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NAVFAC IGS-15720 (MAY 2002)  
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Preparing Activity: LANTNAVFACENGCOM Based on UFGS-15720N

ITALIAN GUIDE SPECIFICATIONS

Use for ITALIAN projects only

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SECTION 15720

AIR HANDLING UNITS

05/02

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NOTE: This guide specification is issued by the Atlantic Division, Naval Facilities Engineering Command for regional use in Italy.

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NOTE: This guide specification covers requirements for air handling equipment including central-station air handlers, fans, (centrifugal fan, propeller fan, vaneaxial fan, power ventilator, in-line tubular centrifugal fan, propeller ceiling fan, and air curtain), gravity ventilators, fan-coil room units, room air-induction units, variable-air -volume terminal units, and unit ventilators. It does not cover and should not be used for local exhaust systems. It may be used for fresh air supply or make-up portion of local exhaust system. Local exhaust systems are appropriate for the containment or removal of contaminants encountered in hazardous work place atmospheres. Consult Section 11501, "Industrial Ventilation and Exhaust Systems (Ducts and Fans)," for guidance regarding local exhaust systems. Noise levels of all equipment shall not exceed 84 dBA on an 8 hour time weighed average. See OPNAVINST 5100.23B, paragraph entitled "Permissible Exposure Limit (PEL)."

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Comments and suggestion on this specification are welcome and should be directed to the technical proponent of the specification. A listing of the technical proponents, including their organization designation and telephone number, is on the Internet.

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

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NOTE: The following information shall be shown on the project drawings:

1. Arrangement plan and details for air handling equipment and accessories.
2. Equipment schedules with sound ratings or loudness level, electrical characteristics, capacities.
3. Equipment foundations, supports, and vibration isolators.

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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 in the text by the basic designation only.

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 430 (1989) Central-Station Air-Handling Units

ITALIAN ELECTROTECHNICAL COMMITTEE (CEI)

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NOTE: A CEI Norm is an Italian technical normative for electrical systems recognized by Italian Law, submitted by a private organization "Comitato Elettrotecnico Italiano" for the Italian territory, available in the Italian language and in some cases (but not all) in English.

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CEI 64-8 (1998-01) Electrical installations of buildings (Parts 1 thru 8)

ITALIAN NATIONAL ASSOCIATION FOR UNIFICATION OF STANDARDS (UNI)

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NOTE: A UNI Norm is a technical normative recognized as Italian Law, submitted by a private organization "Ente Nazionale Italiano di Unificazione" for Italy and is available only in the Italian language. It is the National Standard.

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- UNI 9511/1 (1989) Technical drawings - Representation of installations - Graphical symbols plumbing, heating, ventilation and ducting
- UNI 10339 (1995) Air-conditioning systems for thermal comfort in buildings - General, classification and requirements - Offer, order and supply specifications
- UNI 10531 (1995) Industrial fans - Performance testing using standardized airways.

ITALIAN/EUROPEAN HARMONIZATION STANDARDS (UNI EN)(UNI ENV)(CEI EN)  
(UNI EN ISO)

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**NOTE: A UNI EN, UNI ENV, CEI EN, UNI EN ISO or UNI ISO is a European Standard with a coincident Italian National Standard or International Standard. The two standards are identical, with most (but not all) EN's available in the English language and the UNI available only in the Italian language.**

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- UNI ENV 328 (1993) Heat exchangers - Test procedures for establishing performance of unit air coolers for refrigeration
- UNI EN 779 (1993/AC:1994) Particulate air filters for general ventilation - Requirements, testing, marking.
- UNI EN 1216 (1998) Heat exchangers - Forced circulation air-cooling and air-heating coils - Test procedures for establishing the performance
- UNI ENV 1363-3 (2000) Fire resistance tests - Verification of furnace performance
- UNI EN 1397 (1998) Heat exchanges - Hydronic room fan coil units - Test procedures for establishing the performance
- UNI EN 1505 (1997) Ventilation for buildings - Sheet metal air ducts and fittings with rectangular cross section - Dimensions
- UNI EN ISO 4535 (1998) Vitreous and porcelain enamels - Apparatus for determination of resistance to hot detergent solutions used for

washing textiles.

UNI ISO 5135 (1992) Acoustics - Determination of sound power levels of noise from air terminal devices, air-terminal units, dampers and valves by measurement in a reverberation room

UNI ISO 5136 (1993) Acoustics - Determination of sound power radiated into a duct by fans - In-duct method.

UNDERWRITERS LABORATORIES INC. (UL)

UL 507 (1999; Bul. 1999 & 2000) Electric Fans

UL 705 (1994; Bul. 1994, R 1996) Power Ventilators

1.2 RELATED REQUIREMENTS

Section 15050, "Basic Mechanical Materials and Methods," applies to this section with the additions and modifications specified herein.

1.3 SUBMITTALS

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NOTE:

Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item is required.

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, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Recommended codes for Army projects are "RE" for Resident Engineer approval, "ED" for Engineering approval, and "AE" for Architect-Engineer approval. Codes following the "G" typically are not used for Navy projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

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Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Packaged air handling units

Centrifugal fans

Propeller fans

Vaneaxial fans

Power [roof] [and] [wall] ventilators

In-line tubular centrifugal fans

Air-circulating fans

Air curtains

Fan-coil units

Gravity ventilators

Variable-air-volume (VAV) terminal units

Series fan powered variable air volume (VAV) terminal units

Roof curbs

Electrostatic (Ionizing) air filters

Include certified fan performance curves, coil selections, sound rating data and sound power level for all octave-band center frequencies or loudness level.

Corrosion protection

SD-07 Certificates

Certificate of Coating Specification Compliance

SD-08 Manufacturer's Instructions

Packaged air handling units - installation instructions

Vaneaxial fans - installation instructions

Power [roof] [and] [wall] ventilators - installation instructions

In-line tubular centrifugal fans - installation instructions

Variable-air-volume (VAV) terminal units - installation instructions

Series fan powered variable air volume (VAV) terminal units - installation instructions

Roof curbs - installation instructions

#### SD-09 Manufacturer's Field Reports

[Packaged air handling units - field test plan; equipment greater than 944 L/S 2,000 cfm.]

[Packaged air handling units - field acceptance test report; equipment greater than 944 L/S 2,000 cfm.]

#### SD-10 Operation and Maintenance Data

Packaged air handling units, Data Package 3

Centrifugal fans, Data Package 3

Propeller fans, Data Package 3

Vaneaxial fans, Data Package 3

Power [roof] [and] [wall] ventilators, Data Package 3

In-line tubular centrifugal fans, Data Package 3

Air-circulating fans, Data Package 3

Air curtains, Data Package 3

Fan-coil units, Data Package 3

Gravity ventilators, Data Package 2

Variable-air-volume (VAV) terminal units, Data Package 2

Series fan powered variable air volume (VAV) terminal units

Electrostatic (Ionizing) air filters, Data Package 2

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data."

