UL 1482

STANDARD FOR SAFETY

Solid-Fuel Type Room Heaters

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UL Standard for Safety for Solid-Fuel Type Room Heaters, UL 1482

Seventh Edition, Dated April 25, 2011

Summary of Topics

This revision of ANSI/UL 1482 dated June 15, 2022 includes changes in the Marking Instructions; 4.10, 53.3 and 54.2.3

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The revised requirements are substantially in accordance with Proposal(s) on this subject dated May 14, 2021 and September 10, 2021.

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Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 These requirements cover room heaters which are freestanding fire chamber assemblies of the circulating or direct radiation type. These products are for attachment to a residential type chimney intended for use with low-heat appliances and shall be used to burn solid fuels specified by the manufacturer. These products shall be manually or thermostatically controlled.

1.2 Room heaters are intended for installation in accordance with the Standard for Chimneys, Fireplaces, Vents, and Solid-Fuel Burning Appliances, NFPA 211, and in accordance with codes such as the BOCA National Mechanical Code, the Standard Mechanical Code, and the Uniform Mechanical Code.

1.3 Room heaters intended for use in mobile homes are to be installed in accordance with the Mobile Home Construction and Safety Standards published by the Department of Housing and Urban Development (HUD).

1.4 The product shall include:

a) A field-installed cord-connected or permanently-connected blower assembly; and

b) Other field-installed electrical accessories, rated at 250 volts or less, and intended to be employed in locations in accordance with the National Electrical Code, NFPA 70.

1.5 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this Standard, and that involves a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements to determine that the level of safety as originally anticipated by the intent of this Standard is maintained. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this Standard shall not be judged to comply with this Standard. Where appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this Standard.

2 Components

2.1 General

2.1.1 A component of a product covered by this standard shall:

a) comply with the requirements for that component as indicated in 2.2 – 2.12;

b) be used in accordance with its rating(s) established for the intended conditions of use;

c) be used within its established use limitations or conditions of acceptability;

d) additionally comply with the applicable requirements of this end product standard; and

e) not contain mercury.

Note – Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

Exception No. 1: A component of a product covered by this standard is not required to comply with a specific component requirement that:

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a) involves a feature or characteristic not required in the application of the component in the product,

b) is superseded by a requirement in this standard, or

c) is separately investigated when forming part of another component, provided the component is used within its established ratings and limitations.

Exception No. 2: A component complying with a UL component standard other than those cited in 2.2 – 2.12 is acceptable if:

a) the component also complies with the applicable component standard of 2.2 – 2.12; or

b) the component standard:

1) is compatible with the ampacity and overcurrent protection requirements NFPA 70, where appropriate;

2) considers long-term thermal properties of polymeric insulating materials in accordance with the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B, and

3) any use limitations of the other component standard is identified and appropriately accommodated in the end use application. For example, a component used in a household application, but intended for industrial use and complying with the relevant component standard may assume user expertise not common in household applications.

2.1.2 A component that is also intended to perform other functions, such as over current protection, ground-fault circuit-interruption, surge suppression, any other similar functions, or any combination thereof, shall comply additionally with the requirements of the applicable UL standard(s) that cover devices that provide those functions.

Exception: Where these other functions are not required for the application and not identified as part of markings, instructions, or packaging for the appliance, the additional component standard(s) need not be applied.

2.1.3 A component not anticipated by the requirements of this standard, not specifically covered by the component standards of 2.2 – 2.12, and that involves a potential risk of electric shock, fire, or personal injury, shall be additionally investigated in accordance with the applicable UL standard, and shall comply with 2.1.1 (b) – (d).

2.1.4 With regard to a component being additionally investigated, reference to construction and performance requirements in another UL end product standard is appropriate where that standard anticipates normal and abnormal use conditions consistent with the application of the Standard for Factory-Built Fireplaces, UL 127.

2.1.5 The term "product" as used in these requirements refers to all room heaters or any part thereof covered by these requirements unless specifically noted otherwise.

2.2 Attachment plugs, receptacles, connectors, and terminals

2.2.1 Attachment plugs, receptacles, appliance couplers, appliance inlets (motor attachment plugs) shall comply with the Standard for Attachment Plugs and Receptacles, UL 498.

