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USACE / NAVFAC / AFCEA / NASA UFGS-23 82 23.00 40 (July 2007)  
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Preparing Activity: NASA Superseding  
UFGS-23 82 23.00 40 (April 2007)

## UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2007

Revised throughout - changes not indicated by CHG tags

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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

SECTION 23 82 23.00 40

UNIT VENTILATORS

07/07

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### SECTION 23 82 23.00 40

#### UNIT VENTILATORS 07/07

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NOTE: This specification covers the requirements  
for unit heaters and ventilators.

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

Recommended changes to a UFGS should be submitted 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 will automatically be 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.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (2003) Designation System for Aluminum Finishes

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S12.11/Part 1 (2003) Acoustics-Measurement of Noise and Vibration of Small Air-Moving Devices, Part 1: Airborne Noise Emission

ANSI S12.11/Part 2 (2003) Acoustics-Measurement of Noise and Vibration of Small Air-Moving Devices, Part 2: Structure-borne Vibration

ANSI S12.30 (1990; R 2002) Standard Guidelines for the Use of Sound Power Standards and for the Preparation of Noise Test Codes

ANSI S12.53/1 (1994; R 2004) Acoustics- Determination of Sound Power Levels of Noise Sources - Engineering Methods for Small, Movable Sources in Reverberant Fields - Part1: Comparison Method for Hard-Walled Test Rooms

ANSI S12.53/2 (1994; R 2004) Acoustics- Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Engineering Methods for Small, Movable Sources in Reverberant Fields - Part2: Methods for Special Reverberation Test Rooms

ASTM INTERNATIONAL (ASTM)

ASTM A 568/A 568M (2006a) Standard Specifications for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for

ASTM A 653/A 653M (2006a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM F 1040 (1987; R 2007) Standard Specification for Filter Units, Air Conditioning:

Viscous-Impingement and Dry Types,  
Replaceable

CSA INTERNATIONAL (CSA)

ANSI Z83.8b/CSA 2.6b (2002; Addenda 2004) Standard for Gas Unit  
Heater and Gas-Fired Duct Furnaces First

INTERNATIONAL CODE COUNCIL (ICC)

ICC IFGC (2003) International Fuel Gas Code

ICC IMC (2003) International Mechanical Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2006) Standard for Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54 (2006) National Fuel Gas Code

NFPA 70 (2005; TIA 2005) National Electrical Code

NFPA 90A (2002; Errata 2003; Errata 2005) Standard  
for the Installation of Air Conditioning  
and Ventilating Systems

U.S. DEPARTMENT OF DEFENSE (DOD)

DOD-G-24508 (1998d) Grease, High Performance,  
Multipurpose (Metric)

## 1.2 SUBMITTALS

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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. Submittals should be kept  
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, a code of up to three characters within  
the submittal tags may be used 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 will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### SD-01 Preconstruction Submittals

Material, Equipment, and Fixture List shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

#### Listing of Product Installations

#### SD-02 Shop Drawings

Connection diagrams shall be submitted indicating the relations and connections of the following items. Drawings shall indicate the general physical layout of all controls, and internal tubing and wiring details.

Heat Exchangers  
Burners  
Fans  
Motors  
Controls  
Vertical Discharge Units  
Horizontal Discharge Units  
Heating Element  
Propellers  
Fresh Air Intakes

Control Diagrams shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

Installation drawings shall be submitted for the following items in accordance with the paragraph entitled, "Installation," of this section.

Record Drawings shall be submitted for the following items providing current factual information including deviations from, and amendments, to the drawings and concealed and visible changes in the work.

Gas Unit Heaters  
Propeller Unit Heaters  
Cabinet Unit Heaters  
Unit Ventilators

#### SD-03 Product Data

Equipment and performance data shall be submitted for the following items consisting of use life, system functional flows, safety features, and mechanical automated details. Curves indicating tested and certified equipment responses and performance characteristics shall also be submitted.

