
USACE / NAVFAC / AFCEA / NASA UFGS-23 54 16.00 10 (April 2008)

Preparing Activity: USACE Superseding
UFGS-23 54 16.00 10 (January 2008)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2008

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

SECTION 23 54 16.00 10

HEATING SYSTEM; GAS-FIRED HEATERS

04/08

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 QUALITY ASSURANCE
- 1.4 DELIVERY, STORAGE, AND HANDLING
- 1.5 EXTRA MATERIALS

PART 2 PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT
 - 2.1.1 General
 - 2.1.2 Nameplates
 - 2.1.3 Equipment Guards
- 2.2 ELECTRICAL WORK
- 2.3 HEATERS
 - 2.3.1 Direct Fired Make-Up Air Heaters
 - 2.3.2 Indirect Fired Make-Up Heaters
 - 2.3.3 Unit Heaters
 - 2.3.4 Wall Furnace
 - 2.3.5 Duct Furnace
 - 2.3.6 Infrared Heaters
- 2.4 THERMOSTATS
- 2.5 VENT PIPING
- 2.6 ELECTRIC AUTOMATIC VENT DAMPERS
- 2.7 INSULATION
- 2.8 FACTORY FINISHES

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 INSTALLATION
 - 3.2.1 Heating Equipment
 - 3.2.2 Vents
 - 3.2.3 Gas Piping
- 3.3 TRAINING

3.4 TESTING, ADJUSTING, AND BALANCING

-- End of Section Table of Contents --

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.

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.

CSA AMERICA, INC. (CSA/AM)

CSA 2.6	(2006) Gas Unit Heater and Gas-Fired Duct Furnaces
CSA Directory	(updated continuously online) Certified Products Listings
CSA/AM Z21.66	(1996; R 2006) Automatic Vent Damper Devices for Use with Gas-Fired Appliances
CSA/AM Z21.86	(2008) Vented Gas-Fired Gravity Space Heating Appliances
CSA/AM Z83.19	(2001; R 2005; Addenda 2007) Gas-Fired Infrared Heaters
CSA/AM Z83.4	(2003; A 2004, 2006) Non-Circulating Direct Gas-Fired Industrial Air Heaters

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2007) Standard for Motors and Generators
-----------	---

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 211	(2006) Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances
NFPA 54	(2008) National Fuel Gas Code

UNDERWRITERS LABORATORIES (UL)

UL Gas&Oil Dir	(2008) Flammable and Combustible Liquids and Gases Equipment Directory
----------------	--

1.2 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. 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.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings Installation

Detail drawings as specified.

SD-03 Product Data

Spare Parts

Spare parts data for each different item of materials and equipment specified.

SD-06 Test Reports

Testing, Adjusting, and Balancing

Test reports shall be submitted in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-10 Operation and Maintenance Data

Operation and Maintenance Instructions

[Six] [_____] complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and basic operating features. [Six] [_____] complete copies of maintenance instructions listing routine maintenance, possible breakdowns, repairs and troubleshooting guide. The instructions shall include simplified piping, wiring, and control diagrams for the system as installed.

1.3 QUALITY ASSURANCE

NOTE: All Federal buildings must comply with Executive Order 13423 and Public Law 109-58 (Energy Policy Act of 2005); whether new construction, replacement construction, or, to the greatest extent practical, refurbishment and system replacement. In order to comply with E.O. 13423 and the Energy Policy Act of 2005, building designs must achieve energy consumption levels that are at least 30 percent below the level required by the 2004 publication of ASHRAE 90.1.

In accordance with P.L. 109-58 (Energy Policy Act of 2005), Executive Order 13423, and Federal Acquisition Regulation (FAR) Section 23.203 energy consuming products and systems shall meet or exceed the performance criteria for ENERGY STAR®-qualified or FEMP-designated products as long as these requirements are nonproprietary. The FEMP and ENERGY STAR product requirements are available on the web at www.eere.energy.gov/femp/procurement and www.energystar.gov/products. Where ENERGY STAR or FEMP products are not applicable, energy consuming products and systems shall meet or exceed the requirements of ASHRAE 90.1.

Submit [detail drawings](#) consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operation of the system. Detail drawings for space heating equipment, controls, associated equipment, and for piping and wiring. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.5 EXTRA MATERIALS

Submit [spare parts](#) for each different item of material and equipment specified, after approval of the detail drawings, and not later than [_____] months prior to the date of beneficial occupancy. Include in the data a complete list of parts and supplies, with current unit prices and

source of supply.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 General

Provide materials and equipment which are standard products of a manufacturer regularly engaged in manufacturing of the products and that essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

2.1.2 Nameplates

Secure a plate to each major component of equipment containing the manufacturer's name, address, type or style, model or serial number, and catalog number. Also, affix an ENERGY STAR label as applicable.

2.1.3 Equipment Guards

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts so located that any person may come in close proximity thereto shall be completely enclosed or guarded. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be guarded or covered with insulation of type specified for service.