## PART 2 PRODUCTS

### 2.1 SOURCE MANUFACTURERS

2.1.1 Air Handling Units

The following manufacturers make air handling unit components and systems that generally comply with these specifications:

CARRIER S.p.A.  
Via R. Sanzio, 9  
20058 Villasanta (MI)  
Tel: 039/36361  
Fax: 039/3636432

SABIANA S.p.A.  
Via Poave, 53  
20011 Corbetta (MI)  
Tel: 02/9777021  
Fax: 02/9777281

TRANE ITALIA S.r.l.  
Via Enrico Fermi, 21/23  
20090 Assago (MI)  
Tel: 02/457951  
Fax: 02/4880170

WOODS ITALIANA S.p.A.  
Via Monte Nero, 55  
20092 Cinisello Balsamo (MI)  
Tel: 02/6172591  
Fax: 02/6185992

2.2 FANS

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**NOTE: Indicate sound ratings or loudness level of  
equipment in the Equipment Schedule on the drawings.**  
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Total sound power level of the fan shall not exceed 90 dBA when tested per UNI ISO 5136; statically and dynamically balanced. Fan bearing life shall have a minimum average life of 200,000 hours at design operating conditions. [Equip with automatic (backdraft) dampers where indicated.] Construct housings and impellers of steel, except as specified otherwise. For wiring terminations, provide terminal lugs to match branch circuit conductor quantities, sizes, and materials. Enclose terminal lugs in terminal box sized to CEI 64-8.

Scheduled fan performance is the performance required under indicated installation conditions. Equipment shall be rated for these conditions. Fan shafts shall be solid steel, ground and finished as required for the service indicated, with the first critical speed a minimum 25 percent higher than cataloged fan speed. Vibration isolation mountings shall be spring type and shall limit vibration transmissibility to a maximum 5 percent of the unbalanced force at the lowest equipment speed, unless otherwise specified or indicated.

2.2.1 Centrifugal Fans

UNI 10531. [Spark-proof.] Impeller shall be constructed of steel with smooth curved rim, back plate, blades, and cast iron or cast steel hub riveted to back plate and keyed to shaft with set screws. Provide centrifugal type exhaust fans with aluminum housing, fan wheel, and bird screen. [Provide nominal 2 mesh 1.60 mm wire diameter, stainless steel bird screens for outdoor [inlets] [and] [outlets].] Motors shall be completely shielded from the airstream. Provide exhaust opening and gravity closing type automatic backdraft dampers. [Provide roof curb for roof mounted exhaust fans as recommended by fan manufacturer.] [Provide with] [disconnect] [and] [speed controller].

2.2.2 Propeller Fans

UNI 10531. Provide shaped steel or steel reinforced aluminum blade impeller with heavy hubs, statically and dynamically balanced, locked to shaft. Provide [direct-connected motor.] [or] [v-belt driven with external belt guards and adjustable motor mounts.] Provide with fan guard, [disconnect] [and] [backdraft damper.]

2.2.3 Vaneaxial Fans

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**NOTE: Use automatically variable speed motor or adjustable variable pitch blades for vaneaxial return fans in VAV systems.**  
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UNI 10531, [direct-drive motors of totally-enclosed air-cooled (TEAC) type] [V-belt drive motors, adjustable, with external belt guards]. Provide with adjustable die cast aluminum alloy air-foil impeller blades. Die cast aluminum alloy or cast iron hub with diameter of the fan hubs at least equal to that of the motor frame. In the fan nameplate data, include the factory blade setting and the maximum setting for the motors. Guide vanes, adjustable inlet vanes, inlet bell, and outlet cones shall be constructed of steel. [Provide galvanized steel welded grid inlet screens to fit inlet bell.]

2.2.4 Power [Roof] [and] [Wall] Ventilators

UL 705 with UL label and UNI 10531, fans in spun aluminum housings. Equip motors with unfused safety disconnect switches [mounted under fan housings] and resilient mounts. [Mount motors out of air stream.] [Provide factory-fabricated roof curbs with continuous curb gaskets and aluminum bird screen.] [Provide gravity actuated, aluminum multiple blade construction backdraft damper and cast iron or steel sheaves, dynamically balanced and bored to fit shafts and keyed.]

2.2.5 In-Line Tubular Centrifugal Fans

UNI 10531, welded tubular steel casings, stationary discharge conversion vanes, belt guards, and adjustable motor-mounts. Provide slip-fit or flanged connections between fan casings and ductwork. Air shall enter and

leave fans axially. Streamline inlet with conversion vanes . Enclose and isolate fan bearings and drive shafts from air stream. . Provide welded steel casings, [steel centrifugal backward inclined blades, ][steel stationary discharge conversion vanes,] [internal and external belt guards and adjustable motor mounts] [direct drive]. [Provide guards for discharges.] [Fan ratings shall be with guards in place.] [Air shall enter and leave the fan axially.] Inlet shall be streamlined [and conversion vanes shall eliminate turbulence and provide smooth discharge airflow.] Fan bearings shall be mechanically sealed against dust and dirt and shall be self-aligning, pillow block ball or roller type. Motor and drive shall be provided by fan manufacturer. [Provide with] [disconnect,] [speed controller,] [backdraft damper,] [and] [vibration isolated hanging rod and hardware].

#### 2.2.6 Utility Set(s)

UNI 10531. Provide single width, single inlet blower with backward inclined, non-overloading centrifugal wheel constructed of heavy gage steel. The housing shall be of heavy gage steel with airtight lock seam construction. Provide a weatherhood to protect the motor and drive. Provide [direct drive] [or] [v-belt driven] [exhaust] [and] [supply] fans [as indicated]. [Belt driven fans shall be provided with an adjustable motor plate.] [Provide with [disconnect,] [manual starter switch,] [vibration isolators,] [and] [backdraft damper].]

#### 2.2.7 Air Circulating Fans

UL 507 and UL listed ceiling hugger type fans for close-to-ceiling installation, minimum of four 1320 mm 52 inch diameter fan blades, three-speed pull chain fan motor switch, reversing switch, and light kit adaptable. Provide special fan support including metal electrical ceiling outlet box designed to support the weight of the fan and light assembly, and to prevent fan wobbling and vibrating at all fan speeds. Secure fan support with minimum of two metal hex head screws for each connection. Provide white opal glass schoolhouse type globe light kit to match fan.

#### 2.2.8 Air Curtains

UNI 10531, factory-fabricated, [insect] [thermal] control type, angle adjustment feature, minimum air velocity [3] [8] meter per second (m/s), measured at points one meter above the floor, and minimum air capacities and electrical characteristics.