Gas Unit Heaters  
Propeller Unit Heaters  
Cabinet Unit Heaters  
Unit Ventilators

Manufacturer's catalog data shall be submitted for the following items:

Casing  
Heat Exchangers  
Burners  
Fans  
Motors  
Controls  
Vertical Discharge Units  
Horizontal Discharge Units  
Heating Element  
Propellers  
Filters  
Enclosures  
Wall Sleeve  
Fresh Air Intakes  
Insulation  
Spare Parts  
Vibration Isolation

#### SD-04 Samples

Manufacturer's standard color chart shall be submitted for the following items showing manufacturer's standard color selections and finishes.

Gas Unit Heaters  
Propeller Unit Heaters  
Cabinet Unit Heaters  
Unit Ventilators

#### SD-07 Certificates

Records of Existing Conditions shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

Listing of Product Installations shall be submitted in accordance with paragraph entitled, "Installation," of this section.

Certificates shall be submitted for following items showing conformance with the referenced standards contained in this section.

Heat Exchangers

Burners  
Fans  
Motors  
Controls  
Vertical Discharge Units  
Horizontal Discharge Units  
Heating Element  
Propellers  
Fresh Air Intakes

#### SD-10 Operation and Maintenance Data

Contractor shall submit [6] [\_\_\_\_\_] copies of the Operation and Maintenance Manuals 30 calendar days prior to testing the following systems:

Gas Unit Heaters  
Propeller Unit Heaters  
Cabinet Unit Heaters  
Unit Ventilators

Data shall be updated and resubmitted for final approval no later than 30 calendar days prior to contract completion.

### 1.3 MECHANICAL PROVISIONS

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NOTE: If Section 23 00 00.00 40 HEATING, VENTILATING, AND AIR-CONDITIONING is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted. If Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT is not included in the project specification, applicable requirements therefrom should be inserted and the second paragraph deleted.

\*\*\*\*\*

[Section 23 00 00.00 40 HEATING, VENTILATING, AND AIR-CONDITIONING applies to work specified in this section.]

Submit vibration isolation components

### 1.4 GENERAL REQUIREMENTS

Control Diagrams shall show physical and functional relationships of equipment. Electrical diagrams shall show size, type, and capacity of the systems. Pneumatic diagrams shall be submitted for air and gas systems.

Material, Equipment, and Fixture List shall include manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information.

Records of Existing Conditions shall be submitted consisting of the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work shall constitute acceptance of existing conditions.

Listing of Product Installations shall include identification of at least 5



installed units, similar to those proposed for work, that have been in successful service for a minimum period of 5 years. List shall include purchaser, address of installation, service organization, and date of installation.

## PART 2 PRODUCTS

\*\*\*\*\*  
NOTE: When possible the use of sealed bearings is encouraged. One of the major causes of bearing failures is overlubrication and lubrication contamination. Using sealed bearings helps to eliminate this failure mode.  
\*\*\*\*\*

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

### 2.1 MANUFACTURED UNITS

Spare parts list and information shall be submitted meeting referenced standards within this section.

#### 2.1.1 Gas Unit Heaters (GUH)

Drawings or schedule shall include capacity, gas data and mounting height.

##### 2.1.1.1 Type

Unit heaters shall be suspended type and arranged for discharge of air as indicated. Unit shall comply with ANSI Z83.8b/CSA 2.6b and NEMA MG 1.

##### 2.1.1.2 Casing

Casing shall be manufactured of not less than 1.0 millimeter 20-gage steel.

Casing inside and outside shall be given a phosphate pretreatment, primer, and baked enamel finish. Horizontal [adjustable] [non-adjustable] louvers shall be provided and shall be completely recessed inside the casing frame.

[[Four-way] [\_\_\_\_\_] deflection vanes shall be provided.]