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Exception No. 1: Attachment plugs and appliance couplers integral to cord sets or power supply cords are covered under the requirements of the Standard for Cord Sets and Power-Supply Cords, UL 817 and need not comply with UL 498.

Exception No. 2: Plugs, receptacles, connectors, and terminals for specialty applications (e.g. data processing or communications) and located in a low-voltage circuit, complying with Section 32, Separation of Circuits, and not involving the risk of fire or personal injury need not comply with the Standard for Appliance Wiring Material, UL 758.

2.2.2 Quick-connect terminals, both connectors and tabs, for use with one or two 22 – 10 AWG copper conductors, having nominal widths of 0.110, 0.125, 0.187, 0.205, and 0.250 in (2.8, 3.2, 4.8, 5.2, and 6.3 mm), intended for internal wiring connections in appliances shall comply with the Standard for Electrical Quick-Connect Terminals, UL 310.

Exception No. 1: Other sizes of quick-connect terminals shall be investigated with respect to crimp pull out, insertion-withdrawal, temperature rise, and all tests shall be conducted in accordance with UL 310.

Exception No. 2: Plugs, receptacles, connectors, and terminals for specialty applications (e.g. data processing or communications) and located in a low-voltage circuit, complying with Section 32, Separation of Circuits, and not involving the risk of fire or personal injury need not comply with the Standard for Appliance Wiring Material, UL 758.

2.2.3 Wire connectors shall comply with the Standard for Wire Connectors, UL 486A-486B.

Exception: Plugs, receptacles, connectors, and terminals for specialty applications (e.g. data processing or communications) and located in a low-voltage circuit, complying with Section 32, Separation of Circuits, and not involving the risk of fire or personal injury need not comply with the Standard for Appliance Wiring Material, UL 758.

2.2.4 Splicing wire connectors shall comply with the Standard for Splicing Wire Connectors, UL 486C.

Exception: Plugs, receptacles, connectors, and terminals for specialty applications (e.g. data processing or communications) and located in a low-voltage circuit, complying with Section 32, Separation of Circuits, and not involving the risk of fire or personal injury need not comply with the Standard for Appliance Wiring Material, UL 758.

2.2.5 Equipment wiring terminals for use with all alloys of copper, aluminum, or copper-clad aluminum conductors, shall comply with the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E.

Exception: Plugs, receptacles, connectors, and terminals for specialty applications (e.g. data processing or communications) and located in a low-voltage circuit, complying with Section 32, Separation of Circuits, and not involving the risk of fire or personal injury need not comply with the Standard for Appliance Wiring Material, UL 758.

2.2.6 Terminal blocks shall comply with the Standard for Terminal Blocks, UL 1059, and, if applicable, be suitably rated for field wiring.

Exception No. 1: A fabricated parts performing the function of a terminal block need not comply with UL 1059 if the part complies with the requirements of Section 29, Field Supply Connections; Section 30, Grounding; Section 31, Internal Wiring; and Section 35, Insulating Materials.

Exception No. 2: Plugs, receptacles, connectors, and terminals for specialty applications (e.g. data processing or communications) and located in a low-voltage circuit, complying with Section 32, Separation

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of Circuits, and not involving the risk of fire or personal injury need not comply with the Standard for Appliance Wiring Material, UL 758.

2.2.7 Female devices (such as receptacles, appliance couplers, and connectors) that are intended, or that may be used, to interrupt current in the end product, shall be suitably rated for current interruption of the specific type of load, when evaluated with its mating plug or connector. For example, an appliance coupler that can be used to interrupt the current of a motor load shall have a suitable horsepower rating when tested with its mating plug.

Exception: Plugs, receptacles, connectors, and terminals for specialty applications (e.g. data processing or communications) and located in a low-voltage circuit, complying with Section 32, Separation of Circuits, and not involving the risk of fire or personal injury need not comply with the Standard for Appliance Wiring Material, UL 758.