### 2.3 PACKAGED AIR HANDLING UNITS

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**NOTE: Unitary air conditioning equipment with direct expansion coil are covered by Section 15730, "Unitary Air Conditioning Equipment." Fan-coil units are covered in EN 1397. In the industry, the provision of heating and cooling sections may be added by being rated separately, with coils per UNI EN 1216, electric heaters per CEI 64-8, or gas-fired heaters per UNI 7414 FA 131-84.**

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NOTE: Indicate sound ratings or loudness level of equipment in the Equipment Schedule on the drawings.

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NOTE: A 20 ton rated air-handling unit located on the facility roof should be mounted on its own structural steel skid which in turn is supported by spring isolators from structural roof framing. Designers should determine from equipment manufacturers the most practicable method of mounting the equipment on the roof and indicate the configuration on the design drawings.

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ARI 430 with sound rating in accordance with UNI 10531, [[single-] [multi-] zone] [or] [double-deck] type, sound power level, and static pressure, as indicated. Include damper section, supply blower section, filter section with mixing box section or combination filter-mixing box section, and [coil] [or] [heater] section. Filters, housing coils, and heaters must be completely removable from the unit without having to dismantle the unit or adjacent equipment.

### 2.3.1 Casings

Construct casings of steel, galvanized steel, or aluminum on channel base [and drain pan] coated externally with manufacturers standard paint finish.

Provide removable panels and access doors for inspection and access to internal parts. Insulate casings with manufacturer's standard materials. For outdoor roof mounted units, provide weatherproof casing in accordance with paragraph entitled "Testing for Corrosion Protection." Finish with seal joints, [stationary] [adjustable] galvanized steel louvers with bird screen, and bearing UNI ISO 5135.

### 2.3.2 Dampers

Provide with factory mounted [outside and return air dampers in mixing boxes] [face and bypass dampers] [multi-zone dampers] of galvanized steel blades, [with vinyl bulb edging] [and edge seals] in galvanized frame, in [parallel] [opposed] blade arrangement with non-slip keyed connecting rods and linkages. Permanently secure damper blades on a single shaft with self-lubricating [nylon] [brass] [oil impregnated bronze] bearings. Position damper blades across short air opening dimension. Maximum leakage is 2 percent at 1000 Pa gage differential pressure when sized for 10 m/s face velocity.

### 2.3.3 Supply Fans

#### 2.3.3.1 Double Width Double Inlet (DWDI), Housed Centrifugal Type

- a. Fans shall deliver performance specified in the air handling unit

schedule and shall be UNI 10531 DWDI. Fan wheels shall be backward inclined or backward inclined air foil type. At rated capacity, the unit shall not exceed sound power levels and surrounding space NC levels as specified in the air handling unit schedule.

- b. Fan wheel diameters shall be in accordance with the standard sizes adopted for non-overloading fans. Inlets shall be fully streamlined. Blades shall be welded to backplate and welded to wheel cone. Wheels shall be statically balanced prior to assembly and dynamically balanced as an assembly at the factory at design RPM prior to shipment. Fans shall be balanced at design RPM to a total displacement of less than 1 mil measured at each bearing pad prior to shipment with belts and drives in place.
- c. Fan shafts shall be solid steel machined to standard diameters and tolerances for turned, ground and polished shafts. Center shall be provided at one end of shaft for tachometer reading. Fan shaft shall be designed to be a minimum of 29 percent below critical speed at design RPM. Fan wheels and drive sheaves shall be key-seated to fan shaft.
- d. Fan bearings shall be of spherical roller type mounted in self-alignment split pillow blocks and pre-lubricated with No. 2 consistency lithium base grease. Bearings shall be minimum 200,0000 hour L-50 average life. Lube line shall be extended to drive side of unit near access door. Positive locking to shaft shall be provided by means of a tapered adapter, lock nut and lockwasher. Bearings shall be installed to close tolerances at the factory and shall require no field adjustments.
- e. All bushings, sheaves and belts necessary for fans to achieve design performance shall be factory selected and installed. All drives shall be sized for a service factor of 1.5 (minimum) times the fan motor horsepower. Multiple groove V belts consisting of matched belts permanently tied together with a tie-band shall be supplied. Provide variable pitch adjustable sheave for motor with scheduled fan speed at mid-point. Provide one spare set of v-belts for each fan.
- f. The fan assembly, complete with motor and drive, shall be mounted on a heavy steel base completely isolated from air handling unit casing. Seismically restrained spring type vibration isolators (5 cm deflection) shall be provided to support the fan assembly and isolate all rotating parts. All spring isolators shall be capable of 30 percent over travel before becoming solid and shall be designed stable for a minimum KX/KY (horizontal to vertical spring rate) of 1.0. Provide flexible fan connection and snubber springs at fan discharge.

#### 2.3.3.2 Single Width Single Inlet (SWSI), Plug Type Supply Fans

- a. Fans shall deliver performance specified in the air handling unit schedule and shall be UNI 10531 air foil plug type accepted. Fan

wheels shall operate to pressurize an acoustical plenum to provide uniform discharge velocity profiles and to allow even face velocities across and through the cooling coil. At rated capacity, the unit shall not exceed sound power levels and surrounding space NC levels as specified in the air handling unit schedule.

- b. Backward inclined air foil blade wheel diameters shall be in accordance with the standard sizes adopted for non-overloading fans. Inlets shall be fully streamlined. Blades shall be welded to backplate and welded to wheel cone. Wheels shall be statically balanced prior to assembly and dynamically balanced as an assembly at the factory at design RPM prior to shipment. Fans shall be balanced at design RPM to a total displacement of less than one mil measured at each bearing pad prior to shipment with belts and drives in place.
- c. Fan shafts shall be solid steel machined to standard diameters and tolerances for turned, ground and polished shafts. Center shall be provided at one end of shaft for tachometer reading. Fan shaft shall be designed to be a minimum of 29 percent below critical speed at design RPM. Fan wheels and drive sheaves shall be key-seated to fan shaft.
- d. Fan bearings shall be of spherical roller type mounted in self-alignment split pillow blocks and pre-lubricated with No. 2 consistency lithium base grease. Bearings shall be minimum 200,000 hour L-50 average life. Lube line shall be extended to drive side of unit near access door. Positive locking to shaft shall be provided by means of a tapered adapter, lock nut and lockwasher. Bearings shall be installed to close tolerances at the factory and shall require no field adjustments.
- e. All bushings, sheaves and belts necessary for fans to achieve design performance shall be factory selected and installed. All drives shall be sized for a service factor of 1.6 (minimum) times the fan motor horsepower. Multiple groove V belts consisting of matched belts permanently tied together with a tie-band shall be supplied. Provide variable pitch adjustable sheave for motor with scheduled fan speed at mid-point.
- f. The fan assembly, complete with motor and drive, shall be mounted on a heavy steel base. Open spring type vibration isolators (5 mm deflection) shall be provided which support the fan assembly and isolate all rotating parts. All spring isolators shall be capable of 30 percent over travel before becoming solid and shall be designed stable for a minimum KX/KY (horizontal to vertical spring rate) of 1.0.
- g. Plug fan modules shall be provided with an expanded metal door guard to prevent unauthorized entry to the fan module.