##### 2.1.1.3 Heat Exchangers

Heat exchangers shall be welded construction, heavy aluminized steel. Each exchanger shall be formed in a clam-shell design to completely surround the burner. Individual combustion chambers shall be provided for each burner.

##### 2.1.1.4 Burners

Burners shall be die-formed, aluminum-painted, heavy mild steel with long slot ports for even supply of gas. Burner assembly shall be of unitized construction with integral crossover for positive burner ignition. A draft diverter shall be an integral part of each heat exchanger section to allow

backdrafts to bypass burner assembly without affecting normal operation.

#### 2.1.1.5 Fans

Fans shall be propeller type, designed and manufactured for unit heater application. Fans shall have a minimum of three aluminum blades.

#### 2.1.1.6 Motors

Motors shall be totally enclosed, with and built-in overload protection. Motors shall be mounted to back panel by a fan guard motor mount constructed of spring steel wire.

#### 2.1.1.7 Controls

Controls shall include high limit switch, fan controls [including fan timer, lockout timer [\_\_\_\_]], a 24-volt automatic gas valve with 100 percent safety pilot shutoff, a pressure regulator with leak limiting device, and manual main and pilot valves. An integral junction box for all power and control connections shall be provided.

[A low voltage transformer shall be provided.] [A spark ignition controller shall be provided.]

#### 2.1.2 Propeller Unit Heaters-Hot Water and Steam (PUH)

Drawings or schedule shall include capacity, heating media data and mounting height.

\*\*\*\*\*  
NOTE: This specification is applicable to both hot  
water and steam heating medium.  
\*\*\*\*\*

##### 2.1.2.1 Type

[Unit heaters shall be suspended type and arranged for discharge of air as indicated.]

##### 2.1.2.2 Vertical Discharge Units

[Vertical discharge units shall operate at speeds not in excess of 1,200 revolutions per minute (rpm), except that units with 14.6 kilowatt 50,000 British thermal units per hour output and less shall operate at speeds up to 1,800 rpm. Discharge opening shall be covered with a fan guard.]

\*\*\*\*\*  
NOTE: When one of the following paragraphs is  
selected, the mounting height will be affected.  
\*\*\*\*\*

[Louver cone diffusers shall be provided.] [Adjustable vane diffuser shall be provided.]

##### 2.1.2.3 Horizontal Discharge Units

[Maximum volume in cubic cubic meter per second (cms) feet per minute (cfm) and face velocity in meter second (m/s) feet per minute (fpm) for horizontal discharge units shall be:

<u>Volume (cms)</u>	<u>Velocity (m/s)</u>
Up to 0.47	4.1
0.48 to 1.42	4.6
1.43 and over	5.1]

  

<u>Volume (cfm)</u>	<u>Velocity (fpm)</u>
Up to 1,000	800
1,001 to 3,000	900
3,001 and over	1,000

[Adjustable double deflection louvers shall be provided.]

#### 2.1.2.4 Heating Element

Heating elements shall be manufacturer's standard construction, rated for [standard] [low output temperature] service of not less than 149 degrees C at 517 kilopascal 300 degrees F at 75 pounds per square inch (psi).

#### 2.1.2.5 Casings

Casings with smoothly contoured propeller orifice rings shall be constructed of 1.0 millimeter 20-gage or thicker cold-rolled carbon steel. Casing surface finish shall include phosphate pretreatment, prime coating, and baked enamel finish.

#### 2.1.2.6 Propellers and Motors

Propellers shall have not less than four aluminum blades and shall be dynamically balanced.

[Horizontal-discharge units shall be provided with fan inlet safety guard.]

[Motors shall be mounted on elastomer vibration isolators.]

#### 2.1.2.7 Sound Rating

\*\*\*\*\*  
NOTE: Select the title and the following paragraph  
only if supplemented on the drawings or herein by a  
sound rating in decibels.  
\*\*\*\*\*

[Unit heater shall be tested and sound rated in accordance with ANSI S12.11/Part 1, ANSI S12.11/Part 2, ANSI S12.30, and ANSI S12.53/1 and ANSI S12.53/2.]