2.3 Boxes and raceways

2.3.1 Electrical boxes and the associated bushings and fittings, and raceways, of the types specified in Chapter 3 of NFPA 70 and that comply with the relevant UL standard (such as UL 514A, UL 514C, UL 514D) and 2.1 are considered to fulfill the requirements of this Standard.

Exception: Enclosures complying with Section 26, Enclosure of this end product standard is considered to meet the intent of this requirement.

2.4 Capacitors and filters

2.4.1 The component requirements for a capacitor are not specified. A capacitor complying with the Standard for Capacitors, UL 810, is considered to fulfill the requirements of 17.1.

2.4.2 Electromagnetic interference filters with integral enclosures that comply with the Standard for Electromagnetic Interference Filters, UL 1283, are considered to fulfill the requirements of 17.1.

Exception: A capacitor that complies with Section 34, Capacitors, of this end product standard is considered to meet the intent of this requirement.

2.5 Controls

2.5.1 General

2.5.1.1 Auxiliary controls shall be evaluated using the applicable requirements of this end product standard.

2.5.1.2 Operating (regulating) controls shall be evaluated using the applicable component standard requirements specified in 2.5.2 – 2.5.5, and if applicable unless otherwise specified in this end product standard. Operating controls that rely upon software for the normal operation of the end product where deviation or drift of the control may result in a hazard, such as a speed control unexpectedly changing its output, shall comply with the:

a) Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991; and Standard for Software in Programmable Components, UL 1998; or

b) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1.

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2.5.1.3 Protective (limiting) controls shall be evaluated using the applicable component standard requirements specified in 2.5.2.2.

2.5.2 Electromechanical and electronic controls

2.5.2.1 An operating (regulating) control, other than as specified in 2.5.3 – 2.5.5, shall comply with the:

a) Standard for Solid-State Controls for Appliances, UL 244A;

b) Standard for Temperature-Indicating and -Regulating Equipment, UL 873; or

c) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1.

2.5.2.2 Protective (limiting) controls shall comply with the Standard for Limit Controls, UL 353.

2.5.3 Motor and speed controls

2.5.3.1 A control used to start, stop, regulate or control the speed of a motor shall comply with the:

a) Standard for Solid-State Controls for Appliances, UL 244A;

b) Standard for Temperature-Indicating and -Regulating Equipment, UL 873;

c) Standard for Industrial Control Equipment, UL 508;

d) Standard for Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal and Energy, UL 61800-5-1; or

e) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1.

2.5.4 Temperature controls

2.5.4.1 A temperature control shall comply with the:

a) Standard for Solid-State Controls for Appliances, UL 244A;

b) Standard for Temperature-Indicating and -Regulating Equipment, UL 873;

c) Standard for Industrial Control Equipment, UL 508; or

d) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1 and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Temperature Sensing Controls, UL 60730-2-9.

2.5.4.2 A temperature sensing positive temperature coefficient (PTC) or negative temperature coefficient (NTC) thermistor, that performs the same function as an operating or protective control shall comply with the Standard for Thermistor-Type Devices, UL 1434.

2.5.4.3 A thermal cutoff shall comply with the Standard for Thermal-Links (Thermal Cutoffs) for Use in Electrical Appliances and Components, UL 60691.

2.5.5 Timer controls

2.5.5.1 A timer control shall comply with the:

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a) Standard for Solid-State Controls for Appliances, UL 244A; or

b) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1 and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches, UL 60730-2-7.

2.6 Cords, cables, and internal wiring

2.6.1 A cord set or power supply cord shall comply with the Standard for Cord Sets and Power Supply Cords, UL 817.

2.6.2 Flexible cords and cables shall comply with the Standard for Flexible Cords and Cables, UL 62. Flexible cord and cables are considered to fulfill this requirement when preassembled in a cord set or power supply cord complying with the Standard for Cord Sets and Power Supply Cords, UL 817.

2.6.3 Internal wiring composed of insulated conductors shall comply with the Standard for Appliance Wiring Material, UL 758.