#### 2.3.4 Vibration Isolation

For the entire fan, motor, and drive assembly, provide 50 mm nominal deflection spring vibration isolators, internally mounted at the factory together with fan discharge flexible connection and thrust restraint springs. As an alternate, vibration isolation may be provided external to air handlers. When alternate is chosen, provide 50 mm nominal deflection springs, pipe and duct flexible connections, thrust restraint springs, and spring type pipe hangers on pipes directly-connected to such air handlers.

2.3.5 Filter Sections

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NOTE: Provide two sets of filters for application requiring high infiltration efficiency above 85 percent. Prefilters shall be viscous or dry throw-away type, 60 percent minimum efficiency ; after-filters shall be of dry media type, absolute, or electrostatic precipitators. The following may be used as a guide only; selection of filters should suit the project requirements.

1. General Application:

Air Handling Type	m/3 Range	Filter Type
Factory-fabricated dry type throw-away	Up to 4,000	Viscous or
Factory-fabricated automatic replaceable filter media	Above 4,000	Dry type
Field-fabricated type replaceable filter media	-----	Dry type automatic

2. Hospitals:

See NAVFACINST 11012.143A, FAC 0441A, 31 November 1981, "Design Criteria Guidance for Medical Facilities."

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[Protect permanent holding frames with rust inhibitor coating.] Provide visible identification on media frames showing model number and air-flow direction. [Where filter bank is indicated or required,] provide means of sealing to prevent bypass of unfiltered air. Except extended media with self-supporting cartridge and high efficiency particulate filters, performance shall be determined in accordance with UNI EN 779. [Provide inclined-type manometers for filter stations of 944 liter per second (L/s) capacity or more, including filters furnished as integral parts of

air-handling units. Manometers with 3 mm graduations and spirit level shall be of sufficient length to read at least 76 mm water gage. Equip with over-pressure safety traps and three-way vent valves.]

#### 2.3.5.1 Replaceable Air Filters

UNI EN 779, [those which, when clean, do not contribute fuel when attacked by flame and emit only negligible amount of smoke] [, those which, when clean, burn moderately when attacked by flame or emit moderate amount of smoke, or both], [throw-away frames and media] [permanent frames with replaceable media], [25 mm] [50 mm] nominal thickness, and size as indicated.

#### 2.3.5.2 Cleanable Air Filters

UNI EN 779, [those which, when clean, do not contribute fuel when attacked by flame and emit only negligible amount of smoke] [ those which, when clean, burn moderately when attacked by flame or emit moderate amount of smoke, or both], [adhesive coated media] [dry media], and size indicated. [Provide washing-and-charging tank for every 100 filter sections or fraction thereof.] [Furnish adhesive oil in 19 liters containers sufficient for 12 cleaning operations but not less than one liter per filter section.]

#### 2.3.5.3 Disposable Cartridge Air Filters

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**NOTE: Disposable cartridge are filters with efficiencies of 85 to 95 percent and electrostatic air filters are intended for uses only in instrument shops, hospitals, certain laboratories, and other special buildings where extreme cleanliness is required.**  
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UNI EN 779, and factory assembled. Provide filter media of [cotton and synthetic fibers] [ultra-fine glass fibers] having [35 to 40] [50 to 55] [80 to 85] [90 to 95] percent average dust spot efficiencies with maximum final resistance [188] [250] [300] Pa gage and maximum face velocity 3 m/s. Construct filter frame of 1.519 mm sheet steel or 1.60 mm aluminum with welded or riveted joints. Calk or gasket entire assembly to prevent air leakage around frames.

#### 2.3.5.4 Extended Media (Pleated) Air Filters

UNI EN 779 [, permanent holding frame] and [filter housing with factory-assembled [side] [or] [bottom] access]:

[a. Pre-Filter: [Externally supported] [or] [nonsupported (internally supported)] cartridge.  
Efficiency: [20] [30] [40] percent rated.  
Pre-Filter Track: Required.]

[b. After-Filter: [Externally supported] [or] [nonsupported]

(internally supported)] cartridge.  
Efficiency: [85 (Grade C)] [95 (Grade D)] percent rated.]

[b. After-Filter: Self-supporting cartridge.  
Efficiency: 95 (Grade E) percent rated on standard  
dioctyl-phthalate (DOP) Test with 0.3 micron diameter particles.]

2.3.5.5 High Efficiency Particulate (HEPA) Air Filters

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**NOTE: Use high efficiency particulate air filters  
in "white" room, dust-controlled facilities, medical  
facilities, and clean work stations.**  
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Minimum 99.97 percent efficiency to remove 0.3-micron diameter particles. Construct filters of continuously pleated filter-media of honeycomb design or separated by corrugated inserts. Correct overall frame dimensions and squareness to zero, minus 3 mm to plus 3 mm, respectively. Provide airtight joints with frame retainers and gaskets. Air capacity and normal depth of the filters shall be as indicated.

2.3.5.6 Filter Housing

Minimum thickness, 1.897 mm thick steel with baked finish inside and out. Joints shall be continuously welded. Flange shall have a fixed air sealing gasket with hollow cross section, closed cell rubber or resilient neoprene, suitable for repetitive reuse. Cabinets shall have flanged ends for connection to adjacent ducts. Hinged access doors on both cabinet sides. Provide access doors with fixed air sealing gaskets to be airtight at the static pressure expected in service. Provide two 10 mm flare connection test ports complete with seal cap, one on each side of the filter. Weld test ports into each filter cabinet or plenum. Test port shall not penetrate to filter frame or media.

2.3.5.7 Odor Control

Factory-fabricated, charcoal type with multiple-cells of porous activated carbon. Construct each filter cell with trays to retain the activated carbon and with means to prevent the by-passing of air. Construct filter frames of rigid and corrosion resisting materials.

2.3.6 Mixing Boxes

Include equally sized openings, sized to individually handle full air flow capacity. Provide [automatic] [or] [manual] dampers.

2.3.7 Outside-Air Intake

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**NOTE: Delete this paragraph if the central station  
air handlers are not roof top units.**  
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Provide each roof top unit with a unit-mounted louver, built-in rain lip, and bird screen.