#### 2.1.2.8 Control

[Unit heaters shall be controlled [by line-voltage thermostats] [\_\_\_\_\_].]

### 2.1.1.3 Cabinet Unit Heaters (CUH)

Drawings or schedule shall include capacity, power rating, heating media, filter, pressure drop, size, and other pertinent data.

\*\*\*\*\*  
**NOTE: This specification is applicable to both hot  
water and steam heating medium.**  
\*\*\*\*\*

#### 2.1.1.3.1 Type

Cabinet unit heaters shall be quiet-operating type, complete with heating elements, fans and drives, filters, baffles and division walls, control provisions, and enclosures with access panels.

Cabinet shall not exceed drawing dimensions.

Unit pressure components shall be rated for service at not less than 1050 kilopascal 150 psi at system working temperature.

#### 2.1.1.3.2 Heating Element

Heating element shall be [manufacturer's standard aluminum fin] [serpentine copper-type tube] and shall be drainable and ventable.

Cataloged capacity of the heating element shall be constant and permanent.

Tube material shall be seamless deoxidized copper.

Fins shall be mechanically connected to the tubes. Loose fins at operating temperatures will be regarded as causing a reduction in capacity, and the Contractor shall replace all such material at no additional cost to the Government. Elements with bent or damaged fins are not acceptable.

Expansion provisions and supports shall be such that element movement is strainfree and noiseless.

[Face area of the coil shall be not less than that specified on the drawings.]

#### 2.1.1.3.3 Fan and Drive Assembly

[Fan shall be centrifugal, forward-curved, double-width, double-inlet type, and shall be statically and dynamically balanced at the factory.]

[Fan drives shall be direct.]

[Fan drives shall be direct, except where belt drives are indicated. Belt-drive motors shall be fitted with adjustable rails and an adjustable sheave to permit 20 percent adjustment to fan speed. Independent fan shafts shall be elastomer mounted in self-aligning [antifriction] [sleeve-type] bearings, with essentially lifetime lubrication.]

[Drives shall be [two] [three] [four]-speed. Switch positions shall include an off position.]

[Rotating elements shall be statically and dynamically balanced. Fan and

drive assembly shall be vibration isolated.] Refer to Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT for vibration isolation considerations.

Direct-drive motor rotational speed shall not exceed 1,200 rpm.

#### 2.1.3.4 Filters

Filters shall be 25 millimeter 1-inch minimum thickness, replaceable, throwaway type conforming to ASTM F 1040.

Filters shall be installed in a bypass-proof frame to ensure filtering of all moving air before entry into heating element and shall be removable without tools.

#### 2.1.3.5 Enclosures

\*\*\*\*\*  
NOTE: Architectural and mechanical details not covered herein must be shown on the drawings or the following must be supplemented.  
\*\*\*\*\*

[Enclosure configuration shall not deviate from drawing specifications.]

[Enclosure construction shall be minimum 1.6 millimeter 16-gage, cold-rolled carbon steel of stretcher-leveled quality conforming to ASTM A 568/A 568M. Construction shall have smooth, blemish-free surfaces, without sharp edges, and with flush joints. Wrinkled-metal and notched-corner construction is not acceptable. Enclosure shall provide space for all riser pipes and controls. Access doors shall have tamperproof latches. Doors and panels shall be hinged to protect surface finishes and personnel.]

[Enclosure surface finish shall include manufacturer's standard phosphate pretreatment, prime coat, and baked enamel finish in color as selected by the Contracting Officer.]

#### 2.1.3.6 Insulation

[Backs of recessed units shall be insulated with not less than 13 millimeter 1/2 inch of 48 kilogram per cubic meter 3-pound per cubic foot density fibrous-glass insulation conforming to NFPA 90A.]

