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FEDERAL SPECIFICATION

FURNACES, WARM AIR AND HEATERS, UNIT, FORCED AIR CIRCULATION, OIL - AND GAS - FIRED

This specification is approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers self-contained, forced-circulation, air heating units designed to distribute warm air for heating purposes either through a duct system for central furnaces or by direct diffusion for unit heaters.

1.2 Classification.

1.2.1 Types, styles, groups, and burner kinds. The heating units will be of the following types, styles, groups, and burner kinds, as specified (see 6.2):

Type I - Central furnace.
Type II - Unit heater.

Style A - Upflow, high-boy.
Style B - Upflow, low-boy.
Style C - Downflow.
Style D - Horizontal flow.

1.2.2 Groups. For the purpose of defining requirements, the furnaces and space heaters covered by this specification are classified under the following groups based on the thermal input in BTU/hr therm I input as specified in British thermal units per hour (BTU/hr) (see 3.8.1 and b.2).

Group 1 - 22,000 to 225,000 BTU/hr input.
Group 2 - 225,001 to 400,000 BTU/hr input.
Group 3 - Over 400,000 BTU/hr input.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer (Code 156), Naval Construction Battalion Center, Port Hueneme, CA 9043-5000, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 4520

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1.2.3 Burner kinds. Burners furnished on the furnaces and unit heaters will be of the following kinds, as specified (see b.2). (Burner kinds HO, GLO, and GHO will apply to group 3 units only.)

Burner kind LO - Light-oil-fired (grade 2).
Burner kind G - Gas-fired (natural, manufactured, mixed. or (liquefied petroleum gas, as specified) (see 6.2).
Burner kind HO - Heavy-oil-fired (grade 4).
Burner kind GLO - Combination gas- and light-oil-fired.
Burner kind GHO - Combination gas- and heavy-oil-fired (grade 4).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

(Unless otherwise indicated, copies of federal and military specifications and standards are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

SPECIFICATIONS

MILITARY

MIL-V-173 - Varnish, Moisture- and Fungus-Resistant (for the Treatment of Communications, Electronic and Associated Electrical Equipment).
MIL-B-3180 - Boilers and Related Equipment, Packaging of,
MIL-I-13867 - Treatment, Moisture- and Fungus-Resistant for Fire Control, Electrical, and Electronic Instruments and Equipment.
MIL-I-24092 - Insulating Varnish, Electrical, Impregnating, Solvent Containing.
MIL-S-29115 - Switch, Thermostatic, Low Voltage, Non-setback/Setup and Setback/Setup, Temperature Limiting, Heating, Cooling, and Heating-Cooling.

STANDARDS

FEDERAL

FED-STD-123 - Marking for Shipment (Civil Agencies).

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MILITARY

MIL-STD-129 - Marking or Shipment and Storage.
MIL-STD-130 - Identification Marking of U.S. Military Property.
MIL-STD-461 - Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference.
MIL-STD-462 - Electromagnetic Interference Characteristics, Measurement of.

2.1.2 Other Government documents and publications. The following other Government documents and publications form a part of this specification to the extent specified herein. Unless otherwise specified, the issues are those in effect on the date of the solicitations.

DEPARTMENT OF LABOR (DoL)
OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

OSHA 1910.219

(Application for copies should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

DEPARTMENT OF ENERGY (DOE)

Title 10 Chapter II, Part 430, Subpart 8, Test Procedures.

(Application for copies should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

FEDERAL TRADE COMMISSION (FTC)

Title 16 CRT, Part 305 - Rules for Using Energy Cost and Consumption Information used in Labeling and Advertising for Consumer Appliances Under the Energy Policy and Conservation Act.

(Application for copies should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified,the issues of the documents which are Department of Defense (DoD) adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified. the issues of documents not listed in the DODISS are the issues of the documents which is current on the date of the solicitation (see 6.2).

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AMERICAN GAS ASSOCIATION LABORATORIES (A.G.A.)

Directory of Certified Appliances and Accessories.

(Application for copies should be addressed to the American Gas Association Laboratories, 8501 Last Pleasant Valley Road, Cleveland, Ohio 44131 or 1425 Grande Vista Avenue, Los Angeles, CA 90023.)

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

ANSI Z21.20 - Automatic Gas Ignition Systems and Components.
ANSI Z21.47 - Gas-fired Central Furnaces (Except Direct Vent and Separated Combustion System Central Furnaces).
ANSI Z83.8 - Gas Unit Heaters.

(Application for copies should be addressed to the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ATSM D 396 - Standard Specification for Fuel Oils.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1 - General Standards for industrial Controls and Systems.
NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies.
NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
NEMA MG 1 - Motors and Generators.

(Application for copies should be addressed to the National Electrical Manufacturers Association, 2101 L Street, N.W., Washington, DC 20037.)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 - National Electrical Code.

(Application for copies should be addressed to the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.)

SOCIETY OF AUTOMOTIVE ENGINEERS, INC. (SAE)

SAE J534

(Application for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

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UNDERWRITERS LABORATORIES, INC. (UL)

UL 296 - Oil Burners.
UL 353 - Limit Controls.
UL 378 - Draft Equipment.
UL 727 - Oil-fired Central Furnaces.
UL 731 - Oil Fired Unit Heaters.
UL 795 - Commercial-industrial Gas-Heating Equipment.
UL 900 - Air Filter Units.
- Gas and oil Equipment Directory.

(Application for copies should be addressed to the Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062.)