2.2 ELECTRICAL WORK

**NOTE: Indicate motor type, class, and enclosure
type on the drawings.**

Electrical motor driven equipment shall be provided complete with motors, motor starters, and controls. Motors shall conform to NEMA MG 1. Electrical equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical characteristics shall be as specified or indicated. Integral size motors shall be premium efficiency type in accordance with NEMA MG 1. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control specified. Each motor shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided.

2.3 HEATERS

**NOTE: Heater mounting brackets and related hardware
should be specified to be furnished by the equipment
manufacturer with factory finish if project does not
warrant separate specification sections for
miscellaneous metals and field painting. The
designer should consult UFC 3-31-04 and Sections
13 48 00 and 13 48 00.00 10 to determine if seismic**

details are required. If required, refer to specification sections 13 48 00 and 13 48 00.00 10 or include the necessary details on the drawings. Delete the reference to seismic details, if they are not required. Indicate all applicable vent pipe routing on drawing.

Unless stated otherwise, heaters shall have a minimum combustion efficiency of 80 percent at maximum capacity. Show heater combustion efficiencies on the drawings.

Heaters shall be equipped for and adjusted to burn [natural][liquified petroleum][dual fuel natural/liquified petroleum] gas. Each heater shall be provided with a gas pressure regulator that will satisfactorily limit the main gas burner supply pressure. Heaters shall have an intermittent or interrupted electrically ignited pilot or a direct electric ignition system. Safety controls shall conform to the ANSI standard specified for each heater. Mounting brackets and hardware shall be furnished by the heater manufacturer and shall be factory finished to match the supported equipment. Seismic details shall be [in accordance with UFC 3-310-04 SEISMIC DESIGN FOR BUILDINGS and Sections 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT][as indicated].

2.3.1 Direct Fired Make-Up Air Heaters

NOTE: Designer should choose inlet or discharge damper according to climate zone. Generally, locations which experience more than 2220 heating degree C days (4,000 heating degree F days) should use discharge dampers on units located outdoors, and inlet dampers on units located indoors. Applications in moderate climates can be specified at the designer's option.

Heaters shall be in accordance with CSA/AM Z83.4. Direct fired make-up air heaters use outside air directly ducted to the heater. The products of combustion generated by the heater are released into the outside air stream being heated. Heaters shall be equipped with [motorized [inlet][and] [outlet]] [backdraft] dampers, [discharge air diffuser,] [duct collar,] [air filters,] [and] [bird screen]. Gas control valve shall be [single-stage] [two stage] [modulating] type. Maximum air temperature rise during minimum burner fire shall be 4 degrees C 7 degrees F. Fan shall be [single-speed] [two speed, with low speed approximately two-thirds of high speed] [variable speed]. Outdoor heaters shall be weatherized and shall have manufacturer's standard exterior finish for outdoor units. Motorized [inlet][and] [outlet] dampers shall be closed when the unit is shut down. Dampers shall be interlocked to prevent burner operation when dampers are closed. Heaters shall be provided with a [space] [discharge air] thermostat, a low limit air stream thermostat, and an ambient air thermostat. The [space] [discharge air] thermostat shall control the gas control valve. The low limit air stream thermostat shall shut down the entire unit if the discharge air temperature drops below the [space] [discharge] thermostat setting. The ambient air thermostat shall shut down the burner if the outside air exceeds the [discharge] [space]

thermostat setting.

2.3.2 Indirect Fired Make-Up Heaters

Heaters shall be in accordance with ANSI and CSA Standards. Heaters shall be equipped with motorized inlet dampers, duct collar, and air filters. Gas control valve shall be modulating type. Maximum air temperature rise during minimum burner fire shall be 4 degrees C 7 degrees F. Fan shall be two speed, with low speed approximately two-thirds of high speed. Motorized inlet dampers shall be closed when the unit is shut down. Dampers shall be interlocked to prevent burner operation when dampers are closed. Heaters shall be provided with a space thermostat, a low limit air stream thermostat, and an ambient air thermostat. The space thermostat shall control the modulating gas control valve. The low limit air stream thermostat shall shut down the entire unit if the discharge air temperature drops below the space thermostat setting. The ambient air thermostat shall shut down the burner if the outside air exceeds the space thermostat setting.

2.3.3 Unit Heaters

NOTE: Aluminized steel heat exchangers will be
satisfactory in most applications. Omit the
aluminized if there is a corrosive condition.

Heaters shall conform to requirements of CSA 2.6. Heat exchangers shall be [aluminized steel][or][stainless steel]. Air discharge section shall be equipped with adjustable [horizontal louvers][and][vertical louvers or fins]. Fan shafts shall be either directly connected to the driving motor, or indirectly connected by multiple V-belt drive. Fans in one unit shall be of the same size. Heaters shall be power-vented type, suitable for sidewall vent discharge and single-wall-thickness vent piping. Heaters shall have automatic ignition. Heaters shall employ metered combustion air with enclosed draft diverter (no open flue collar). Heaters shall be provided with a space thermostat which controls both unit's fan and burner.

2.3.4 Wall Furnace

NOTE: ANSI Z21.49 defines the gravity type units
which are designed to draw combustion air from
within the space. Indicate on the drawings the type
of air discharge; top or front.