#### 2.1.3.7 Control Cycle

[Sequence of operation shall be [as per manufacturer's recommendations] [\_\_\_\_].]

[Control components shall conform to requirements specified under Section 23 09 33.00 40 ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC.]

#### 2.1.4 Unit Ventilators (UV)

Drawings or schedule shall include capacity, power rating, heating duty and method, and other pertinent data.

\*\*\*\*\*  
NOTE: This specification is applicable to both hot  
\*\*\*\*\*

water and steam heating equipment.

Where large numbers of units are required, a standard size cabinet may be specified.

Where only one or two units are involved, polarized plug-in module requirement may be deleted.

\*\*\*\*\*

#### 2.1.4.1 Type

[Unit ventilators shall be quiet-operating modular type, complete with heating elements, fans and drives, filters, baffles and division walls, dampers, control provisions, and enclosures with access panels.]

[Unit pressure components shall be rated for service at not less than 1050 kilopascal 150 psi at system working temperature.]

[Intercomponent wiring shall conform to NFPA 70. Components of unit assembly shall be UL listed and approved.]

[Heating, fan, and control modules shall have polarized, color-coded, plug-in connections.]

#### 2.1.4.2 Heating Element

[Heating element shall be [the manufacturer's standard aluminum fin] [serpentine copper-tube type] and shall be drainable and ventable.]

[Cataloged capacity of the heating element shall be constant and permanent.]

[Tube material shall be seamless deoxidized copper.]

[Fins shall be mechanically connected to the tubes. Loose fins at operating temperatures will be regarded as causing a reduction in capacity, and the Contractor shall replace all such material at no additional cost to the Government. Elements with bent or damaged fins are not acceptable.]

[Expansion provisions and supports shall be such that element movement is strainfree and noiseless.]

[Face area of the coil shall be not less than specified drawing dimensions.]

#### 2.1.4.3 Fan and Drive Assembly

Fan shall be centrifugal, forward-curved, double-width, double-inlet type, and shall be statically and dynamically balanced.

\*\*\*\*\*

**NOTE: Select, rewrite, or delete the following paragraph only after checking direct drive units.**

\*\*\*\*\*

[Fans shall be belt driven, mounted on a common shaft. Shaft shall be supported by independent, elastomer-mounted, self-aligning, antifriction or sleeve-type bearings with lifetime lubrication. Motor sheave shall be adjustable to provide not less than 20 percent speed variation either way from capacity point. Belt tension shall be adjustable.]

[Motor shall be manually controlled by two-position on/off switch.]

\*\*\*\*\*  
**NOTE: Select the following paragraph for direct  
drive units in lieu of preceding paragraph.**  
\*\*\*\*\*

[Motor shall be manually controlled by [three] [four]-position switch.]

\*\*\*\*\*  
**NOTE: For very small units, only shaded-pole-type  
motors are available from some manufacturers.**  
\*\*\*\*\*

Motors shall be elastomer vibration-isolation mounted, permanent  
split-capacitor type with adjustable rail mounting.

#### 2.1.4.4 Filters

Filters shall be 25 millimeter 1-inch minimum thickness, replaceable,  
throwaway type conforming to ASTM F 1040.

Filters shall be installed in a bypass-proof frame to ensure filtering of  
all moving air before entry into the heating element and shall be removable  
without tools.

#### 2.1.4.5 Dampers

Dampers shall be opposed-blade type constructed to resist salt air. Blades  
shall be galvanized steel with [mechanically attached] [secure sealing  
provisions] not dependent upon adhesives. Bearings shall be high-grade  
commercial quality flanged-type with extended race and corrosion-resistant  
steel balls and [plated races] [heat-treated carbon steel] construction  
with factory-applied grease conforming to DOD-G-24508, suitable for salt  
air exposure. Bearings shall be sleeve-type oil-impregnated bronze.