#### 2.3.8 [Heating] [and] [Cooling] Sections

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NOTE: ARI 210, 240, or 360, unitary air conditioning equipment with direct expansion coil are covered by Section 15730, "Unitary Air Conditioning Equipment." Fan-coil units are covered in EN 1397. For other exclusions, see ARI 430. In the industry, the provision of heating and cooling sections may be added by being rated separately, with coils per UNI ENV 1216, electric heaters per CEI 64-8, or gas-fired heaters per UNI 7414 FA 131-84.  
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##### 2.3.8.1 Coils

Provide removable coils per UNI ENV 328, UNI EN 1216 and UNI ENV 1363-3 with access to both sides. Enclose [heating] [and] [cooling] coils in a common or individual casing with headers and return bends [exposed outside] [fully contained within] casing. [Cooling coils shall have drain pans with threaded piping connections to remove condensate. Drains pans shall be insulated adequately with water impervious insulation to prevent condensation on its surace.] Seal coils to casing to prevent leakage of air around coils. [Provide face and bypass dampers to regulate the proportions of conditioned and unconditioned air delivered.]

##### 2.3.8.2 Heaters

[Electric heaters per CEI 64-8. Elements shall be [nickel chromium alloy] [\_\_\_\_\_] [manufacturer's standard]. Heater elements shall cover at least 70 percent of air outlet area to minimize bypass air and reduce surface temperature.] [Construct heat exchanger of minimum 1.588 mm thick stainless steel. Provide electric ignition type burners.]

##### 2.3.8.3 Eliminators

Equip each cooling coil having an air velocity of over 2 m/s through the net face area with moisture eliminators, unless the coil manufacturer guarantees, over the signature of a responsible company official, that no moisture will be carried beyond the drip pans under actual conditions of operation. Construct of minimum [0.711 mm zinc-coated steel] [0.511 mm copper] [0.511 mmcopper nickel] [or] [0.635 mm stainless steel], removable through the nearest access door in the casing or ductwork. Eliminators shall have not less than two bends at 0.785 rad and shall be spaced not more than 63 mm center-to-center on face. Each bend shall have an integrally formed hook as indicated in the UNI EN 1505.

##### 2.3.8.4 Drip Pans

Provide each cooling coil section in both field-and-factory assembled

casings with a 1.270 mm stainless or 1.321 mm galvanized steel drip pan with threaded drain connections. Drip pans shall collect, confine, and dispose of all condensate from cooling coils and attachments, including headers, return bends, distributors, and uninsulated pipe and fittings. Where individual eliminator blades are in section (not in one piece from top to bottom of coil bank), provide auxiliary drip troughs at bottom of each section with drains to drip pans. Insulate drip pans with water impervious insulation of sufficient thickness to prevent condensate formation on the exterior at ambient conditions to be encountered.

2.3.9 Sprayed Coil Dehumidifiers

Provide assembly with reinforced, braced, and externally insulated galvanized steel casing, vertical in-line spray pump, bronze self-cleaning spray nozzles, galvanized steel pipe spray headers. adjustable float valve with replaceable neoprene seat, manufacturer's standard cooling coil, and welded black steel drain tank. Provide overflow drain, make-up, and bleed connection.

2.3.10 Humidifiers

Factory-assembled, single or multiple units as required to obtain the capacities indicated.

2.3.10.1 Evaporative Pan

Units shall have submerged [steel coils] [or] [electric heating elements] to evaporate water from pans into the surrounding air. [Steam coils shall be of copper construction with pan of copper or stainless steel.] Provide low water cut-off switch.

2.3.10.2 Steam Grid

\*\*\*\*\*  
**NOTE: Steam containing amines should not be injected directly into the air stream. A dedicated "clean steam" boilers is recommended to supply steam to this equipment.**  
\*\*\*\*\*

Units shall inject steam directly into the air stream. Factory mounted [in plenum with drain pan for draw-thru units] [in diffuser section of blow-thru units].

- a. For single grid units, equip each unit with a single [copper] [galvanized steel] distribution grid with pipe connection on one end and cap on the other end. Evenly space orifices along grid length. Provide automatic steam control valve and condensate traps. House grid in [copper] [galvanized steel] enclosures with built-in condensate drain connection for enclosed-grid type and wrap grid with wicks for exposed-grid type.
- b. For packaged units, equip each unit with provisions to trap out and re-evaporate condensate and to supply dry steam for a single

distribution grid. Provide modulating [electric] [electronic] [or] [pneumatic] steam-control valve, steam-jacket with condensate drain, and condensate trap.

- c. Electronic Electrode Steam Units: Self-contained, electronic steam generators with steam output as indicated and equipped with disposable tank. Provide each unit with a solid state energy saving control circuit to control steam output and compensate for changing water conditions without chemical additives. Include an integral control and monitoring panel, with a capacity meter, a "change cylinder (container)" indicator, a capacity adjustment control adjusting from 20 to 100 percent of rated output capacity, an on-off drain switch, and an on-auto push button with indicator light. Equip each unit with double-wall insulated steam supply hose, a steam distributor, an automatic fill with cleanable strainers, or an automatic drain valve.

#### 2.3.10.3 Mechanical Water-Spray

Equip each unit with a water reservoir with float-controlled makeup valve, inlet and overflow connections, motor-driven fan, and [centrifugal atomizing-disk] [or] [water pump with atomizing breaker-device]. Distribute air steam [radially in each directions] [or] [in one or two directions]. Provide air filters of humidifier-manufacturer's standard and nonferrous parts in contact with water. Fan shall have fractional horsepower motor with stainless steel shaft.

#### 2.3.10.4 [Atomizing] [or] [Wetted Element]

[By-pass] [or] [duct]-mounted; capacities as indicated. Do not employ fan or electric heating coil for normal operation of units. [Provide drain outlet and [manual on-off switch] [saddle (manual shut-off) valve] [remotely located] [or] [integral with each unit].] Materials shall be corrosion resistant.

- a. Atomizing Units: Electric power units with metered nozzle, relay, solenoid valve, sail switch, and integral humidistat. Electrical characteristics shall be as indicated.
- b. Wetted Element Units: Reservoir or recirculating design units with a drain outlet, [automatic bleed] and cock valve to permit manual draining of the drain pan.

#### 2.4 GRAVITY VENTILATORS

Factory-fabricated, minimum 0.711 mm galvanized sheet steel, storm proof and rain tight, [self-flashing-prefabricated roof curbs,] [bird [and snow] screens,] [removable hoods], and maximum static pressure of 12 Pa at L/s indicated. Provide [factory-fabricated roof curbs with continuous curb gaskets] [flashing].

#### 2.5 FAN COIL UNITS

Provide factory assembled, UNI EN 1397 tested and labeled units consisting

of supply fan assembly with direct drive motor, chilled water cooling coil, hot water heating coil, filter rack, cooling coil drain pan, galvanized steel chassis, and furniture grade steel enclosure.

#### 2.5.1 Casing

Fabricate of galvanized steel. Finish with oven-baked paint. Line cabinet panels with 12.5 mm thick glass fiber acoustic and thermal insulation. Provide vibration isolation between fan motor (with drive assembly) and the unit casing.

