SECTION 23 8239

UNIT HEATERS

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LANL MASTER SPECIFICATION SECTION

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| --- |
| Rev. 2 Summary of changes: Updated manufacturer names. Updated code/standard references. Streamlined submittals. Minor editorial updates. |

Word file at <https://engstandards.lanl.gov>

This template must be edited for each project.  In doing so, specifier must add job-specific requirements. Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer. Once the choice is made or text supplied, remove the brackets. The specification section must also be edited to delete items for processes, items, or designs that are not included in the project -- and specifier’s notes such as these.  This template is tailored to meet requirements contained in the LANL Engineering Standards Manual (ESM). To seek a variance from requirements of the ESM that are applicable, contact the ESM Mechanical[POC](http://engstandards.lanl.gov/POCs.shtml#mech). Please contact POC with suggestions for improvement as well.

When assembling a specification package, include applicable specification sections from all Divisions, especially Division 1, General Requirements.

This template is developed for ML-4 projects. For ML-1, 2, and 3 applications, additional requirements and independent reviews should be added if increased confidence in procurement or execution is desired; see ESM Chapter 1 Section Z10 Specifications and Quality sections.

This template was developed to meet the requirements of ASHRAE 90.1-2019 and ASME B31.9-2020. The designer is responsible to update the template if the edition differs from the above for the specific project.

Seismic: If all unit heaters are not exempt from seismic design per ASCE 7 paragraph 13.1.4 then, prior to attempting to edit this section to be project-specific, refer to Sections 22 0548.23, *Vibration and Seismic Controls for Mechanical Systems*, and 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*, as applicable. To edit this section for job-specific seismic requirements, refer to author notes that begin with “Seismic.” Also, see the Seismic Specification Guide for Mechanical Non-Structural Components webposted with the LANL Master Specifications [here](https://engstandards.lanl.gov/seismic-editing.shtml) for guidance on properly editing this section.

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1. GENERAL
	* + 1. SUMMARY
				1. Section Includes:

Cabinet unit heaters with centrifugal fans and [hot-water] [electric-resistance heating] coils.

Propeller unit heaters with [hot-water] [electric-resistance heating] coils.

Wall and ceiling heaters with propeller fans and electric-resistance heating coils.

Gas-fired unit heaters.

* + - 1. PERFORMANCE REQUIREMENTS
				1. Unit heaters shall perform satisfactorily in the following service conditions:
			2. Elevation: 7500 feet above sea level.
			3. Maximum ambient temperature: 104 degrees F.
			4. Minimum ambient temperature: Minus 20 degrees F.
			5. 24-hour average temperature: not exceeding 86 degrees F.

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Seismic: Delete paragraph below if unit heaters are exempt from seismic design. However, if paragraph applies:

* Edit it in accordance with content of 22 0548.23 and/or 01 8734

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1. Seismic Performance Requirements: The unit(s) shall remain in place without separation of any parts when subjected to the design basis earthquake [per Section 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*] [as represented by the seismic forces derived from the criteria indicated [on the Drawings] [in Section 22 0548.23, *Vibration and Seismic Controls for Mechanical Systems]].*
	* + 1. REFERENCES
				1. AHRI 440 I-P – *Performance Rating of Fan-coil Units*
				2. ANSI Z83.8 – *Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters, and Gas-Fired Duct Furnaces*
				3. ASHRAE 62.1 – *Ventilation for Acceptable Indoor Air Quality*
				4. ASHRAE 90.1 *– Energy Standard for Buildings Except Low-Rise Residential Buildings.*
				5. ASHRAE 33 – *Methods of Testing Forced-Circulation Air-Cooling and Air-Heating Coils*
				6. ASME B16.22 – *Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings*
				7. ASME B31.9 – *Building Services Piping*
				8. ASTM A126 – *Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings*
				9. ASTM B88 – *Standard Specification for Seamless Copper Water Tube*
				10. ASTM C916 – *Standard Specification for Adhesives for Duct Thermal Insulation*
				11. ASTM E84 – *Standard Test Method for Surface Burning Characteristics of Building Materials*
				12. IEEE 841 - *Premium-Efficiency, Severe-Duty, Totally Enclosed Squirrel Cage Induction Motors from 0.75 kW to 370 kW (1 HP to 500 HP)*
				13. NFPA 54 – *National Fuel Gas Code*
				14. NFPA 70 – *National Electric Code*
				15. NFPA 90A – *Standard for the Installation of Air-Conditioning and Ventilation Systems*
				16. NFPA 90B – *Standard for the Installation of Warm Air Heating and Air-Conditioning Systems*
				17. UL 1995 – *Heating and Cooling Equipment*
				18. UL 2021 – *Fixed and Location-Dedicated Electric Room Heaters*
				19. 29 CFR 1910 – *Occupational Safety and Health Standards*