[Face and bypass damper shall be provided with external bypass duct if  
required by unit.]

[Mixing dampers shall be provided as an assembly within a mixing box.  
Dampers shall be capable of varying the mixed air in any proportion from  
100 percent room air to 100 percent outside air.]

#### 2.1.4.6 Enclosures

\*\*\*\*\*  
**NOTE: Architectural and mechanical details not  
covered herein must be shown on the drawings or the  
following must be supplemented.**  
\*\*\*\*\*

[Enclosure configuration shall be as per manufacturer's recommendations.]

[Enclosure shall be of not less than 1.6 millimeter 16-gage cold-rolled  
carbon steel of stretcher-leveled quality conforming to ASTM A 568/A 568M.  
Construction shall be smooth with blemish-free surfaces, without sharp  
edges, and with flush joints. Enclosure shall be formed and braced to  
ensure plane surfaces with no oilcan effect. Wrinkled metal and notched  
corner construction is not acceptable. Louvers shall be pencilproof

venetian type. Louvers shall be constructed of metal and, in their normal position, shall sustain a distributed load of 890 newton 200 pounds, maximum. Enclosure shall provide space for all riser pipes and controls. Access doors shall have tamperproof latches.]

[Enclosure internal surfaces, exposed to condensation and to salt airstream, shall be specially protected with [heavy coatings] [noncorroding materials]. Flash chrome- and cadmium-plating is not acceptable.]

[Enclosure surface finish shall include manufacturer's standard phosphate pretreatment, prime coat, and baked enamel finish. Color shall be as selected by the Contracting Officer.]

#### 2.1.4.7 Wall Sleeve

Wall sleeve shall be constructed of not less than 1.3 millimeter 18-gage galvanized carbon steel, with commercial zinc weight conforming to ASTM A 653/A 653M. Finish shall consist of manufacturer's standard galvanized surface preparation and not less than [two finish coats of baked enamel] [one finish coat of high-build epoxy]. Color shall be as selected by the Contracting Officer.

#### 2.1.4.8 Thermal and Acoustic Insulation

Insulation shall prevent heat loss, heat gain, condensation, and shall provide acoustic treatment of surfaces.

#### 2.1.4.9 Control Cycle

\*\*\*\*\*  
NOTE: Select or delete the title and the following  
two paragraphs or rewrite and supplement by  
including the control cycle for this equipment to  
suit the project conditions.  
\*\*\*\*\*

[Sequence of operation shall be as per manufacturer's recommendation's.]

[Control components shall conform to requirements specified under Section 23 09 33.00 40 ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC.]

#### 2.1.4.10 Fresh Air Intakes

Extruded-aluminum intake louvers with 1.6 millimeter 16-gage, 13 by 13 millimeter 1/2-by 1/2-inch mesh aluminum wire birdscreens shall be provided for all fresh air intakes. Extruded aluminum shall be subjected to caustic etch and 0.5 micrometer anodize treatment in accordance with AA DAF-45. Aluminum shall be protected from dissimilar metals and causticity of concrete or mortar by elastomeric seals. Intake shall be particularly suited to indicated building-construction penetration.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

##### 3.1.1 Equipment

Equipment shall be installed in accordance with manufacturer's recommendations.



### 3.1.2 Gas Piping

Gas piping shall be installed in compliance with ICC IFGC, NFPA 54 and Section 23 11 23.00 40 FACILITY NATURAL-GAS PIPING.

### 3.1.3 Combustion Air

Combustion Air shall be provided in compliance with ICC IMC.

### 3.1.4 Location

Heaters shall be installed in compliance with clearance and mounting height requirements of ICC IFGC and NFPA 70.

### 3.1.5 Venting

Heaters shall be vented in compliance with NFPA 54, ICC IMC and ICC IFGC.

## 3.2 FIELD QUALITY CONTROL

Operational tests shall be conducted per manufacturer's instructions.

-- End of Section --