(Non-government standards and other publications are normally available from the organizations which prepare or that distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specifications sheets or MS standards), the text of this specification takes precedence. Nothing in this specification, however, will supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Description. The furnaces and unit heaters shall be self-contained, indirect, oil- or gas-fired, forced-air, heating appliances. Type I central furnaces shall be designed to supply heated air through a duct system. Type II space heaters may be similar to type I units except that the type II heaters shall be equipped with direct-diffusion, rotatable, sheet metal, or louvered nozzles designed to discharge a stream of heated air along a preselected path directly into the space in which the heater is located. Both the furnaces and unit heaters shall consist essentially of a heat exchanger; burner;centrifugal blower(s) or propeller fan(s), as applicable; a sheet metal cabinet-type casing with provisions for duct, discharge-nozzle, or louvered connection; and all required operating, limit, and safety controls. The furnaces and heaters shall be completely factory-assembled and wired except that the following components may be packed separately at the option of the supplier provided such components accompany the basic unit in shipment: oil burners; blower assembly; discharge nozzles and plenum extensions for type II units; air filter boxes, if furnished; and any other accessories normally shipped disassembled from the unit such as induced draft fan and thermostat.

3.1.1 Upflow unit. An upflow unit shall be designed with air flow discharge, vertically upward. at or near the top of the unit. Upflow, high-boy units shall be arranged with the blower mounted below or adjacent to

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the heating element. Upflow, low-boy units shall be arranged with the blower mounted beside the heating element. On the low-boy units, both the return air and discharge air connections shall be located on the top of the unit. Type II unit heaters covered by this paragraph shall be of the upflow, high-boy design only.

3.1.2 Downflow unit. A downflow unit shall be designed with air flow essentially in a vertical path wherein the air discharges downward at or near the bottom of the unit. Downflow unit shall be type 1, group I only and shall be suitable for alcove or closet installation in residential structures.

3.1.3 Horizontal unit. A horizontal unit shall be designed basically for low headroom installation with the air flow through the heating element of the unit essentially in a horizontal path. Type II units of the horizontal style shall be equipped, when required, with suitable hangers for horizontal mounting.

3.2 Standard commercial product. The units shall, as a minimum, be in accordance with the requirements of this specification and shall be the manufacturer’s standard commercial product. Additional or better features which are not specifically prohibited by this specification but which are a part of the manufacturer’s standard commercial product, shall be included in the units being furnished. A standard commercial product is a product which has been sold or is being currently offered for sale on the commercial market through advertisements or manufacturer’s catalogs or brochures, and represents the latest production model.

3.3 First article. When specified (see 6.2), the contractor shall furnish a unit for first article inspection approval (see 4.2.1 and 6.3).

3.4 Materials. Materials used shall be free from defects which would adversely affect the performance or maintainability of individual components or of the overall assembly. Materials not specified herein shall be of the same quality used for the intended purpose in commercial practice. Unless otherwise specified herein, all equipment, material, and articles incorporated in the work covered by this specification are to be new and fabricated using materials produced from recovered materials to the maximum extent possible without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered form solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw material. Unless otherwise specified, none of the above shall be interpreted to mean that the use of used or rebuilt products are allowed under this specification.

3.5 Interchangeability. All units of the same classification furnished with similar options under a specific contract shall be identical to the extent necessary to insure interchangeability of component parts, assemblies, accessories, and spare parts.

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3.6 Codes and standards. Forced-circulation furnaces and unit heaters furnished under this specification shall meet the requirements of the following codes and standards to the extent specified:

a. Type I, group 1, oil-fired units shall meet the requirements of UL 727, including the burners and controls. Burners shall be of the high pressure or low pressure type with direct spark ignition and primary safety controls in accordance with UL 296. Vaporizing type burners shall not be permitted.
b. Type I, type II, group 1 and group 2, gas-fired unit shall meet the requirements of ANSI Z21.47 and shall be A.G.A. Design Certified as complete units, including the burners and controls. Ignition systems shall be of the hot-surface or direct spark, intermittent or interrupted types. Gravity furnaces and continuous pilots shall not be permitted.
c. Type I, group 2, group 3 and type II, group 3, oil-fired units shall meet the requirements of UL 731. The oil burners shall conform to UL 296, and be of the mechanical atomizing type with direct spark or interrupted ignition.
d. Type I, group 3 and type II, group 3 gas-fired units shall meet the requirements of UL 795 or ANSI Z21.47. Heaters with atmospheric burners shall meet ANSI Z83.8 and power burners shall meet UL 296. Continuous pilots shall not be permitted.
e. Combination oil- and gas-fired units shall comply with the applicable provisions of 3.6c and 3.6d.

3.7 Compliance. Prior to approval of the first shipment, the contractor shall submit for the approval of the contracting officer, or his authorized representative, satisfactory evidence that the furnaces and heaters he proposes to furnish under this specification meets the requirements of UL 727, UL 731, UL 795, ANSI Z21.47 and ANSI Z83.8 as applicable.

3.7.1 Type I and type II oil-fired units. Acceptable evidence of meeting the requirements of UL 727 for Type I and UL 731 for Type II units will be the UL listing mark plus a listing in the current UL Gas and Oil Equipment directory indicating that the unit has been approved for the specified installation clearances (see 3.9). Also acceptable is a certificate of Compliance as part of the first article from a recognized independent testing laboratory acceptable to the Government, indicating the equipment has been tested and conforms to UL 727 or UL 731 and the specified installation clearances (see 3.9).

3.7.2 Type I and type II, group 1 and group 2 gas-fired units. Acceptable evidence of meeting the requirements of ANSI Z21.47 will be the A.G.A. Laboratories certification symbol and a listing in the A.G.A. Laboratories Directory of Certified Gas Appliances. Also, acceptable is a Certificate of Compliance as part of the first article tests from a recognized independent testing laboratory acceptable to the Government, indicating the furnace design

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conforms to ANSI Z21.47. The listing or certificate shall indicate that the unit has been approved for the specified input capacity (see 3.8.1), installation clearances (see 3.9), and type of gas (see 7.2.3).