#### 2.5.2 Fans

Centrifugal fan, with forward-curved, double-width wheels. Fabricate blower housings of galvanized steel with rolled perimeter seams to provide added rigidity.

#### 2.5.3 Coils

Construct of 12.5 mm outside diameter copper tubes with aluminum fins mechanically bonded to the tubes. Leak test coils under water and be suitable for design pressures of 1725 kPa at 95 degrees C.

#### 2.5.4 Drain Pans

Drain and drip pans shall be sized and located to collect all water condensed on and dripping from any item within the unit enclosure or casing. Drain pans shall be constructed of not lighter than 0.9 mm (21 gauge) steel, with threaded drain connections, galvanized after fabrication, thermally insulated to prevent condensation. Insulation shall have a flame spread rating not over 25 without evidence of continued progressive combustion, a smoke developed rating no higher than 50, and shall be of a waterproof type or coated with a waterproofing material. Auxiliary drain pans to catch drips from control and piping packages, eliminating insulation of the packages, may be plastic; if metal, the auxiliary pans shall comply with the requirements specified above. Insulation at control and piping connections thereto shall extend 25 mm minimum over the auxiliary drain pan.

#### 2.5.5 Motor

Provide resilient-mounted, three speed fan motor with UL listed integral thermal overload protection. Provide sleeve type or ball type motor bearings with oversized oil reservoirs provided to assure positive lubrication with minimum servicing required. Assure positive speed reduction through careful matching of motor torque to blower loading.

#### 2.5.6 Accessibility

Design the motor blower assembly for easy removal from the basic unit to provide for ease of servicing components. Removal of this assembly shall provide access to the entering air face of the coil.

#### [2.5.7 Controls

Automatic with wall mounted thermostat to cycle fan and operate chilled water and hot water control valves in sequence. Electric or electronic control valves wired to the unit. Thermostats to have fan "high-medium-low-off" control, temperature adjustment and automatic heat-cool changeover.

]2.6 ELECTROSTATIC (IONIZING) AIR FILTERS

\*\*\*\*\*  
**NOTE: Do not use roll-type air filters unless specifically requested by the Government. Air filter per UNI EN 779 is for use only in non-residential air cleaning systems.**  
\*\*\*\*\*

[For roll-type filter, controls may be pressure-drop, timer, or timer with pressure-drop override types. Provide runout switch to break control circuit and turn on control-panel signal light at the end of media roll. Filter media shall receive not less than 0.50 kilogram per square meter dust-holding capacity, with 75 percent efficiency at 2.5 m/s and average resistance of 112 Pa gage.]

]2.7 VARIABLE-AIR-VOLUME (VAV) TERMINAL UNITS

Sound power level, capacities, static pressures, and other operating conditions as indicated. Include sound-attenuator boxes, variable-volume dampers, adjustable maximum air-volume regulators, and other items for system operation. Equip units with integral air-volume control dampers. Thermostats may be mounted in the units if room air is induced over the thermostats. Maximum air-leak rate shall be 2 percent at static pressures from 100 to 750 Pa gage. Furnish units with round primary damper or valve, and VAV Terminal unit mounting brackets.

2.7.1 Casings

Minimum 0.559 mm galvanized steel or minimum one mm thick aluminum, welded construction. Provide removable access panels that open the entire VAV terminal unit bottom to access where required for inspection, adjustment, and maintenance of internal components without disconnecting ducts.

2.7.2 Insulation

UNI 10339 and UNI 9511/1 for 2 hour fire-rated classification with minimum 13 mm [\_\_\_mm\_] 682 grams[\_\_\_in\_] glass fiber. Acoustically and thermally insulate internal surfaces of units, air diffusers, and accessories. Surface coat the insulation to prevent erosion.

2.7.3 Controls

\*\*\*\*\*  
**NOTE: Select one of the following paragraph as appropriate. Direct digital controls shall only be used with the approval of the Engineering Field**  
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Division, Code 403.

\*\*\*\*\*

[Requirements for controls are specified in Section 15901, "Space Temperature Control Systems."]

[Requirements for controls are specified in Section 15910, "Direct Digital Control Systems."]

[[Pneumatic], [Electric], [or] [Duct-pressure-powered] type. All thermostatic air-volume controls shall be pressure [independent] [dependent] type.]

2.7.4 Air-Volume Regulators

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NOTE: For electric heat, use 30 percent for minimum regulator setting. Otherwise, use 25 percent for minimum regulator setting. In addition to regulator VAV units, there are pressure independent system-powered VAV units available. These system-powered VAV units do not require energy-consuming external controls. The system-powered VAV units can only maintain the set air flow quantity plus or minus ten percent, twice as much as permitted in Navy air leakage tests for ducts of pressure class 750 Pa or less gage. In some project locations, system-powered VAV units may be considered by the designer, if and only if economic and life cycle analysis can justify.

\*\*\*\*\*

Static-pressure-compensated or velocity-pressure type. At any damper position, maintain constant-volume L/s within plus-or-minus 5 percent of design-rated L/s setting. Provide factory-fabricated and field-adjustable set-points to set maximum and minimum L/s.

2.7.5 Air Diffusers

[Fixed] [or] [Variable] type. Construct diffusers to operate without loss of Coanda effect. [Provide remote diffusers with integral boots and bellows or dampers.]

2.7.6 Reheat Coils

[2.7.6.1 Water Coils

One-row or two-row hot water coils for [\_\_\_\_\_] degrees C degrees F temperature differential, with entering water temperature at [\_\_\_\_\_] degrees C degrees F. On reduction in cooling loads, the air supply quantity shall be gradually reduced to a fixed minimum setting. Then, the reheat coil shall be activated in sequence to maintain thermostat setting.

][2.7.6.2 Electric Coils

Factory-fabricated, electric-resistance coils, and open-type heaters. Provide integral terminal box containing automatic reset thermal-cutout primary safety device, load carrying heat limits or manual reset thermal-cutout secondary safety device, and air-flow switch in control circuit.

12.8 SERIES FAN POWERED VARIABLE AIR VOLUME (VAV) TERMINAL UNITS

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**NOTE: For evaporator variable airflow applications such as VAV or multizone, provisions for capacity control and minimum capacity must be indicated. Capacity control may be compressor unloading or multiple compressors. For minimum capacity control, these applications should be provided with factory installed hot-gas bypass.**

\*\*\*\*\*

Units shall provide a supply air discharge mix by modulation of conditioned primary air and recirculating of return air. Units shall include casing, centrifugal fan and motor, primary VAV damper or valve, electronic volume regulator, discharge air damper, primary air inlet cone with high and low pressure flow sensors, recirculating air filter frames, filter, and electrical disconnect. [Provide hot water heating coils.]

