable for pressure class indicated with leaktight joints, closures, penetrations, and access provisions. Provide cabinet that does not expand or contract perceptibly during starting and stopping of fans and that does not pulsate during operation. Reinforce cabinet surfaces with deflections in excess of 0.002778 of unsupported span prior to acceptance by the Contracting Officer. Stiffen pulsating panels, which produce low frequency noise due to diaphragming of unstable panel walls, to raise natural frequency to an easily attenuated level. Provide enclosure that is fabricated from mill-galvanized or primed and painted carbon steel sheet of required thickness. Provide mill-galvanized sheet metal that conforms to ASTM A 653/A 653M and that is coated with not less than 0.38 kilogram of zinc per square meter 1.25 ounces of zinc per square foot of two-sided surface. Provide mill-rolled structural steel that is hot-dip galvanized or primed and painted. Corrosion protect edges, burns, and scratches in galvanized surfaces. Provide primed and painted black carbon steel cabinet construction that complies with this specification.

Provide removable panels to access the interior of the unit cabinet. Provide seams that are welded, bolted or gasketed and sealed with a rubber-based mastic. Make entire floor as well as ceiling unit hot-dipped galvanized steel. Provide removable access doors on both sides of all access, filter, and fan sections for inspection and maintenance.

Where cabinet size is such that personnel access is possible, strengthen cabinet floor to permit entry without damage to any component. Hinge and latch access doors and panels at a spacing sufficiently close to preclude leaks caused by distortion, and effectively gasket.

[Make all door handles operable from inside the casing.]

Black carbon steel cabinet construction is acceptable when the following conditions are met:

Coat all interior and exterior surfaces, including lapped contacting surfaces, with a corrosion-protective coating.

Certify coating as passing a 500-hour exposure salt-spray fog test in accordance with ASTM B 117.

Immediately after completion of the test, provide a specimen that shows no signs of wrinkling, cracking or loss of adherence, and no signs of rust creepage beyond 3 millimeter 1/8 inch on either side of the scratch mark.

Ensure inspection of interior and exterior cabinet surfaces will pass examination for the same defects as the salt-spray fog test specimen, after 11 months of service and prior to expiration of guarantee.

Interior surfaces of cabinets constructed of intact mill-galvanized steel require no further protection.

Provide cabinets with exterior surfaces constructed of mill-galvanized steel that are [left unpainted] [painted] [prepared by a phosphatizing treatment, and painted with two coats of manufacturer's standard enamel finish in color selected by the Contracting Officer].

Provide cabinets and casings that are double walled with [25 mm1 inch][50 mm2 inch] [_____] insulation. Provide interior wall that is [stainless steel] [galvanized] [non-absorbent coating] [_____].

Dynamically and statically balance fan wheels at the factory. Provide fan with RPM that is 25 percent less than the first critical speed. Provide fan shaft that is solid, ground and polished steel and coated with a rust inhibitor. Provide V-belt driven fans that are designed for 50 percent overload capacity. For variable air volume air handling units that are provided with variable frequency drives, have their fans balanced over the entire range of operation (20 percent - 100 percent RPM). Balancing fans of only 100 percent design of RPM is not acceptable for air handling units to be used with variable frequency drives.

Mount fans on isolation bases. Internally mount motors on same isolation bases and internally isolate fans and motors with 50.8 millimeter 2-inch. Install flexible canvas ducts or vibration absorbent fan discharge seal between fan and casings to ensure complete isolation. Provide flexible canvas ducts that comply with NFPA 90A.

Weigh fan and motor assembly at air handling unit manufacturer's factory for isolator selection. Statically and dynamically balance fan section assemblies. Fan section assemblies include fan wheels, shafts, bearings, drives, belts, isolation bases and isolators. Allow isolators to free float when performing fan balance. Measure vibration at each fan shaft bearing in horizontal, vertical and axial directions.

Factory install all motors on slide bases to permit adjustment of belt tension.

Provide heavy duty, open drip-proof, operable at 460 volts, 60 hertz, 3-phase fan motors. Provide high efficiency motors. Refer to specification Section 26 05 70.00 40 HIGH-VOLTAGE OVERCURRENT PROTECTIVE DEVICES and Section 26 05 71.00 40 LOW-VOLTAGE OVERCURRECT PROTECTIVE DEVICES.

Provide a marine-type, vapor proof service light in the fan segment. Provide 100 watt service light that is wired to an individual switch. Light requires 115 Volt, single phase, 60 Hertz service that is separate from the main power to the AHU. Provide a single 115 volt outlet at the light switch.

2.3 FAN

Provide an overall fan-section depth that is equal to or greater than the manufacturer's free-standing fan.

[Provide single-wheel fans.]