3.7.3 Type I, group 3 and type II, group 3 gas-fired units. Acceptable evidence to meeting the requirements of UL 795 will be the UL listing mark or ANSI Z21.47 will be the A.G.A. Laboratories certification symbol and a listing in the A.G.A. Laboratories Directory of Certified Gas Appliances. Also acceptable is a Certificate of Compliance as part of the first article test from a recognized independent testing laboratory acceptable to the Government that the heater has been tested or designed and conforms to UL 795 or ANSI Z21.47, as applicable. The listing or certificate shall indicate that the unit has been approved for the specified input capacity (see 3.8.1), installation clearances (see 3.9). and type of gas (see 1.2.3).

3.8 Performance.

3.8.1 Thermal input. The contractor's rated thermal input of the unit in Btu/hr for oil and cubic feet per hour for gas shall be not less than the specified capacity (see 6.2). For combination burners, the requirements herein for separate oil-fired and gas-fired burners shall apply.

3.8.2 Efficiency. Unless otherwise specified (see 6.2), the thermal efficiency of type I and type II units at the contractor's rated thermal input, shall be not less than the following:

Group 1 - As certified by the contractor to the Federal Trade Commission 10 CFR Part 305, but not less than the 75 percent.
Group 2 and group 3 - 75 percent of the contractor's rated thermal input as listed or certified under the appropriate standards cited in 3.6.

3.8.3 Output capacity. Unless otherwise specified (see 6.2), the rated output (bonnet) capacity shall not be less than 75 percent of the contractor's rated thermal input as listed or certified under the appropriate standards cited in 3.6. For group 1, type I furnaces, the applicable information maybe provided on the fact sheets required by the Federal Trade Commission.

3.8.4 Temperature rise. The nominal air temperature rise between the inlet and outlet connections at the contractor's rated thermal output shall be 85 degrees Fahrenheit (deg. F) +/- 2 deg.F or other rise as specified by the manufactures and shown on the rating name plate (see 6.2). All units shall be capable of being adjusted or regulated to provide a minimum 30 deg. F range of temperature rise, the lower limit being 15 deg. F less than the rated temperature rise and without exceeding a temperature 15 deg. F below high limit cutout of 200 deg. F.

3.8.5 Air flow. The air flow at the rated output (bonnet) capacity, in cubic feet per minute (cfm) of air at the blower or fan intake, shall be established in accordance with UL 727, UL 731, UL 795, ANSI Z21.47, or ANSI

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Z83.8 as applicable. The calculated air flow rate for the specified rated temperature rise (85 deg. F) shall be attained against the applicable external static pressure(esp) given in the standards, unless an alternate esp or temperature rise is shown on the rating name plate (see 6.2). When an alternate temperature rise and esp are required, the air flow rate shall be established in accordance with the following formula:

$$\text{Air delivery} = \frac{\text{input x efficiency}}{\text{1.08 x temperature rise}}$$

where: Air delivery = cfm.
Thermal input = manufacturer's rated input Btu/hr (see 3.8.1)
Efficiency = 0.75 (not less than)

$$1.08 = \frac{0.244 \times 60}{13.5}$$

where: 0.244 = specific heat of standard air (70 deg. F db and 50 percent rh)
60 = minutes per hour
13.5 = specific volume of standard air.

3.8.6 Heat transfer rate. The heat transfer rate per square foot of heating surface shall be such that at the specified outlet air test temperature rise, the coincident temperature rise at any point on the primary or secondary heating surface does not exceed the allowable heating element temperature rise specified in UL 727, UL 731, UL 795, ANSI Z21.47, or ANSI Z83.8 as applicable, for the material used.

3.9 Casing. Each unit shall be enclosed in a sheet metal casing to form a passage around the heat exchanger for the stream of air being heated. The casing thickness shall not be less than the thickness in the reference standards of 3.6. The casing on group 1, vertical units shall enclose the burner and associated fuel system components and controls. On group 2 and group 3 units, the casing shall be braced and reinforced with structural members so that components of the heat exchanger section will not be directly supported solely by the sheet metal casing. Removable panels shall be provided on all units to provide required access to components requiring cleaning, servicing, or adjustment. The interior of the casing shall be equipped with baffles, shields, heat reflecting insulation or inner-liner to prevent the casing heat losses from exceeding 1.5 percent for group 1 and group 2 and no heat loss for group 3 and all oil fired appliances of the thermal input and to prevent the casing temperature from exceeding the limits necessary for compliance with installation clearances allowed under the UL or A.G.A. listings. Unless otherwise specified (see 6.2), units furnished under this specification shall be listed as designed for installation with clearances applicable to the Table 42.1 of UL 795 or A.G.A listing.

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3.9.1 Air filters. For group 1 units, integral racks or filter retainers with permanent cleanable or throw-away type air filters shall be furnished. When specified (see 6.2), air filters for group 2 and group 3 units shall be furnished with integral racks or auxiliary boxes, as specified. Filters may be of the throw-away type or permanent, cleanable type at the option of the supplier unless one type only is specified (see 6.2). Filters shall conform to the requirements of UL 900 for class 1 and class 2. Filters on all units shall be fitted in a manner to preclude air bypassing and to permit ready removal for cleaning or replacement. The total net face area of all filters on each unit shall be such that the face velocity of the air a maximum flow rate attainable within normal operating limits of the unit will not exceed 300 feet per minute (fpm) for standard velocity filters and 520 fpm for high velocity filters.

3.9.2 Warm air connections. Type I units shall include provisions for connecting discharge and return air ductwork. Type II units shall be equipped with directional discharge louvers. Optional nozzles or deflector hoods shall be furnished when specified (see 6.2).