Wall furnace shall have a minimum combustion
efficiency of 77 percent and a minimum AFUE of 73
percent. Indicate wall furnace efficiencies on the
drawings.

Wall furnace shall be the [gravity][fan] type in accordance with
CSA/AM Z21.86 and as indicated. Furnace shall be provided with a space
thermostat which controls both the unit's fan and burner.

2.3.5 Duct Furnace

NOTE: Aluminized steel heat exchangers will be satisfactory in most applications. Omit the aluminized steel if there is a corrosive condition.

Duct furnace shall be in accordance with [CSA 2.6](#). Furnace shall be power-vented type, suitable for sidewall vent discharge and single wall thickness vent piping. Furnace shall have automatic ignition. Furnace shall employ metered combustion air with enclosed draft diverter (no open flue collar). Furnace heat exchangers shall be [aluminized steel][or][stainless steel]. Furnace shall have minimum steady state thermal efficiency of 80 percent at maximum rated capacity and 75 percent at minimum rated capacity that is provided and allowed by the controls. Furnace shall be provided with a [space][discharge air] thermostat which controls the unit's burner.

2.3.6 Infrared Heaters

NOTE: Unvented infrared heaters may be employed only in buildings with high ceilings such as shop buildings, industrial buildings, etc. Exhaust vents will not be located directly above infrared heaters. The location of the heaters should be coordinated with light fixtures, sprinkler systems, structural members, and any other items that may be sensitive to the heat that will be generated. Where the units are used in metal buildings, the roof will be insulated and an adequate noncombustible vapor barrier will be provided. Unvented infrared heaters will not be used in hazardous areas. Select type of heater required and delete the inapplicable type of ventilation. Capacity of the exhaust system must be a minimum of 6.4 liters per second per 1000 Watt hour (4 cfm per 1,000 Btu per hour) input to properly dilute the carbon dioxide produced. Provision will be made to provide air to the space in an amount equal to the exhaust.

Heaters shall conform to the requirements of [CSA/AM Z83.19](#) and shall be [vented][or][unvented] type[as indicated]. [Vented heaters shall be vented to the outside atmosphere.] Heater style shall be [surface combustion][tubular] type[as indicated]. Reflector shape shall be[parabolic][horizontal][or][standard][as indicated]. Heaters shall be provided with space thermostats which control the unit's burner. Thermostats located in the direct radiation pattern shall be covered with a metal shield.

2.4 THERMOSTATS

NOTE: Single stage thermostats are used to control a unit at 100 percent capacity only. Two stage thermostats can be used to stage a unit's capacity to either 50 or 100 percent. Two stage thermostats are only applicable for unit heaters and duct furnaces.

Thermostats shall be the adjustable electric or electronic type. Control wiring required to complete the space temperature control system shall be included. Thermostats shall have a 2 degree C 3 degree F differential and a set point range of [4 to 24 degree C 40 to 75 degrees F] [minus 18 to plus 38 degrees C 0 to 100 degrees F] [27 to 49 degrees C 80 to 120 degrees F]. Thermostats shall be the [single] [two] stage type.

2.5 VENT PIPING

Vent piping shall conform to the requirements of NFPA 54. Plastic material polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases.

2.6 ELECTRIC AUTOMATIC VENT DAMPERS

Electric automatic vent dampers shall conform to the requirements of CSA/AM Z21.66 and shall be provided in the vents of heaters [except unvented infrared heaters] using indoor air for combustion air.

2.7 INSULATION

Insulation for piping and equipment and application shall be in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.8 FACTORY FINISHES

Equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

install equipment as indicated and in accordance with the recommendations of the equipment manufacturer and the listing agency, except as otherwise specified.

3.2.1 Heating Equipment

install heaters with clearance to combustibles, complying with minimum distances as determined by CSA Directory, UL Gas&Oil Dir and as indicated on each heater approval and listing plate. Support heaters independently from the building structure, as indicated, but not relying on suspended ceiling systems for support.

3.2.2 Vents

Locate vent dampers, piping and structural penetrations as indicated. Vent damper installation shall conform to CSA/AM Z21.66. Vent pipes, where not connected to a masonry chimney conforming to NFPA 211, shall extend through the roof or an outside wall and shall terminate, in compliance with NFPA 54. Vents passing through waterproof membranes shall be provided with the

necessary flashings to obtain waterproof installations.

3.2.3 Gas Piping

Connect gas piping as indicated, complying with the applicable requirements at Section 23 11 25 FACILITY GAS PIPING.

3.3 TRAINING

**NOTE: Insert the number of hours to train personnel
for equipment operations. Consult equipment
manufacturer for recommended time.**

Conduct a training course for the maintenance and operating staff. The training period of [_____] hours normal working time shall start after the system is functionally complete but before the final acceptance tests. The training shall include all of the items contained in the approved operation and maintenance instructions as well as demonstrations of routine maintenance operations. Give the Contracting Officer at least two weeks advance notice of such training.

3.4 TESTING, ADJUSTING, AND BALANCING

Perform testing, adjusting, and balancing as specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

-- End of Section --