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Seismic: If the unit heaters are exempt from seismic design, then delete both 01 8734 and 22 0548.23. Otherwise, see the seismic portion of the previous author note.

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* + - 1. RELATED SECTIONS
				1. Section 01 2500, *Substitution Procedures*
				2. [Section 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*, for requirements.]
				3. [Section 01 8113.13, *Sustainable Design* **[LEED v4 and]**Guiding Principles 2020: Requirements for water efficiency, energy efficiency, material composition, and indoor air quality requirements]
				4. Section 22 0529*, Hangers and Supports for Plumbing Piping and Equipment*.
				5. [Section 22 0548.23, *Vibration and Seismic Controls for Mechanical Systems,* for [seismic-design criteria,] submittal requirements, devices for seismic restraint, and installation requirements for these devices]
				6. Section 23 1123, *Facility Natural-Gas Piping*.
				7. Section 23 2123, *Hydronic Piping*
				8. Section 26 0519, *Low Voltage Electrical Power Conductors and Cables.*
				9. Section 26 0526, *Grounding and Bonding for Electrical Systems.*
			2. ACTION SUBMITTALS
				1. Product Data: For each type of product.

Include rated capacities, operating and physical characteristics (weight, dimensions, mounting details etc.), furnished specialties, wiring diagrams, and accessories.

* + - 1. INFORMATIONAL SUBMITTALS

Retain "Coordination Drawings" Paragraph below for situations where limited space necessitates maximum utilization for efficient installation of different components or if coordination is required for installation of products and materials by separate installers. Coordinate paragraph with other Sections specifying products listed below. Preparation of coordination drawings requires the participation of each trade involved in installations within the limited space.

Retain "Seismic Qualification Data" Paragraph below if required by seismic criteria applicable to Project. Coordinate with Section 23 0548.23 "Vibration and Seismic Controls for Mechanical Systems." See ASCE/SEI 7 for certification requirements for equipment and components.

* + - * 1. Field quality-control reports.
				2. Installation instructions.
				3. At Closeout:

Operation and Maintenance Data: For propeller unit heaters to include in operation, and maintenance manuals.

Warranty.

* + - 1. QUALITY ASSURANCE
				1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by any nationally recognized testing laboratory (NRTL) recognized under 29 CFR 1910.7.
				2. ASHRAE Compliance:

Applicable requirements in ASHRAE 62.1, Section 5 - Systems and Equipment; and Section 7 - Construction and Startup.

Applicable requirements in ASHRAE 90.1, Section 6 - Heating, Ventilating, and Air-Conditioning.

* + - * 1. Gas-Fired Unit Heater Performance Requirements: Conform to minimum efficiency prescribed by ASHRAE 90.1 when tested in accordance with ANSI Z83.8.
				2. ASME B31.9 Compliance: Applicable requirements for listed items, per section 926.
			1. WARRANTY
				1. Furnish [five] [ten] [\_\_\_\_] year manufacturer warranty for unit heater.
1. PRODUCTS

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For unit heaters that are not exempt from seismic, if project specification package includes 22 0548.23, and if mounting and/or anchorage devices are to be used that differ from those specified in 22 0548.23, they must be described herein (in PART 2).

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* + - 1. PRODUCT OPTIONS AND SUBSTITUTIONS
				1. Alternate products may be accepted; follow Section 01 2500, *Substitution Procedures*.
			2. MANUFACTURERS
				1. Subject to compliance with requirements, provide products indicated on drawings or a comparable product by one of the following:

Chromalox, Inc.; a division of Emerson Electric Company.

Indeeco.

Modine Manufacturing Company.

Daikin Applied.

Reznor/Thomas & Betts Corporation.

Trane Technologies.

* + - 1. CABINET UNIT HEATERS
				1. Description: A factory-assembled and tested unit complying with AHRI 440 I-P, Performance Rating of Room Fan-Coils.