3.9.3 Automatic vent damper device. When specified (see 6.2), the furnace shall be furnished downstream of the appliance draft hood with an automatic vent damper which is designed to automatically open the venting system when the appliance is in operation and to automatically close off the venting system when the appliance is in a standby condition. The furnace and vent damper combination shall be explicitly designed and certified by ANSI Z21.47, ANSI Z83.8 or listed by UL.

3.10 Heat exchange surfaces. Heat exchange surfaces shall include the combustion chamber (primary heating surface) plus any secondary surfaces,such as wrap-around radiators, box-type panels, or tube sections, interposed between the combustion chamber and the flue-gas stack connection. On gas-fired units with multiple, manifold-connected burners, combustion chambers may be die-formed integrally with supplemental heat transfer surfaces to provide a unitized, multi-section clam-shell type heat exchanger. All heat exchangers shall be gas-tight construction, designed, and installed to allow the metal to expand and contract within the casing without developing leaks or causing damage to associated parts. Combustion chambers and secondary heating surfaces shall be constructed of materials and sheet metal gages acceptable under UL or ANSI standards for the maximum temperature which the surfaces are exposed at specified test temperatures. Refractory used for chamber linings shall be of the castable, preformed type consisting primarily of alumina, silica, or magnesia compositions with suitable binders. Refractory linings shall be rated to withstand temperatures to 2500 deg. F and shall be replaceable with a minimum of disassembly.

3.11 Burners and fuel systems.

3.11.1 Oil. Group 1 and group 2 oil burner shall be of the high-pressure or low-pressure atomizing type in accordance with UL 296. Group 3 oil burners shall be of air or mechanical atomizing type, conforming to UL 296. Burners

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shall be designed to fire fuel oil conforming to ASTM D 396 grades No. 1 and No. 2 for burner types LO and GLO and grade No. 4 for burner types HO and GHO. The burner shall be completely automatic and shall include a motor, combustion air blower, ignition system, fuel pump, burner tube, and for group 3 units, a safety shutoff valve. Combination burners shall be designed for selective burning either of gas or grade No. 1 or No. 2 fuel oil. Both oil burners and combination burners shall be UL listed.

3.11.2 Gas. Type I, group 1 and group 2 gas burners shall meet the requirements of ANSI Z21.41 Type II, group 1 and group 2 shall meet the requirements of ANSI A83.8 as specified in 3.6(b). Type I, group 3 gas burners shall meet the requirements of UL 795 or ANSI Z21.47 and type 1, with ANSI Z83.8 as specified in 3.6(d). Burners shall be designed, adjusted, rated, and certified to fire natural, manufactured, mixed, or propane gas, as specified (see 1.2.3). Burners shall be rated for use at altitudes to 2,000 feet unless higher altitudes are specified (see 6.2). Gas pressure regulators shall be furnished for all units.

3.12 Ignition systems. The ignition systems shall comply with the pertinent provisions of UL 296, UL 795, ANSI Z21.47, and Z83.8 as applicable. Burners shall be equipped with ignition systems as follows:

a. Ignition systems for group 1 and group 2, gas-fired units, shall be of the direct spark, intermittent or interrupted types with electrically-ignited proven pilots or shall be of the pilotless hot-surface ignition type. Continuous pilots shall not be permitted.
b. Ignition systems for group 3 atmospheric gas burners shall be intermittent or interrupted type in accordance with ANSI Z21.47. Ignition systems for group 3 power gas burners shall meet UL 795 or ANSI Z83.3.
c. Ignition systems for group 1 and group 2 oil-fired units shall be of the direct-electrical spark type in accordance with UL 296.
d. Ignition systems for group 3 oil-fired units shall be direct-electric spark type or intermittent or interrupted type in accordance with UL 296.

3.13 Supply fan(s) and blower(s). The blower(s) shall be of centrifugal type and the fan(s) shall be of propeller type, quiet in operation and adequately secured to the shafts. Airflow rating shall be established in accordance with 3.8.5. Bearings shall be self-oiling with adequate oil reservoirs or permanent life-lubricated ball bearings. Oil or grease fittings, when used, shall be located or extended, as required, to provide ready access for periodic lubrication. When the fan or blower is belt driven, the motor shall be provided with an adjustable base and guard conforming to OSHA 1910.219 or enclosed in the unit casing. The belt drive shall be in accordance with RMA Engineering standards with service factor of at least 1.2. The direction of rotation shall be clearly and permanently marked on each fan and fan housing. All centrifugal blowers shall be statically and dynamically balanced, and belt driven fans shall be supported by at least two

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self-aligning bearings. Blower speed(s) shall be single, or multi-speed, be adjustable by the use of variable pitch drive sheaves, or be multiple speed motors to provide the range of air temperature rises required in 3.8.4, as specified (see 6.2).

3.14 Controls. Each central furnace and unit heater shall be furnished with the following basic operating and limit controls:

a. Means for connecting a thermostatic switch.
b. Blower or fan on-off control.
c. Bonnet temperature limit control.
d. Burner primary safety control.

The blower of fan on-off control and the temperature limit control may be furnished as a single combination control at the option of the contractor. Group 3 atmospheric gas burners shall have combustion control systems in accordance with ANSI Z21.47, ANSI Z83.8 or UL 795 as applicable. Group 3 powered gas burners, oil burners and combination burners shall be equipped with automatic sequence programmers to effect a timed, pre-ignition,pre-purge period in accordance with UL 296, UL 795 or UL 731, as applicable. Burner combustion control systems shall provide for on-off operation unless as for group 3 units, high-low-off operation or modulated controls are specified(see 6.2). When high-low-off controls are specified, units shall be equipped with multi-position, motorized, fuel-flow control valves, and motorized, two-position damper controls. In lieu thereof, dual high- and low-fireburner nozzles with appropriate automatic control valves may be used for oil; gas valves with three-position, high-low-off actuators may be used for gas. The low position on both high-low-off and modulated controls shall be not less than 33 percent of rated input.