Locate fan inlet where it provides not less than one-half fan-wheel

diameter clearance from cabinet wall or adjacent fan inlet where double wheels are permitted.

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NOTE: Where open or TEFC motor and bearing noise, belt noise, and thermal load of motor located within cabinet airstream is objectionable, select or revise one of the following two paragraphs.

****

Mount AHU fan drive external to casing.

Install AHU fan motor and drive inside fan cabinet. Provide motor that conforms to NEMA MG 1 and is installed on an adjustable base. Provide an access door of adequate size for servicing motor and drive. Provide a belt guard inside the cabinet, or interlock the access door with the supply fan so that power to the fan is interrupted when the access door is opened.

2.4 DRAIN PANS

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NOTE: Following coil drip-pan requirements are based on air velocities of 152 meter per second 500 feet per minutemaximum, normal size coils to 965 millimeter 38 inches height, latent to total loads not in excess of 33 percent.

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Provide intermediate-coil, 80 millimeter 3-inch deep drip pans for each tiered coil bank.

Extend top pan 300 millimeter 12 inches beyond face of coil, and extend bottom pan not less than 600 millimeter 24 inches beyond face of coil. Where more than two pans are used, make pan extension proportional. Make adequate supports from the same type material as pans or hot-dip galvanized angle iron with isolation at interface. Provide pan material that is 0.85 millimeter 22-gage AISI Type 304 corrosion-resistant steel with silver-soldered joints. Minimum size of drain opening is 32 millimeter 1-1/4 inches. Pipe pan to drain.

Extend integral cabinet drain pan under all areas where condensate must be collected and make watertight with welded or brazed joints, piped to drain, corrosion protect in condensate collection area, and insulate against sweating. Provide minimum 2.0 millimeter 14-gage sheet metal, except that 1.6 millimeter 16-gage double-drain-pan construction is acceptable.

Provide cooling coil ends that are enclosed by cabinet and are factory insulated against sweating or drain to a drain pan.

Provide drain pans that are double pan construction, thermally isolated from the exterior casing with 25.4 millimeter 1-inch thick fiberglass insulation. Provide drain pans that slope to drain and drain substantially dry by gravity alone when drains are open.

Provide pans that have a double slope to the drain point.

[Plastic drain pan material is allowed.]

2.5 INSULATION

[Provide unit that is internally fitted at the factory with a sound-attenuating, thermal-attenuating, fibrous-glass material not less than [50.8 millimeter 2 inch] thick with 37.6 millimeter 1-1/2 inch density neoprene coated fiberglass. Ensure insulation effectiveness precludes any condensation on any exterior cabinet surface under conditions normal to the unit's installed location. Provide acoustic treatment that attenuates fan noise in compliance with specified noise criteria. Apply material to the cabinet with waterproof adhesives and permanent fasteners on 100 percent coverage basis. Provide adhesive and insulating material in accordance with NFPA 90A.]

[Provide insulated plenums and bypasses.]

2.6 PLENUMS

[Provide plenums in the following minimum widths:

150 millimeter 6 inches for mounting temperature controls and to separate two or more coils of different size mounted in series

355 millimeter 14 inches between face and bypass dampers and upstream accessories and at change in cross section

600 millimeter 24 inches for access sections]

2.7 MULTIZONE AHU

[Provide multizone unit delivery dampers that are part of the manufacturer's standard unit construction and that meet the requirements specified under paragraph entitled, "Power-Operated Dampers," of Section 23 09 33.00 40 ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC.]

[Provide face and bypass dampers and multizone unit delivery dampers that are part of the manufacturer's standard unit construction and that meet the requirements specified under paragraph entitled, "Power-Operated Dampers," of Section 23 09 33.00 40 ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC.]

[Add a balancing plate to the heating coil when required to equalize resistance in airstreams of multizone units.]

2.8 BLOW-THROUGH AHU

[Fit blow-through AHU with pressure equalizing baffles.]

2.9 COILS

2.9.1 Coil Section

Provide coil section that encases cooling coils and drain pipes. Arrange coils for horizontal air flow. Provide intermediate drain pans for multiple coils installation. Completely enclose coil headers with the insulated casing with only connections extended through the cabinet.

2.9.2 Coil Pressure and Temperature Ratings

Provide coils that are designed for the following fluid operating pressures and temperatures:

SERVICE	PRESSURE	TEMPERATURE
Hot Water	200 PSI	250 degrees F
Chilled Water	200 PSI	40 degrees F

SERVICE	PRESSURE	TEMPERATURE
Hot Water	289 Pa	121 degrees C
Chilled Water	289 Pa	4 degrees C

Provide coils that are air-pressure tested under water at the following minimum pressures:

SERVICE	PRESSURE
Water (hot and chilled)	250 PSI

SERVICE	PRESSURE
Water (hot and chilled)	289 Pa

2.9.3 Coil Casings

Provide stainless steel casings. Provide cast iron, brass, or copper coil headers. Fit water coil headers with 6.35 millimeter .25 inch ops spring-loaded plug drains and vent petcocks. Provide automatic air vents with ball type isolation valves for each coil piped to the drain pan.