- a. Casing: Provide removable full bottom access panels for servicing internal components without disturbing duct connections. Insulate inside of casing with manufacturer's standard insulation. Units shall have recirculating air inlet equipped with filter frame, round primary damper or valve, and unit mounting brackets.
- b. Fans and motors: Provide centrifugal, forward curved, multiblade, fan wheels with direct-drive motors. Motors shall be high efficiency permanent-split capacitor type with thermal overload protection and permanently lubricated bearings. Motors shall have three speeds or be equipped with solid state speed controllers. Provide isolation between fan motor assembly and unit casing. Fan and motor shall be removable through casing access panel.
- c. Flow sensor: Sensor shall be ring or cross type with minimum of two pickup points which average the velocity across the inlet. Flow measurement shall be within plus or minus 5 percent of rated airflow with 1.5 diameters of straight duct upstream of unit and inlet static variation of 124 to 1240 Pa (gage) 0.5 to 5.0 inches W.G. Flow measuring taps and calibration flowchart shall be supplied with each unit for field balancing airflows.
- d. Primary VAV damper or valve: Galvanized steel damper blade shall close against gasket inside unit. Connect damper to operating shaft with a positive mechanical connection. Provide nylon bearing for damper shaft. Cylindrical die cast aluminum valve inlet tapered to fit round flexible ducts with integral flow diffuser and beveled self-centering disc. Damper or valve leakage

at shutoff shall not exceed 2 percent of capacity at 249 Pa (gage) one inch W.G. pressure.

- e. Regulator: Volume regulator shall be electronic. Provide electronic controls contained enclosure sealed from airflow. Controls shall be mounted on side of unit or on air valve. System powered regulators shall not be permitted. Volume regulator shall reset primary air volume as determined by thermostat, within upstream static pressure variation noted in paragraph entitled "Flow Sensor." Volume regulators shall be field adjustable and factory set and calibrated to indicated maximum and minimum primary airflows. Volume regulators shall be direct acting and normally [open] [closed] upon loss of pneumatic pressure.
- f. Electrical: Unit shall incorporate single point electrical connection with electrical disconnect. Electrical components shall be mounted in control box. Units, when factory assembled as a unit do not require airflow switch interlock with electric heating coil .
- g. Filters: Provide UL listed throwaway 25 mm one inch thick fiberglass filters, standard dust-holding capacity.

## 2.9 ELECTRICAL

\*\*\*\*\*  
**NOTE: If fan powered variable air volume (VAV) terminals are provided in the HVAC systems, the requirements in brackets in the paragraph below will probably be needed in this specification section.**  
\*\*\*\*\*

### 2.9.1 Electrical Motors, Controllers, Contactors, and Disconnects

Furnish with respective pieces of equipment. Motors, controllers, contactors, and disconnects shall conform to Section 16402, "Interior Distribution System." Provide electrical connections under Section 16402, "Interior Distribution System." Provide controllers and contactors with maximum of 120 volt control circuits, and auxiliary contacts for use with controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section. [Provide variable frequency drive (VFD) systems in compliance with Section 16261, "Variable Frequency Drive Systems Under 600 Volts."]

### 2.9.2 Electrical Work

Provide under Section 16402, "Interior Distribution System." [Provide control wiring under Section 15901, "Space Temperature Control Systems."]  
[Provide control wiring under Section 15910, "Direct Digital Control Systems."]  
[Provide control wiring under this section in accordance with CEI 64-8.]

2.10 ROOF CURBS

Factory-fabricated steel structural members. Provide minimum 100 mm cants for built-up roofing, 50 by 150 mm factory-installed wood nailers, and fully mitered end sections. Provide welded 1.321 mm galvanized steel shell, base plate, and counterflashing and provide stiffness required to eliminating deflection.

2.11 FINISH COATING FOR AIR HANDLING UNIT CASINGS

Comply with UNI EN ISO 4535, except as supplemented and modified by this specification. Protect equipment with a corrosion-inhibiting coating or paint system that has proved capable of satisfactorily withstanding corrosion in accordance with UNI EN ISO 4535. The manufacturer shall submit documentation that his standard cataloged products have met the following coating test requirements: Test 125 hours for equipment installed indoors and 500 hours for equipment installed outdoors or subjected to a marine atmosphere. Upon completion of exposure, evaluate coating or painting in accordance with UNI EN ISO 4535. Coat or paint shall show no indication of deterioration, loss of adhesion, or indication of rust or corrosion extending further than 3 mm on either side of original scratch.

[2.12 CORROSION PROTECTION FOR MARINE ENVIRONMENTS

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**NOTE:** Use this paragraph and its subparagraphs only for air handling equipment exposed to the weather within 1 mile of a sea (salt) water coast.

**NOTE:** Having selected the appropriate air handling units from three acceptable manufacturers that suit the intended application, specify the manufacturer's standard factory-produced corrosion protection systems for sea coast applications. Specify all three standard systems as options if the systems are different. If any of the three manufacturers do not advertise a standard factory-produced corrosion protection system, include the requirements specified below as an option.

\*\*\*\*\*

Provide one of the following special finish coatings on the interior and the exterior surfaces of air handling equipment exposed to the weather. Requiring the special finish coating also are all coil surfaces and interior equipment surfaces belonging to the first air handling equipment (excluding louvers) in the supply ductwork system that is subjected to outside supply air. The coating shall not act as an insulating barrier to the air handling heat exchange capability.

Finish coating shall be applied at the premises of the air handling equipment manufacturer or at the premises of the coating manufacturer or his authorized applicator. Provide finish coating in colors gray, or aluminum, or ivory. All components of the special finish coating systems,

including primers and intermediate coats, shall be applied by immersion dip-coating or spray-coating in accordance with coating manufacturer's written procedures.

If special finish coatings are applied at the finish coating manufacturer's (or his authorized applicator's) premises, the equipment to be finish coated shall be transported to and from the finish coating manufacturer's premises by the Contractor. The finish-coating manufacturer shall be responsible for necessary disassembly of the air handling equipment and re-assembly of final finish coated equipment.

Submit for approval a Certificate of Coating Specification Compliance. Requirements for certificate include:

- a. Name of firm that provided the finish coating.
- b. Project title and Navy construction contract number.
- c. Listing of the pieces of equipment that were finish coated by this firm.
- d. Certificate shall certify that the finish coating materials and application procedures employed conform to the contract specifications.
- e. Date of final inspection by this firm and printed name and signature of the inspector.
- f. Printed name and signature of the officer of the firm that is responsible for firm's certification program.

#### 2.12.1 Polyelastomer or Vinyl Finish Coating

##### 2.12.1.1 Heat Exchanger Coil (Including Evaporator Coil) Surfaces

- a. Acrylic polymer resin primer: 0.025 mm (1 mil) minimum dry film thickness.
- b. Polyelastomer resin top coating: 3 coats, 0.038 mm (1.5 mils) minimum total dry film thickness.