3.14.1 Thermostatic switches. When specified (see 6.2), a room thermostatic switch conforming to MIL-S-29175 shall be furnished with each unit as a separate item for installations and wiring at the site. The thermostatic switch shall be low voltage with temperature limits for family housing of 72 deg. F maximum for heating and 78 deg. F minimum for cooling; or for nonfamily housing of 68 deg. F maximum for heating and 78 deg. F minimum for cooling, as specified (see 6.2). When specified (see 6.2), a thermometer shall be furnished on the thermostatic switch. When specified (see 6.2), alternate or supplementary temperature controls such as system selector switch and fan switch are not required. The combinations of thermostatic switches available for heating and cooling shall be as in 3.14.1.1 and 3.14.1.2.

3.14.1.1 Group 1 and group 2 units. Thermostatic switches for group 1 and group 2 units shall be one stage heating only; one stage heating and one stage cooling with manual changeover; one stage heating and two stage cooling with manual changeover; or one stage heating and one stage cooling with automatic changeover for nonfamily installations, as specified (see 6.2).

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3.14.1.2 Group 3 units. Thermostatic switches for group 3 units shall be one stage heating only; two stage heating and one stage cooling with manual changeover; one stage heating and one stage cooling with automatic changeover; or two stage heating and two stage cooling with automatic changeover, as specified (see 6.2).

3.14.2 Bower or fan control. The blower or fan control shall prevent operation of the blower or fan after the burner has fired until the discharge air at the bonnet reaches a predetermined temperature. The fan "on" setting shall be adjustable within a minimum range of 90 deg. F to 140 deg. F. The differential setting may be fixed at a point between 24 deg. F and 36 deg. F or shall be adjustable within the minimum range of 20 deg. F to 50 deg. F at the option of the supplier. The blower or fan control shall include a suitable manual switch or setting to permit continuous operation of the fan for summer ventilation purposes. When a temperature sensing blower or fan control is not provided, a device which will provide for blower or fan operation to prevent abnormal air temperature shall be furnished. On group 2 units with high-low-off controls, the blower or fan shall reduce its speed to maintain the normal outlet temperature of the furnace within the limits of 3.8.4.

3.14.3 Limit control. The limit control, conforming to UL 353, shall be designed and installed to shut down the burner before the bonnet air temperature reaches 200 deg. F or at the temperature specified by the applicable standard. The differential shall be fixed at not less than 10 deg. F and not more than 24 deg. F. Controls with adjustable limits up to 250 deg. F shall be equipped with stops factory-set to shut down the burner when the bonnet air temperature reaches 200 deg. F and will require a manual reset.

3.14.4 Primary safety controls. Primary safety controls (combustion safeguards) shall be furnished on each oil-, gas-, and combination oil-gas-fired unit. The primary control shall monitor the flame and, in the event of ignition failure on startup or unintentional flame extinguishment during a firing cycle, shall cause safety shutdown of the burner.

3.14.4.1 Group 1 and group 2 units. Primary controls for group 1 and group 2 oil-fired units shall be of the cadmium sulfide type, which responds to the luminous energy in the flame. Controls shall lock out if the flame is not established in accordance with UL 296 on ignition and shall require manual reset. The automatic ignition and safety shutoff system for group 1 and group 2 gas-fired units shall be of the, intermittent or interrupted direct spark, or hot-surface ignition types which shall function to cause complete shutdown of the gas in case of pilot or main flame failure or provide safe re-ignition in accordance with ANSI Z21.47. The timing for actuation of the gas safety shutoff device and automatic valves shall be as specified in ANSI Z21.47.

3.14.4.2 Group 3 units. The flame safeguard and programming control for group 3 units shall be of the electronic type employing flame detectors to monitor the presence of a flame. Flame sensing elements shall be limited to infrared, (lead-sulfide type) or ultraviolet photocells, except that flame

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rods may be used with gas flames. The programming control, in conjunction with the flame safeguard circuit, shall provide the timed operational sequence in atmospheric gas burners in accordance with ANSI Z41.47, ANSI Z83.8 and UL 795 as applicable in power gas burners and oil burners in accordance with UL 296.

3.14.5 Oil delay valve. When specified (see 6.2), oil-fired units not equipped with programming controls shall be equipped with a delayed-opening oil shutoff valve. The valve shall automatically delay delivery of oil to the burner until such time as the combustion air fan and,when applicable, the induced draft fan are operating at rated speed.

3.15 Electrical requirements. Except as otherwise specified herein, all interconnecting wiring for motors, operating controls (thermostatic switches), limit controls, and programmers shall be furnished and installed. When components are shipped unmounted, interconnecting wiring shall be installed up to the location of the unmounted component and the terminals of the wires identified to facilitate connection when the unmounted component is installed. All external wiring shall conform to and be installed in accordance with NFPA 70.

3.15.1 Motors. Motors shall be furnished and installed for the fans and blowers, the oil burner when applicable, and the induced draft fan, if furnished. Motors shall be rated and constructed in accordance with the applicable provisions of NEMA MG 1. Motors shall have the electrical characteristics as specified (see 6.2). The blower and fan motor horsepower (hp) shall be sufficient to insure compliance with the limits of motor winding temperature rise specified in UL 727, UL 731, ANSI Z21.47 or ANSI Z83-8, as applicable, when the units are operating at the rated bonnet capacity and maximum air flow rate against the applicable esp specified in the referenced standards. Unless otherwise specified (see 6.2), motors shall have drip proof enclosures in accordance with NEMA MG 1. Direct drive motors for group 1 units shall not have less than three rated speeds to cover the range of temperature rises specified in 3.8.4.