Exception No. 1: Insulated conductors need not comply with UL 758 if they comply with one of the following:

a) Standard for Thermoset-Insulated Wires and Cables, UL 44;

b) Standard for Thermoplastic-Insulated Wires and Cables, UL 83;

c) Standard for Fixture Wire, UL 66; or

d) the appropriate UL standard(s) for other insulated conductor types specified in Chapter 3, Wiring Methods and Materials, of NFPA 70.

Exception No. 2: Insulated conductors for specialty applications (e.g. data processing or communications) and located in a low-voltage circuit, complying with Section 32, Separation of Circuits, and not involving the risk of fire or personal injury need not comply with UL 758.

2.7 Overcurrent protection

2.7.1 Fuses shall comply with the Standard for Low-Voltage Fuses – Part 1: General Requirements, UL 248-1; and the applicable UL 248 Part 2 (e.g. UL 248-5). Defined use fuses that comply with UL 248-1 and another appropriate UL standard for the fuse are considered to fulfill this requirement.

2.7.2 Fuseholders shall comply with the Standard for Fuseholders – Part 1: General Requirements, UL 4248-1, and the applicable Part 2 (e.g. UL 4248-9).

2.7.3 Circuit breakers shall comply with the Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures, UL 489.

Exception: Circuit breakers used in telecommunications circuitry that comply with the Standard for Circuit Breakers For Use in Communications Equipment, UL 489A, need not comply with UL 489.

2.7.4 Circuit breakers having integral ground fault circuit interrupter capability for protection against electrical shock shall additionally comply with the Standard for Ground-Fault Circuit-Interrupters, UL 943.

2.7.5 Supplementary protectors shall comply with the Standard for Supplementary Protectors for Use in Electrical Equipment, UL 1077.

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2.7.6 Fusing resistors shall comply with the Standard for Fusing Resistors and Temperature-Limited Resistors for Radio- and Television-Type Appliances, UL 1412.

2.8 Polymeric materials and enclosures

2.8.1 Unless otherwise specified in this end product standard, polymeric electrical insulating materials and enclosures shall comply with the applicable requirements of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

2.8.2 Metallized or painted polymeric parts or enclosures shall comply with the applicable requirements of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. This requirement is not applicable to exterior surfaces of polymeric enclosure materials or parts provided that the metallized coating or paint does not offer a continuous path for an internal flame to propagate externally.

2.9 Power supplies

2.9.1 A Class 2 power supply shall comply with one of the following:

a) Standard for Class 2 Power Units, UL 1310; or

b) Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1, with an output marked "Class 2", or that complies with the limited power source (LPS) requirements and is marked "LPS"; or

c) Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1, marked “Class 2” or the equivalent.

2.9.2 A non-Class 2 power supply shall comply with one of the following:

a) Standard for Power Units Other Than Class 2, UL 1012; or

b) Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1; or

c) Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1.

2.10 Printed wiring boards

2.10.1 Printed wiring boards, including the coatings, shall comply with the Standard for Printed Wiring Boards, UL 796.

Exception: A printed-wiring board in a Class 2 nonsafety circuit is not required to comply with the bonding requirements in UL 796 if the board is separated from parts of other circuits such that loosening of the bond between the foil conductor and the base material will not result in the foil conductors or components coming in contact with parts of other circuits of the control or of the end-use product.

2.11 Switches

2.11.1 Switches shall comply with one of the following, as applicable:

a) Standard for Special-Use Switches, UL 1054;

b) Standard for Switches for Appliances – Part 1: General Requirements, UL 61058-1;

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c) Standard for General-Use Snap Switches, UL 20; or

d) Standard for Nonindustrial Photoelectric Switches for Lighting Control, UL 773A.

Exception: Switching devices that comply with the appropriate UL standard for specialty applications (e.g. transfer switch equipment), industrial use (e.g. contactors, relays, auxiliary devices), or are integral to another component (e.g. switched lampholder) need not comply.

2.11.2 A clock-operated switch, in which the switching contacts are actuated by a clock-work, by a gear-train, by electrically-wound spring motors, by electric clock-type motors, or by equivalent arrangements shall comply with one of the following:

a) Standard for Clock-Operated Switches, UL 917; or

b) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1 and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches, UL 60730-2-7.