Provide coils that are factory tested, dehydrated, vacuum tested, purged with inert gas, and sealed prior to shipment to the job site.

2.9.4 Chilled Water coils

Provide 15.875 millimeter 0.625 inch outside diameter copper tubing for coils. Provide fins that are [aluminum] [copper] mechanically bonded by tubing expansion with a maximum spacing of 12 fins per 25.4 millimeter 1 inch unless otherwise noted. Provide coils that have supply and return connections on the same end. Provide a maximum of four coil rows.

2.9.5 Hot Water Coils

Provide heating coils that have copper tubing [aluminum] [copper] fins.

2.9.6 Drainable Coils

Provide drainable coils that are capable of being purged free of water with compressed air.

Provide self-draining coils that have a drain point at the end of every tube and are pitched to that point. Provide drain provisions that include: drained headers; U-bends with integral plugs; or nonferrous plugs in cast-iron headers. Provide tubes that drain substantially dry by gravity alone when drains and vents are open.

2.10 ELIMINATORS

Provide eliminators that are SMACNA three-break, hooked-edge design, constructed of reinforced 1.52 millimeter 16 gage galvanized steel with

assembled brazed joints. Provide easily removable eliminator sections for cleaning from side of the air handling unit without causing partial or complete disassembly of the Air Handler Unit casing.

2.11 FILTERS

2.11.1 Filter Housing

Provide factory fabricated filter section of the same construction and finish as unit casings. Provide filter sections that have filter guides and full height, double wall, hinged and removable access doors for filter removal. Provide air sealing gaskets to prevent air bypass around filters. Provide visible identification on media frames showing model number and airflow direction. Where filter bank is indicated or required, provide means of sealing to prevent bypass of unfiltered air. Performance in accordance with ASHRAE 52.1.

2.11.2 Replaceable Air Filters

UL 900, Class 1, those which, when cleaned, do not contribute fuel when attacked by flame and emit only negligible amount of smoke. Permanent frames with replaceable media, 25.4 millimeter 1-inch thickness and size as indicated.

2.11.3 Disposable Cartridge Air Filters

UL 900, Class 2, UL classified, and factory assembled. Provide media of ultra-fine glass fibers having 50-55 percent average dust spot efficiencies with maximum final resistance 19 millimeter 0.75 inch water gage and maximum face velocity of 152.4 meter 500 feet per minute. Construct filter frame of 1.21 millimeter 18 gage galvanized steel or aluminum with welded or riveted joints. Caulk or gasket entire assembly to prevent air leakage around frames. Ensure minimum efficiency of filter is 60 percent per ASHRAE 52.1

2.11.4 Outside Air Filters

The factory assembled air filters of the extended surface type with supported cartridges for removal of particulate matter in air conditioning, heating, and ventilating systems. Provide the extended surface type filter units fabricated for disposal when the dust-load limit is reached as indicated by maximum (final) pressure drop.

Filter Classification: UL approved for Class 1 or 2 conforming to UL 900.

Filter Grades, Nominal Efficiency and Application:

Grade B: 80-85 percent nominal efficiency afterfilter
Grade D: 25-30 percent nominal efficiency prefilter

Filter Media: Grade B Supported (Rigid Pleated) Type: Provide media that is composed of high density glass fibers or other suitable fibers. Fastening methods used to maintain pleat shape, seal aluminum separators in a proper enclosing frame to ensure no air leakage for life or filter. Staples and stays are prohibited.

Grade D Type: Provide media that is composed of synthetic/natural fibers. Bond a metal grid backing to the air leaving side of the media to maintain uniform pleat shape and stability for proper airflow and maximum dist

loading. Provide a media frame that is constructed of high strength moisture resistant fiber or beverage board. Bond the pleated media pack on all four edges to ensure no air leakage of the life of the filter. Staples and stays are prohibited.