3.15.2 Magnetic starters. Integral hp motors shall be furnished with magnetic, across-the-line starters rated and constructed in accordance with NEMA ICS I and ICS 2. The starter shall provide thermal overload and under-voltage protection and shall include manual and automatic control stations. The overload protection shall include thermal cutouts in all three phases. Unless otherwise specified (see 6.2), enclosures for magnetic starters shall be NEMA type I in accordance with NEMA ICS 6.

3.15.3 Control panel. For group 3 units, the controls, including operating switches, indicating lights, alarms, motor starters, fuses, and circuit elements of the control systems shall be mounted and factory wired on a single control panel or cabinet insofar as practicable in order to centralize the control functions. The control panel shall be mounted on the unit. A schematic wiring diagram of the control circuits shall be furnished

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in accordance with the referenced standards. Unless otherwise specified (see 6.2), the control panel or cabinet shall be provided with NEMA type 1 enclosure in accordance with NEMA ICS 6. All terminals requiring connection upon installation shall be permanently identified in the instructions and wiring diagrams provided with the equipment. Terminal connections for control functions shall be segregated from power circuit terminals. External wiring shall be in accordance with NFPA 70.

3.16 Accessory equipment.

3.16.1 Induced draft fan. Induced draft fans shall be furnished on group 3 units and, when specified (see 6.2), on group 2 units intended for horizontal, inverted, or other special installations. The fans shall be of the direct-driven or belt-driven centrifugal type. All parts of the fan normally exposed to the flue gases shall be constructed of corrosion-resistant metals or metals suitably treated to resist corrosion.

3.16.2 Vent connections. When specified (see 6.2), the following vent connections and fittings shall be furnished with each type II unit heater:

a. One 90-degree elbow or one tee.
b. Two 45-degree elbows.
c. Ten 2-foot sections of furnace pipe.

The furnace pipe and fittings shall be zinc-coated sheet steel having a nominal thickness of not less than 0.0276 inch (24 gage). The weight of zinc-coating in ounces per square foot shall be not less than 1.25 commercial. Not less than 30 cadmium-plated sheet metal screws for assembling the stack shall be furnished. The nominal size of the furnace pipe and fittings for the specified furnace sizes shall not be less than shown in table 1.

TABLE 1. Furnace pipe sizes for type II space heaters.

Rated input Btu/hr thousands	Size inches w/o exhauster	w/exhauster
22 - 225	8	6
26 - 400	10	8
401 - 1250	NA	10
1300 - 2500	NA	12
2600 - 3125	NA	128 sq. inches
3200 - 4000	NA	182 sq. inches

Note: If furnace piping and fittings are specified in the contract or order and the standard vent connection on the furnace is other than the size specified for the furnace pipe, a suitable adapter shall be furnished.

3.16.3 Draft regulator. When specified (see 6.2), a barometric draft regulator shall be furnished for oil-fired units. The regulator shall be adjustable to encompass a range of settings from 0.02 to 0.08 of an inch of

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water and shall meet the requirements of UL 378. When both vent connections and a draft regulator are specified in the contract, the draft regulator shall be mounted in a tee-section. Otherwise, the regulator shall be furnished separately for mounting at the site.

3.17 Treatment and painting. Unless otherwise specified (see 6.2), the parts shall be treated and painted in accordance with the manufacturer's standard practice. All surfaces of the parts other than corrosion-resisting steel shall be protected against corrosion and present a neat appearance.

3.18 Electromagnetic interference suppression. When specified (see 6.2), motors and controls shall be designed and equipped to meet class C3, group 1 of MIL-STD-461.

3.19 Lubrication. Unless otherwise specified (see 6.2), means for lubrication shall be in accordance with the manufacturer's standard practice. The lubricating points shall be easily visible and accessible. Hydraulic lubrication fittings shall be in accordance with SAL J534. Where use of high pressure lubricating equipment, 1,000 pound-force per square inch (psi) or higher, will damage grease seals or other parts, a suitable warning shall be affixed to the equipment in a conspicuous location.

3.20 Fungus resistance. When specified (see 6.2), electric components and circuit elements including terminal and circuit connections shall be treated for moisture and fungus resistance in accordance with MIL-T-13867 as specified herein. Electrical components with temperature rise of 40 deg. centigrade (C) or less shall be coated in accordance with type II of MIL-1-13867 with fungus resistance varnish conforming to MIL-V-173. Components with a temperature rise exceeding 40 deg. C shall be coated in accordance with type III or IV of MIL-T-13867 with varnish conforming to MIL-1-24092 with grade and class of varnish dependent on the component, class of insulation above 40 deg. C and the recommendation of the manufacturer of the equipment.

3.21 Identification date. Identification shall be permanently and legibly marked directly on the furnace or on a corrosion-resisting metal plate securely attached to the furnace at the source of manufacturer. Identification shall include definitive specification part number, manufacturer's model and serial number, name and trademark to be readily identifiable to the manufacturer.

3.21.1 Definitive specification part number. The specification part number is a definitive part number which will be formulate to identify each item covered by this specification. The part number will be formulated by selecting the appropriate type, style, groups and burner kind designator. Example: WW-F-2743.2.1.2.1 represents a type II, style A, group 2, burner kind LO unit heater.