2.11.3 A timer or time switch, incorporating electronic timing circuits or switching circuits, with or without separable contacts, shall comply with the requirements for an operating control with Type 1 action for 6000 cycles of operation, or as a manual control for 5000 cycles of operation, in accordance with the following:

a) Standard for Solid-State Controls for Appliances, UL 244A;

b) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1 and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches, UL 60730-2-7.

2.11.4 A timer or time switch, incorporating electronic timing circuits or switching circuits, with or without separable contacts, that functions as a protective control, shall comply with the requirements for a protective control; see 2.5.1.3.

2.12 Transformers

2.12.1 General-purpose transformers shall comply with the Standard for Low Voltage Transformers – Part 1: General Requirements, UL 5085-1; and the Standard for Low Voltage Transformers – Part 2: General Purpose Transformers, UL 5085-2.

Exception: A transformer that is completely enclosed within the end product enclosure, and that meets the applicable construction and performance requirements of this end product standard when tested in conjunction with the end product, meets the intent of this requirement.

2.12.2 Class 2 and Class 3 transformers shall comply with the Standard for Low Voltage Transformers – Part 1: General Requirements, UL 5085-1; and the Standard for Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers, UL 5085-3.

Exception: Transformers located in a low voltage circuit, and that do not involve a risk of fire or personal injury, need not comply with this requirement.

3 Units of Measurement

3.1 If a value for measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement.

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4 Glossary

4.1 For the purpose of this standard, the following definitions apply.

4.2 CHIMNEY CONNECTOR – The flue pipe that connects a fuel-burning appliance to a chimney.

4.3 COMBUSTIBLE MATERIAL AND NONCOMBUSTIBLE MATERIAL – As used in this standard, these terms are defined in the Standard Glossary of Terms Relating to Chimneys, Vents, and Heat-Producing Appliances, NFPA 97M.

4.4 DAMPER – A valve or plate that regulates draft or flow of flue gases or inlet combustion air. The damper shall be either manually or automatically operated.

4.5 GRATE – A frame for supporting the fuel within a room heater.

4.6 HEARTH – The floor area within the fire chamber of a room heater.

4.7 FLOOR PROTECTOR – A manufactured floor protector per the Standard for Wall Protectors, Floor Protectors, and Hearth Extensions, UL 1618.

4.8 FLOOR PROTECTOR (STOVE MAT) – The noncombustible material applied to the combustible floor area located beneath the product and extending beyond the front and sides and to the rear of the product. The area is to be of the dimensions specified in the installation instructions.

4.9 ROOM HEATER, SOLID FUEL TYPE – A chimney-connected solid fuel burning room heater that is designed to be operated with the fire chamber closed.

4.10 FACTORY-BUILT FIREPLACE SYSTEM – A fire chamber and its chimney, consisting entirely of factory-made parts designed for unit assembly without requiring field fabrication. A factory-built fireplace system may also include combustion air and warm air ducts, grilles and accessories.

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ALL ROOM HEATERS

CONSTRUCTION

5 Materials

5.1 A room heater and a chimney connector, when provided, shall be made of noncombustible corrosion-resistant materials. Metals shall not be used in combinations that cause galvanic action at any location within the assembly.

5.2 The minimum thickness of metal, including any coatings, shall comply with Table 5.1.

Exception: Decorative metal parts are not required to comply with Table 5.1.

Table 5.1
Minimum metal thickness

	Inch	(mm)
Aluminum-coated steel Type T1-40 regular [0.40 oz per sq ft (0.12 kg/m^2)]	0.018	0.46
Aluminum alloys	0.016	0.41
Cast iron	0.125	3.17
Galvanized steel (G60 coating class)	0.018	0.45
Porcelain-enameled steel	0.032	0.81
Stainless steel	0.012	0.030
Steel (uncoated or painted)	0.042	1.07

5.3 Aluminum alloys containing more than 1 percent magnesium shall not be used when the reflectivity of the material is employed to reduce the risk of fire.