##### 2.12.1.2 Uninsulated Interior Surfaces and Exterior Surfaces

- a. Polyelastomer resin: 3 coats, 0.100 to 0.150 mm (4 to 6 mils) minimum total dry film thickness.

##### 2.12.1.3 Insulated Interior Surfaces

- a. Vinyl: 0.050 to 0.250 mm (2 to 10 mils) minimum dry film thickness

#### 2.12.2 Phenolic Finish

Provide a resin base thermosetting phenolic finish.

##### 2.12.2.1 Heat Exchanger Coil (Including Evaporator Coil) Surfaces

- a. Apply phenolic finish to the entire coil. Provide a minimum of two coats. Total minimum dry film thickness shall be 0.075 mm

(3 mils).

2.12.2.2 Uninsulated Interior Surfaces and Exterior Surfaces

- a. Amine cured epoxy phenolic finish: 0.150 to 0.175 mm (6 to 7 mils) minimum total dry film thickness.

2.12.2.3 Insulated Interior Surfaces

- a. Polyester or Vinyl Ester finish: 0.050 to 0.250 mm (2 to 10 mils) minimum dry film thickness.

]PART 3 EXECUTION

3.1 INSTALLATION

Installation of air handling equipment including materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in compliance with the manufacturer's written installation instructions, including the following:

Packaged air handling units - installation instructions

Vaneaxial fans - installation instructions

Power [roof] [and] [wall] ventilators - installation instructions

In-line tubular centrifugal fans - installation instructions

Variable-air-volume (VAV) terminal units - installation instructions

Series fan powered variable air volume (VAV) terminal units - installation instructions

Roof curbs - installation instructions

3.2 FIELD QUALITY CONTROL

Upon completion and before final acceptance of work, test each system in service to demonstrate compliance with the contract requirements. Adjust controls and balance systems prior to final acceptance of completed systems. Test controls through every cycle of operation. Test safety controls to demonstrate performance of required function. Correct defects in work provided by Contractor and repeat tests. Furnish steam, fuel, water, electricity, instruments, connecting devices, and personnel for tests. Flush and clean piping before placing in operation. Clean equipment, piping, strainers, ducts, and filters.

3.2.1 Equipment

3.2.1.1 Field Testing

Test each item of equipment in operation for continuous period of not less than 24 hours under every condition of operation in accordance with each equipment manufacturer's recommendation. Verify that the equipment operating parameters are within limits recommended by the manufacturer.

[3.2.1.2 Field Acceptance Test Plans

- a. Manufacturer's Test Plans: Within [120] [\_\_\_\_\_] calendar days after contract award, submit the following plans:

(1) Packaged air handling units field test plan; equipment greater than 944 L/S 2,000 cfm.

Field test plans shall developed by the equipment manufacturer detailing recommended field test procedures for that particular type and size of equipment. Field test plans developed by the installing Contractor, or the equipment sales agency furnishing the equipment, will not be acceptable.

The Contracting Officer will review and approve the field test plan for each of the listed equipment prior to commencement of field testing of the equipment. The approved field test plans shall be the plan and procedures followed for the field acceptance tests of the equipment and test reporting.

- b. Coordinated testing: Indicate in each field test plan when work required by this section requires coordination with test work required by other specification sections. Furnish test procedures for the simultaneous or integrated testing of equipment controls which interlock and interface with controls factory prewired or external controls for the equipment provided under [Section 15901, "Space Temperature Control Systems"] [Section 15910, "Direct Digital Control Systems"].
- c. Prerequisite testing: Equipment for which performance testing is dependent upon the completion of the work covered by Section 15950, "HVAC Testing/Adjusting/Balancing" must have that work completed as a prerequisite to testing work under this section. Indicate in each field test plan when such prerequisite work is required.
- d. Test procedure: Indicate in each field test plan each equipment manufacturers published installation, start-up, and field acceptance test procedures. Include in each test plan a detailed step-by-step procedure for testing automatic controls provided by the manufacturer.

Each test plan shall include the required test reporting forms to be completed by the Contractor's testing representatives. Procedures shall be structured to test the controls through all modes of control to confirm that the controls are performing with the intended sequence of control.

Controllers shall be verified to be properly calibrated and have the proper set point to provide stable control of their respective

equipment.

- e. Performance variables: Each test plan shall list performance variables that are required to be measured or tested as part of the field test.

Include in the listed variables performance requirements indicated on the equipment schedules on the design drawings. Manufacturer shall furnish with each test procedure a description of acceptable results that have been verified.

Manufacturer shall identify the acceptable limits or tolerances within which each tested performance variable shall acceptably operate.

- f. Job specific: Each test plan shall be job specific and shall address the particular item of equipment and particular conditions which exist with this contract. Generic or general preprinted test procedures are not acceptable.
- g. Specialized components: Each test plan shall include procedures for field testing and field adjusting specialized components, such as hot gas bypass control valves, or pressure valves.

#### ]]3.2.1.3 Equipment Field Acceptance Testing

- a. Equipment Requiring Test Reports: Each piece of equipment listed as requiring a field acceptance test plan shall be field acceptance tested in compliance with that plan and the resulting following field acceptance test reports submitted for approval:
  - 1. Packaged air handling units - field acceptance test report; equipment greater than 944 L/S 2,000 cfm.
- b. Manufacturer's recommended testing: Conduct the manufacturer's recommend field testing in compliance with the approved test plan. Furnish a factory trained field representative authorized by and to represent the equipment manufacturer at the complete execution of the field acceptance testing.
- c. Operational test: Conduct a continuous 24 hour operational test for each item of equipment. Equipment shutdown before the test period is completed shall result in the test period being started again and run for the required duration. For the duration of the test period, compile an operational log of each item of equipment. Log required entries every two hours. Use the test report forms for logging the operational variables.
- d. Notice of tests: Conduct the manufacturer's recommended tests and the operational tests; record the required data using the approved reporting forms. Notify the Contracting Officer in writing at least 15 calendar days prior to the testing. Within 30 calendar days after acceptable completion of testing, submit each test report for review and approval.

- e. Report forms: Type data entries and writing on the test report forms. Completed test report forms for each item of equipment shall be reviewed, approved, and signed by the Contractor's test director and the QC manager. The manufacturer's field test representative shall review, approve, and sign the report of the manufacturer's recommended test. Signatures shall be accompanied by the person's name typed.
  
- f. Deficiency resolution: The test requirements acceptably met; deficiencies identified during the tests shall be corrected in compliance with the manufacturer's recommendations and corrections retested in order to verify compliance.

]3.2.2 Testing and Balancing

Requirements for testing, adjustment, and balancing, including duct air leakage testing, are specified in Section 15950, "HVAC Testing, Adjusting, and Balancing".

-- End of Section --