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Definitive specification Number WW-F-2743 - X - X - X - X
                                         |       |   |   |   |
Specification Number———————————————————┘       |   |   |   |
type Designator (see 3.21.2———————————————————┘   |   |   |
Style Designator (see 3.21.3)———————————————————┘   |   |
Group Designator (see 3.21.4)———————————————————┘   |
Burner Kind Designator (see 3.21.5)———————————————————┘
```

3.21.2 Type designator. A one-position field used to designate types (I-1, or 2-II).

3.21.3 Style designator. A one-position field used to designate styles (Style A-1, style B-2, style C-3, and style D-4).

3.21.4 Group designator. A one position field used to designate groups (group 1-1, group 2-2, and group 3-3).

3.21.5 Burner kinds. A one-position field used to designate burner kinds (LO-1, G-2, HO-3, GLO-4, and GHO-5).

3.22 Instruction plates. The equipment shall be provided with instruction plates describing special or important procedures for operating and servicing equipment and warnings of hazardous procedures. Instruction plates shall comply with the provisions of ANSI Z21.47, ANSI Z83.8, UL 727, UL 731 or UL 795, as applicable.

3.22.1 Military marking. When specified (see 6.2), units shall be marked for identification in accordance with MIL-STD-130 in addition to the marking specified in 3.21. The marking shall be applied to the units on a plate which shall be made of a material which will last and remain legible for the life of the equipment. Plates shall be attached to the equipment by bolts, screws, or rivets in a conspicuous location affording protection against damage or disfigurement during normal use of the equipment.

3.23 Technical manuals. The contractor shall provide technical manual(s) conforming to the Data Item Description(s) listed on the Contract Data Requirements List (DD Form 1423). Each manual shall contain at least the basic operating and installation instructions required under UL 727, UL 731, UL 795, ANSI Z21.47, or ANSI Z83.8, as applicable.

3.24 Workmanship.

3.24.1 Steel fabrication. The steel used in fabrication shall be free from kinks, sharp bends, and other conditions which would be deleterious to the finished product. Manufacturing processes shall not reduce the strength of the steel to a value less than intended by the design. Manufacturing processes shall be done neatly and accurately. All bends shall be made by controlled means to insure uniformity of size and shape.

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3.24.2 Bolted connections. Bolt holes shall be accurately punched or drilled and shall have the burrs removed. Washers or lockwashers shall be provided in accordance with good commercial practice, and all bolts, nuts, and screws shall be tight.

3.24.3 Welding. Welding procedures shall be in accordance with a nationally recognized welding code. The surface of parts to be welded shall be free from rust, scale, paint, grease, or other foreign matter. Welds shall be of sufficient size and shape to develop the full strength of the parts connected by the welds. Welds shall transmit stress without permanent deformation or failure when the parts connected by the weld are subjected to proof and service loadings.

3.24.4 Machine work. Tolerances and gages for metal fits shall conform to the standards of commercial practice. Finished contact and bearing surfaces shall be true and exact.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor’s overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Component and material inspection. Components and materials shall be inspected in accordance with all the requirements specified herein and in applicable referenced documents.

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4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. First article inspection (see 4.2.1).
b. Quality conformance inspection (see 4.2.2).

4.2.1 First article inspection. The first article inspection shall be performed on one of each classification of furnace as specified when a first article is required (see 3.3 and 6.2). This inspection shall include the examination of 4.3, the tests of 4.4 and 4.6, and, when specified, the preproduction pack inspection of 4.7 (see 4.7 and 6.2). The first article may be either a first production item or a standard production item from the supplier's current inventory provided the item meets the requirements of the specification and is representative of the design, construction, and manufacturing technique applicable to the remaining items to be furnished under the contract.

4.2.2 Quality conformance inspection. The quality conformance inspection shall include the examination of 4.3, the tests of 4.5, and the packaging inspection of 4.7.

4.3 Examination. Each unit shall be examined for compliance with the requirements specified in section 3 of this specification. Any redesign or modification of the contractor's standard product to comply with specified requirements, or any necessary redesign or modification following failure to meet specified requirements shall receive particular attention for adequacy and suitability. This element of inspection shall encompass all visual examinations and dimensional measurements. Noncompliance with any specified requirements or presence of one or more defects preventing or lessening maximum efficiency shall constitute cause for rejection.

4.3.1 Standards compliance. The contractor shall make available to the contracting officer or his authorized representative evidence of compliance with the applicable standards cited in 3.6. The Government reserves the right to examine and test all units to determine the validity of the certification.

4.4 First article tests.

4.4.1 Operational test. The first article shall be subjected to an operational fire test to verify the functional adequacy of burners, blowers, and controls. This unit shall be set up with the test duct as specified in the applicable UL or ANSI standard to maintain the required external static test pressure. The unit shall be operated sufficiently to assure equilibrium is established with the air flow rate adjusted to give the rated outlet temperature of 85 deg. F rise or as required in the contract. Under these conditions, the unit shall operate continuously at rated thermal input without interference from the limit control. After the initial test period,

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the limit control cutout point shall be checked as prescribed in UL 727, UL 731, UL795, ANSI Z21.47, or ANSI Z83.8. During the operational test, the ignition system shall be checked for proper light-off, the burner flame observed for proper shape, color, or excessive smoking, and the blower control checked for proper setting.

4.4.2 Flame safeguard test. After completion of the test of 4.4.1, the flame safeguard control on the sample test unit shall be tested by manually closing the main fuel supply valve to simulate a flame failure. The time required for safety shutdown of the unit shall be checked for requirements of 3.14.4.

4.4.3 Heat exchanger tightness test. During or after the test of 4.4.1, the heat exchanger on the sample test unit shall be tested for tightness. The test may be conducted by introducing a fuming or smoking material into the combustion chamber; by taking comparative carbon dioxide readings at two different external static pressures; by pneumatic pressure tests conducted prior to final assembly of the units; or by an equivalent method normally used by the manufacturer.