5.4 The fire chamber of the room heater, and other parts that are visible after installation and in contact with flue gases, shall be of material having the durability and resistance to fire and heat equivalent to fireclay tile, Series 300 or 400 stainless steel, aluminum-coated steel, cast iron, or 0.042 inch (1.07 mm) thick unprotected or painted steel.

5.5 Cast iron and unprotected and painted sheet steel complying with the requirements of footnotes k and l of Table 10.1 comply with the requirements of 5.4.

5.6 Parts that are in contact with flue gases and that are not visible after installation shall be of a material having the durability and resistance to corrosion, fire, and heat equivalent to fireclay tile or Series 300 or 400 stainless steel.

5.7 Thermal insulation material shall be of metal or of a mineral base.

5.8 Thermal insulation shall comply with the following conditions when the room heater is tested in accordance with these requirements:

a) The products resulting from the combustion or volatilization of any combustible binder shall be discharged to the chimney.

b) Insulating material shall remain in the intended position.

c) Thermal conductivity of the insulation shall not increase.

d) The insulation shall not show evidence of softening, melting, or deterioration.

5.9 Thermal insulation shall be protected against contact with the products of combustion.

5.10 Thermal insulation that is not self-supporting shall be applied to solid surfaces so that the insulation does not sag. An adhesive or cement used to attach such material shall retain its adhesive qualities at any temperature the adhesive attains when tested in accordance with these requirements and at 0 °F (minus 17.8 °C).

5.11 A water-absorbing insulating material shall be protected against wetting by condensation or rain when installed as intended.

5.12 The combustion air duct system (when applicable) shall be made of sheet metal not less than 0.016 inch (0.41 mm) thick. See 6.9.1 and 6.9.2.

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Exception: Thinner materials classified as Class 0 or Class 1 air ducts, as defined in the Standard for the Installation of Warm Air Heating and Air Conditioning Systems, NFPA 90B, and in the requirements in the Standard for Factory-Made Air Ducts and Air Connectors, UL 181, shall not be used unless:

a) They comply with the requirements of NFPA 90B and UL 181; and

b) They have been investigated for the intended application.

5.13 Asbestos material shall not be used.

6 Assembly

6.1 General

6.1.1 A room heater and related parts shall be constructed and assembled to have the strength, rigidity, and durability to withstand damage during tests in accordance with these requirements and during handling and installation.

6.1.2 A joint in a metal surface of a fire chamber or flue gas passageway shall be made tight by being welded, lock-seamed, riveted, or bolted. A joint shall not depend primarily on cement for tightness.

6.1.3 Each part or assembly shall be constructed for attachment of one to the other without requiring alteration, cutting, threading, drilling, welding, or similar task by the installer.

Exception: An assembly or component part intended to be cut to length or to be fitted by the installer shall not be provided unless means are furnished for joining any altered part to a companion part or assembly. All fasteners required to complete the assembly shall be provided with the product by the manufacturer. Drilling shall not occur unless:

a) The drilling operation does not weaken the assembly or drill into the fire chamber; and

b) The size of the required drill bit is specified and the instructions clearly describe the locations to be drilled, such as by the use of templates, drawings, or descriptions.

6.1.4 Insulating materials shall be an integral part of the assembly when required to protect combustible parts of the building when the room heater is installed in accordance with the manufacturer's instructions.

Exception: Fire chamber materials shall be packaged and shipped with the heater when:

a) The installation instructions provide for a description of method of placement of this material; and

b) The heater is marked with an adhesive-backed warning marking indicating that the material is to be installed before firing.

6.1.5 Two or more parts or subassemblies that must bear a definite relationship to each other shall be:

a) Arranged and constructed to permit them to be incorporated into the complete assembly without requiring alteration or alignment and only in the correct relationship with each other; or

b) Assembled and shipped from the factory as one element.

6.1.6 Parts of a room heater, such as support legs, chimney, chimney connector parts, and similar materials, that are required to limit temperatures on adjacent construction shall be factory-attached, or shall comply with all of the following:

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a) The parts shall be:

1) Shipped with the room heater; or

2) Marked with the name or trademark of the manufacturer or private labeler, with a catalog number or equivalent designation, and with the type of equipment with which it is intended to be used. The associated heater shall be marked to indicate the catalog number or equivalent designation of such a part, and the name of the manufacturer or private labeler of that part.

b) Assembly of the parts shall comply with the requirements of 6.1.3.

c) The installation instructions shall define and illustrate the intended assembly of the parts.