Comply with the safety requirements in [UL 1995 for heaters with hot water coils] [UL 1995 and UL 2021 for heaters with electric heating coils].

* + - * 1. Cabinet: Steel with baked-enamel finish with manufacturer's standard paint.

Vertical Unit, Exposed Front Panels: Minimum [16 gage] [14 gage], galvanized, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.

Horizontal Unit, Exposed Bottom Panels: Minimum [16 gage] [14 gage], galvanized, sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.

Control Access Door: Key operated.

Vertical Mounted Units:

Base: Minimum 16 gage steel, finished to match cabinet, 6 inches high with leveling bolts.

False Back: Minimum 18 gage thick steel, finished to match cabinet.

Extended Piping Compartment: [8-inch] [ ] wide piping end pocket.

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Based on heating coil selected, retain applicable paragraph on hot-water or electric-resistance heating coil below.

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* + - * 1. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 degrees F. Include manual air vent and drain.

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* + - * 1. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, mounted in ceramic inserts in galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate coils in stainless-steel machine-staked terminals secured with stainless-steel hardware.
				2. Fan and Motor:

Fan: Centrifugal; forward curved, double width, directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.

Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in IEEE 841.

Wiring Terminations: Connect motor to chassis wiring with plug connection.

* + - * 1. Coil Section Insulation: Glass-fiber insulation; surfaces exposed to airstream shall be [aluminum-foil facing] [erosion-resistant coating] to prevent erosion of glass fibers.

Thickness: [1/2 inch] [1 inch] [1-1/2 inches].

Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 degrees F mean temperature.

Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E84.

Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.

Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

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Retain first paragraph and one or more of the subparagraphs below to require factory piping package.

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* + - * 1. Factory, Hot-Water Piping Package: [ASTM B88, Type L] [ASTM B88, Type M] copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet and outlet.

Hose Kits: Minimum 400-psig working pressure, and operating temperatures from 33 to 211 degrees F. Tag hose kits to equipment designations.

Length: [24] [36] [ ] inches.

Minimum Diameter: Equal to cabinet unit heater connection size.

Two-Piece, Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum cold working pressure (CWP) rating and blowout-proof stem.

Calibrated-Orifice Balancing Valves: Bronze body, ball type, 125-psig working pressure, 250 degrees F maximum operating temperature; with calibrated orifice or venture, connection for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.

Y-Pattern, Hot-Water Strainers: Cast-iron body (ASTM A126, Class B); 125-psig minimum working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 threaded pipe and full-port ball valve in strainer drain connection.

Wrought-Copper Unions: ASME B16.22.

* + - * 1. Basic Unit Controls:

[Provide control via the Building Automation System.]

[Control voltage transformer.]

[Wall-mounting] [Unit-mounted] thermostat with the following features:

Heat-off switch.

Fan on-auto switch.

Adjustable deadband.

[Concealed] [Exposed] set point.

[Concealed] [Exposed] indication.

Temperature indication.

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[Wall-mounting] [Unit-mounted] temperature sensor.

Unoccupied period override push button.

Data entry and access port.

Input data includes room temperature, and occupied and unoccupied periods.

Output data includes room temperature, supply-air temperature, entering-water temperature, operating mode, and status.

* + - * 1. Electrical Connection: Factory wire motors and controls for a single field connection.
			1. PROPELLER UNIT HEATERS
				1. Description: An assembly including casing, coil, fan, and motor in [vertical] [and] [horizontal] discharge configuration with adjustable discharge louvers.

Comply with the safety requirements in [UL 1995 for heaters with hot water coils] [UL 1995 and UL 2021 for heaters with electric heating coils].

* + - * 1. Cabinet: Removable panels for maintenance access to controls. Baked-enamel finish applied to factory-assembled and factory-tested propeller unit heater before shipping.
				2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
				3. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

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Based on heating coil selected, retain applicable paragraph on hot-water or electric-resistance heating coil below.

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* + - * 1. Hot-Water Coil: Test and rate hot-water propeller unit heater coils according to ASHRAE 33. Copper tube, minimum 0.025-inch wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 325 degrees F, with manual air vent. Test for leaks to 350 psig underwater.

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* + - * 1. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Coil ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 degrees F at any point during normal operation.

Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.