4.4.4 Thermal efficiency. The unit shall be tested to verify compliance with the thermal input of 3.8.1 and the efficiency requirements of 3.8.2. During the tests, the stack temperature and smoke reading shall also be recorded. Tests shall be conducted as follows:

a. For group I units; in accordance with DOE 10 CFR, Part 430, subpart B, Appendix N for steady state efficiency only.
b. For group II, group III, and type 1 units, in accordance with UL 727, UL 731, UL 795, ANSI Z21.47, and ANSI Z83.8, as applicable.

Efficiency tests shall be conducted only after satisfactory completion of the tests of 4.4.1, 4.4.2, and 4.4.3.

4.4.5 Control tests. In addition to the tests of 4.4, the following controls on group 3 first article shall be checked, as applicable, to verify compliance with the applicable requirements of this specification and of referenced standards:

a. Programming sequence control.
b. High-low-off control.
c. On-off control.

4.5 Quality conformance tests. The contractor shall have an established test system which shall assure compliance with the requirements of the specification and of the referenced standards. The system shall include the methods, procedures, controls, records, and maintenance of the system to provide verification for the certifying agency of compliance with the requirements of this specification and of the reference standards and has been found mutually acceptable to the contractor and the certifying agency.

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4.6 Test for electromagnetic interference suppression. When conformance to electromagnetic interference suppression limits is required, the equipment shall be tested in accordance with MIL-STD-462 to determine conformance to the electromagnetic suppression characteristics of 3.18. Then suppressed to conform to 3.18 the contractor may, upon approval of the contracting officer, furnish a certificate of compliance in lieu of the test, together with a list of the suppression devices installed. The list shall be sufficiently detailed to allow visual determination that the devices are installed. This requirement shall apply to the first production unit when a first article is not required.

4.7 Packaging inspection. The inspection of the preservation, packing, and marking shall be in accordance with the requirements of section 4 of Mil-B-3180. The inspection shall consist of the quality conformance inspection; and, when specified (see 6.2), a preproduction pack shall be furnished for examination and test within the time frame required (see 6.2).

5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, and packing. Preservation, packaging, and packing shall be in accordance with the requirements of MIL-B-3180 with the level of preservation, packaging and the level of packing as specified (see 6.2).

5.2 Marking.

5.2.1 Military agencies. Shipments to military agencies shall be marked in accordance with MIL-STD-129.

5.2.2 Civil agencies. Shipments to civil agencies shall be marked in accordance with FED-STD-123.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Central furnaces are intended for installation in family housing or nonfamily housing structures primarily to supply heated air through a sheet metal duct system. Unit heaters are intended primarily for installation in such nonfamily structures as warehouses, industrial shops, auditoriums, hangars, and gymnasiums where warm air will be directly diffused into the space in which the heater is located. Downflow furnaces can be used to an advantage with under-floor duct systems in structures having no basements for central-furnace location. Downflow furnaces are also referred to as counterflow units since the heated-air path runs in a direction counter to the flue gas passage.

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6.2. Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.
b. Type, style, and burner type required; type of gas for burner types G, GLO, and GHO (see 1.2.3, 3.8.1 and 3.21).
c. Issue of DoDISS to be cited in the solicitation and if required, the specific issue of individual documents cited (see 2.1.1 and 2.2).
d. When a first article is required (see 3.3).
e. Thermal input required Btu/hr (see 3.8.1).
f. When efficiency, output capacity, and temperature rise will be other than as specified (see 3.8.2, 3.8.3 and 3.8.4).
g. When external static pressure and air flow (cfm) other than rated will apply (see 3.8.5).
h. When installation clearances will be other than as specified (see 3.9).
i. When group 2 and group 3 units will be equipped with air filters and, if so, when a particular type is required (see 3.9.1).
j. When discharge nozzles or deflector hood are required (see 3.9.2).
k. When automatic vent damper device is required (see 3.9.3).
l. Heating value and supply pressure for gas-fired units if other than natural gas will be used; altitude at which gas-fired units will operate if above 2,000 feet (see 3.11.2).
m. When blower speeds on units will be adjustable and with number of speeds (see 3.13).
n. When group 3 units will be equipped with high-low-off controls or modulated controls (see 3.14).
o. When thermostatic switch is required; whether for family housing, or nonfamily housing; when thermometer is required; or whether alternate or supplementary controls are required (see 3.14.1).
p. When thermostatic switches for group 1 and group 2 units require heating only, heating-cooling, one stage, two stages and manual or automatic changeover (see 3.14.1.1).
q. When thermostatic switches for group 3 units require heating only, heating-cooling, one stage or two stage, and manual or automatic changeover (see 3.14.1.2).
r. When an oil delay valve is required on group 1 and group 2 units (see 3.14.5).
s. Required electrical characteristics of motors; when other than drip proof motors are required (see 3.15.1).
t. When other than NEMA type 1 enclosures are required for magnetic starters (see 3.15.2).
u. For group 3 units, when other than NEMA type 1 enclosures are required for the control panel (see 3.15.3).
v. When induced draft fans will be furnished on group 2 units (see 3.16.1).
w. When vent connections are required for space heaters (see 3.16.2).
x. When a draft regulator is required (see 3.16.3).
y. When treatment and painting procedures will be other than Manufactures Standards (see 3.17).

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z. When electromagnetic interference control is required (see 3.18).
aa. When lubrication will be different (see 3.19).
bb. When treatment for fungus resistance is required (see 3.20).
cc. When military marking in accordance with MIL-STD-130 is required and the information to be marked (see 3.22.1).
dd. When a preproduction pack inspection is required and time frame required for submittal (see 4.7).
ee. Level of preservation and level of packing required (see 5.1).

6.3 First article. When a first article inspection is required, the item will be tested and should be a first article sample, or it may be a standard production item from the contractor's current inventory as specified in 4.2.1. The first article should only be required when compliance with the applicable standards cited in 3.6 or certification specified in 3.7 are not made available. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examination, test, and approval of the first article.

MILITARY INTERESTS:

Custodians:

Navy - YD
Air Force - 99

Review Activities:

Air force - 84
DLA - CS

User Activity:

Army - CL

Preparing Activity:

Navy - YD

(Project No. 4520-0334)