6.1.7 The room heater shall have no edges, corners, or projections presenting a risk of a cut or puncture-type injury to persons.

6.2 Flue damper

6.2.1 A flue gas outlet damper operated through a linkage or other mechanism shall be constructed so that breakage of a part does not result in the damper partially or completely closing.

6.3 Flue collar

6.3.1 A flue collar shall be made of material not thinner than that required for the fire chamber, and shall provide for attachment and fastening of the chimney connector by at least two screws or other equivalent mechanical methods.

6.3.2 A flue collar shall be of a nominal whole-inch (mm) size diameter of 6 inches (152 mm) or greater or the heater shall be provided with an increasing adaptor to fit to the next larger whole-inch size diameter of 6 inches or greater.

6.4 Radiation shield and baffle

6.4.1 A radiation shield or a baffle shall be constructed, formed, and supported to provide the intended positioning and to prevent distortion or sagging when tested in accordance with these requirements.

6.5 Thermostatic control

6.5.1 A thermostatically controlled air inlet damper shall be constructed so that breakage or malfunction of a part results in the combustion air inlet closing.

6.5.2 When the mechanism of the thermostat control is not accessible (see 10.12), and the thermostatic control is relied upon to limit maximum temperatures, the thermostatic control shall comply with the Standard for Limit Controls, UL 353.

6.6 Grate

6.6.1 A heater that is intended to burn coal only or both coal and wood shall have an integral grate constructed for burning coal.

Exception: A detachable grate constructed for burning coal shall not be provided and shipped separately unless the assembly complies with the requirements in 6.1.6.

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6.7 Separable handle

6.7.1 A separable handle, when provided, shall not remain in position when the user's hand is withdrawn following use.

6.7.2 Storage means shall be provided on the device for separable handles so that when the handle is stored as intended, during the Radiant Fire Test, Section 11 and Brand Fire Test, Section 12, the temperatures on the separable handle do not exceed the temperature limits shown in (f) of Table 10.1.

6.8 Barometric draft regulator

6.8.1 A barometric draft regulator used in conjunction with the flue of a room heater shall comply with the Standard for Draft Equipment, UL 378. It shall be adjusted and set at the heater manufacturer's factory to the maximum draft specified on the heater and shall be shipped with the product.

6.9 Combustion air duct system

6.9.1 The air inlet shall permit zero clearance to combustible construction.

6.9.2 The air inlet shall prevent material from dropping into the inlet or into the area beneath the dwelling, and also prevent rodents from entering from the outside [a wire mesh having openings not larger than 1/4 by 1/4 inch (6.4 by 6.4 mm) meets the intent of the requirement].

PERFORMANCE

7 General

7.1 When a room heater is tested in accordance with these requirements, temperatures on combustible construction adjoining the room heater, chimney connector, and floor area shall be maintained within the limits specified.

7.2 The draft created by the product during its intended operation shall not result in the spillage of the products of combustion from the product into the area served by the device.

7.3 After being tested in accordance with these requirements, the product shall be capable of being further used. After completion of the fire tests, the heater is to be allowed to cool to room temperature and then subjected to the Mechanical Tests, Section 16.

7.4 Results that verify compliance with the requirements of 7.3 include the following:

a) No part has become damaged or permanently distorted so that it ceases to function as intended.

b) Other than paint or porcelain enamel not intended to be a protective coating, the effectiveness of any required protective coating or finish on metal parts has not been impaired.

c) A ceramic or refractory material does not show evidence of cracking, disintegration, or spalling to an extent that impairs the serviceability of the part or the assembly.

d) Cracks are not observable in porcelain enamel used as required protective coating, see 6.1.4, when the surface is examined under a microscope of 60 magnification.

e) The reflectivity of a surface has not been impaired when the reflectivity of such surface is employed to reduce the risk of fire.

f) The effectiveness of insulating material has not been reduced.