Wiring Terminations: Stainless-steel or corrosion-resistant material.

* + - * 1. Fan and Motor:

Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

Motor: Permanently lubricated. Comply with requirements in IEEE 841.

* + - * 1. Control Devices: [[Unit-mounted] [Wall-mounting] thermostat (tamperproof for locations where heater is used for freeze protection only)] [Provide control via the Building Automation System].
			1. WALL AND CEILING ELECTRIC UNIT HEATERS
				1. Description: An assembly including chassis, electric-resistance heating coil, fan, motor, and controls. Comply with UL 2021.
				2. Cabinet:

Front Panel: [Stamped-steel louver] [Extruded-aluminum bar grille], with removable panels fastened with tamperproof fasteners.

Finish: Baked enamel over baked-on primer with manufacturer's [standard] [custom] color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.

Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

* + - * 1. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.
				2. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate coils in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection. Provide integral circuit breaker for overcurrent protection.
				3. Fan: Aluminum propeller directly connected to motor.

Motor: Permanently lubricated. Comply with requirements in IEEE 841.

* + - * 1. Controls: [Unit-mounted thermostat (tamperproof for locations where heater is used for freeze protection only). Low-voltage relay with transformer kit.] [Provide control via the Building Automation System.])
				2. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.
			1. GAS-FIRED UNIT HEATERS
				1. Description: Self-contained, packaged, factory assembled, consisting of cabinet, supply fan, heat exchanger, burner, controls, and accessories, piped and wired, and complying with ANSI Z83.8.
1. Fuel Type: Natural gas.
2. Discharge Louvers: Individually adjustable [vertical] [horizontal] louvers to match cabinet finish.
3. Downturn Nozzle: Discharge at 25 to 65 degrees to match outlet and cabinet finish.
4. Location: [Floor mounted] [Suspended overhead].
	1. Cabinet: Galvanized steel, easily removed and secured access panels, insulated or double panel construction.
	2. Supply Fan: Propeller type with [direct] [belt] drive [, variable pitch motor pulley].
	3. Heat Exchanger: [Aluminized steel] [Stainless steel] welded construction.
	4. Gas Burner Venting: [Atmospheric type] [Induced Draft] [Forced Draft] [Gravity vented] [Power-vented with non-corrosive air blower with permanently lubricated motor].
	5. Controls: Regulated redundant gas valve containing pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
		* 1. Gas Control Valve: [Single state] [Two stage] [Modulating-electric or mechanical].
			2. Ignition System: [Standing pilot] [Electronically controlled electric spark with flame sensor].
			3. Fan Thermal Switch: Operates fan on heat-exchanger temperature.
			4. Vent Flow Verification: [Flame rollout switch] [Differential pressure switch to verify open vent].
			5. Control transformer.
			6. High Limit: Thermal switch or fuse to stop burner.
			7. Thermostat: [[Single-stage] [Two stage] wall-mounting type with operating range of 50 to 90 degrees F and fan ON switch] [Provide control via the Building Automation System.]
5. EXECUTION

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For unit heaters that are not exempt from seismic, if project specification package includes 22 0548.23, and if requirements associated with installation, testing, and inspection of mounting and/or anchorage devices differ from those requirements in 22 0548.23, they must be described herein (in PART 3). Also, if this is applicable, identify special types of seismic-control devices required for each application using the same terminology used for those devices in PART 2.

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* + - 1. INSTALLATION
				1. Install unit heaters to comply with NFPA 90A.

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Seismic: Flexible connections (between the unit heaters and other nonstructural components it’s associated with) are one of the requirements for the exemption from seismic design. Ensure such connections are indicated on the drawings in the applicable location(s).