Filter Efficiency and Arrestance: Determine efficiency and arrestance of filters in accordance with ASHRAE 52.1 Standard Atmospheric dust spot efficiency and synthetic dust weight arrestance that is not less than the following:

	Initial Efficiency (Percent)	Average Efficiency (Percent)	Average Efficiency (Percent)
Grade B	58	79	98
Grade D	Less than 20	22	89

Maximum initial and final resistance, inches of water gauge, for each filter cartridge when operated at 152.4 meter 500 feet per minute face velocity:

	Initial Resistance	Final Resistance
Grade B (Rigid Pleated)	0.60	1.00
Grade D (2 inches Deep)	0.32	0.70
Grade D (50.8 millimeter)	0.32	0.70

Dust Holding Capacity: When tested to 1.00 inch w.g. at 500 feet per minute face velocity, provide a dust holding capacity from each 24-inch by 24-inch (face area) filter at least equal to the values listed below. For other filter sizes, provide a dust holding capacity that is proportionally higher or lower.

Grade B (Rigid Pleated)	6.17 ounces
Grade D (2 inches Deep)	2.29 ounces
Grade D (4 inches Deep)	10.58 ounces

Grade B (Rigid Pleated)	175 grams
Grade D (50.8 millimeter Deep)	150 grams
Grade D (100.16 millimeter)	300 grams

Minimum Media Area: Provide minimum net effective area in square feet for each 24-inch by 24-inch (face area) filter at 500 feet per minute face velocity of at least the values listed below. For other filter sizes, provide a net effective media that is proportionally higher or lower.

Grade B (Rigid Pleated)	57.0
Grade D (2 inches Deep)	14.8

2.11.5 Air Filter Gauges

Provide manometer air filter gauges of the inclined tube differential type, of solid acrylic plastic construction with built-in level vial and with an adjustable mirror-polished scale. Equip gauges with vent valves for zeroing and over-pressure safety traps. Provide adequate gauge range for the particular installation. Provide gauges manufactured by Dwyer or approved equal.

Provide one (1) air filter gauge at each filter bank.

PART 3 EXECUTION

3.1 AHU EQUIPMENT INSTALLATION

Install equipment in accordance with manufacturer's recommendations.

Provide Installation drawings in accordance with referenced standards in this section.

Submit Listing of Product Installations for air handling units showing a minimum of 5 installed units, similar to those proposed for use, that have been in successful service for a minimum period of 5 years. Provide list that includes purchaser, address of installation, service organization, and date of installation.

3.2 VIBRATION ANALYZER

Use an FFT analyzer to measure vibration levels. The following characteristics are required: A dynamic range greater than 70 dB; a minimum of 400 line resolution; a frequency response range of 5 Hz-10 KHz(300-600000 cpm); the capacity to perform ensemble averaging, the capability to use a Hanning window; auto-ranging frequency amplitude; a minimum amplitude accuracy over the selected frequency range of plus or minus 20 percent or plus or minus 1.5 dB.

Use an accelerometer, either stud-mounted or mounted using a rare earth, low mass magnet and sound disk (or finished surface) with the FFT analyzer to collect data. Ensure the mass of the accelerometer and its mounting have minimal influence on the frequency response of the system over the selected measurement range.

3.3 ACCEPTANCE

Prior to final acceptance, use dial indicator gages to demonstrate that fan and motor are aligned as specified.

Prior to final acceptance, verify conformance to specifications using vibration analysis. Ensure maximum vibration levels are .075 in/sec at 1 times run speed and at fan/blade frequency, and .04 in/sec at other multiples of run speed.

3.4 AHU TESTING

Performance test and rate AHU and components in accordance with AMCA 211 and ASHRAE 51. Provide AHU ratings in accordance with AHRI 430.

Provide final test reports to the Contracting Officer. Provide reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

Perform air handling unit start-up in the presence of the Contracting Officer.

3.5 OPERATION AND MAINTENANCE

Submit Operation and Maintenance Manuals prior to testing the air handling

units. Update and resubmit data for final approval no later than 30 calendar days prior to contract completion.

3.6 COORDINATION

Coordinate the size and location of concrete equipment pads, variable frequency drives, control and electrical requirements.

3.7 TEMPORARY CONSTRUCTION FILTERS

Have temporary construction filters in place during normal building construction whenever the air handling units are run for general ventilation, building dehumidification, and for other purposes during construction. Install two (2) layers of blanket filter at a time. Replace temporary construction filters as required during construction and after completion of duct system cleaning.

After systems have been cleaned and temporary construction filers are removed, and before test and balance operations are started, install set of final filters. Do not have final filters in place while general building construction is taking place, to avoid unnecessary loading with construction dust. Clean permanent filter bank before testing and balancing.

Submit all required installation, Fabrication and Connection drawings and obtain approval prior to the start of work detailed on these drawings.

[Perform operation tests on each fire damper in the presence of the Contracting Officer by removing the fusible link and demonstrating the operation of the damper.]

Maximum number of coil rows is four (4). Maximum number of fins per inch is ten (10).

Provide VAV terminal units that are AHRI 880 certified and UL listed.

-- End of Section --