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* + - * 1. Install and connect gas-fired unit heaters and associated fuel and vent features and systems according to NFPA 54. [Install flexible connections where shown on drawings].
				2. Suspended Units: Suspend unit heaters from structure with all-thread hanger rods and seismic restraint. Adjust hangers so unit is level and plumb. Hanger rods and attachments to structure are specified in Section [22 0529, *Hangers and Supports for Plumbing Piping and Equipment*] [22 0548.23, *Vibration and Seismic Controls for Mechanical Systems]*. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with drawings and room details before installation.
				3. Gas Piping: Comply with Section 23 1123, *Facility Natural-Gas Piping*. Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.
				4. Hot Water Unit Heaters: Comply with Section 23 2113, *Hydronic Piping*. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater.
				5. Install piping adjacent to machine to allow service and maintenance.
				6. Connect piping to unit heater's factory, hot-water piping package. Install the piping package if shipped loose.
				7. Ground equipment according to Section 26 0526, *Grounding and Bonding for Electrical Systems.*
				8. Connect wiring according to Section 26 0519, *Low Voltage Electrical Power Conductors and Cables.*
				9. Adjust initial temperature set points.
				10. Adjust burner and other unit components for optimum heating performance and efficiency.
			1. FIELD QUALITY CONTROL
				1. Perform the following field tests and prepare test reports:

Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

For units that have electric resistance heating coils, operate electric heating coils through each stage to verify proper operation and electrical connections.

Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

* + - * 1. Remove and replace malfunctioning units and retest as specified above.
			1. SCHEDULE
				1. See the equipment schedule on the drawings.

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As a minimum, the following information and performance characteristics shall be shown on the drawings as part of the equipment schedule.

Cabinet Unit Heaters:

Manufacturer & Model Number

Fan:

Airflow: [ ] cfm.

External Static Pressure: [ ] inches wg.

Fan Speed: [ ] rpm.

Motor Size: [ ] hp

Heating Capacity:

Output: [ ] Btu/h.

Entering-Air Temperature: [ ] degrees F.

Air-Temperature Rise: [ ] degrees F.

Hot-Water Heating Coil:

Water Flow: [ ] gpm.

Water-Side Pressure Loss: [ ] feet wg.

Entering-Water Temperature: [ ] degrees F.

 \*\*\*\*\*\*\*\*\*\*\*\*OR\*\*\*\*\*\*\*\*\*\*\*\*

Electric-Resistance Heating Coil:

Capacity: [ ] kW.

Number of Steps: [ ].

Filters:

Face Area: [ ] sq. ft.

Thickness: [1/2 inch] [1 inch].

Electrical Characteristics for Single-Point Connection:

Volts: [120] [208] [230] V.

Phase: [Single] [Three].

Hertz: 60

Propeller Unit Heaters:

Manufacturer & Model Number

Supply Air:

Airflow: [ ] cfm.

Leaving-Air Temperature: [ ] degrees F

Entering-Air Temperature: [ ] degrees F

Fan

Fan Speed: [ ] rpm.

Motor Size: [ ] hp

Heating Capacity:

Output: [ ] Btu/h.

Entering-Air Temperature: [ ] degrees F.

Air-Temperature Rise: [ ] degrees F.

Hot-Water Heating Coil:

Water Flow: [ ] gpm.

Water-Side Pressure Loss: [ ] feet wg.

Entering-Water Temperature: [ ] degrees F.

Temperature Difference: [ ] degrees F.

 \*\*\*\*\*\*\*\*\*\*\*\*OR\*\*\*\*\*\*\*\*\*\*\*\*

Electric-Resistance Heating Coil:

Capacity: [ ] kW.

Number of Steps: [ ].

Electrical Characteristics for Single-Point Connection:

Volts: [120] [208] [230] V.

Phase: [Single] [Three].

Hertz: 60

Wall & Ceiling Electric Unit Heaters:

Manufacturer & Model Number

Airflow: [ ] cfm.

Fan Speed: [ ] rpm.

Electric-Resistance Heating Coil: [ ] kW.

Electrical Characteristics for Single-Point Connection:

Volts: [120] [240] [480].

Phase: [Single] [Three].

Hertz: 60.

Gas-Fired Unit Heater:

1. Manufacturer & Model Number
2. Gas Input: [ ] Btu/h
3. Gas Output: [ ] Btu/h
4. Minimum Combustion Efficiency: 80 [ ] percent.
5. Minimum Airflow: [ ] cfm
6. External Static Pressure: [ ] inches wg
7. Motor Size: [ ] horsepower
8. Motor Speed: [ ] rpm.
9. Electrical Characteristics:

Volts: [120] [208] [230] V.

Phase: [Single] [Three].

Hertz: 60.

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END OF SECTION

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Do not delete the following reference information.

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THE FOLLOWING STATEMENT IS FOR LANL USE ONLY

This project specification section is based on LANL Master Specification Section 23 8239 Rev. 2, dated October 21, 2024.