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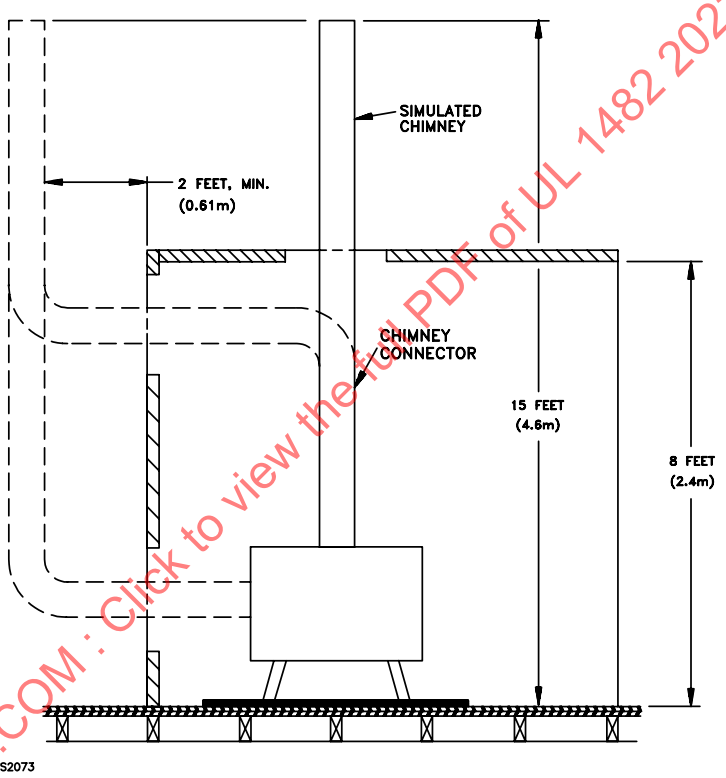
8 Test Installation

8.1 Tests are to be conducted as described in 8.2 – 8.17 on each type of room heater. When the heater is manufactured in more than one size, tests are to be conducted on as many sizes as required to determine compliance with the requirements in 8.2 – 8.17.

8.2 The room heater to be tested is to be installed in a structure similar to that illustrated by Figure 8.1, constructed to accommodate the product as it is to be tested.

Figure 8.1

General form of test structure



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8.3 The test structure is to be erected within a room having ventilation capable of maintaining the buildup of carbon monoxide to less than 50 parts per million throughout the period of any test. The room is to be free of drafts and the chimney is to exhaust into the same space, or into a space freely communicating with the space, from which the combustion air is taken. During any one test the room temperature shall not increase more than 20 °F (11 °C) above the value recorded at the beginning of the test.

8.4 The temperature of the room and the entire test structure within the room shall be between 60 and 90 °F (15.6 and 32.2 °C) at the beginning of the Radiant and Brand Fire Tests, Sections 11 and 12.

8.5 Ventilating, combustion, or cooling air openings into the room heater are to be sealed unless:

a) The openings are more than 1-1/2 inches (40 mm) above the floor and are otherwise arranged to prevent unintentional closure.

b) The openings are not capable of being blocked by the user to overcome a nuisance, such as downdrafts, a cold room, or an overheated room; and

c) The air is drawn from the room in which the room heater is installed and is discharged into the same room or into the flue-gas passageway below the damper, or the air is drawn into the heater through the chimney at the cap which is an integral part of the heater assembly and discharged into the flue-gas passageway below the damper or separate discharge passageway of the chimney.

8.6 That part of the test structure representing the living-space area in which the room heater is to be installed is to consist of a back wall, one side wall, a ceiling, and a floor. See Figure 8.1.

8.7 The combustible floor below the room heater is to consist of two layers of 3/4 inch (19 mm) thick plywood over trade size 2- by 4-inch [nominal 1-1/2 by 3-1/2 inch (38- by 89-mm)] floor supports placed on 16 inch (405 mm) centers.

8.8 The floor under the room heater is to extend at least 4 feet (1.2 m) in front of the heater opening. The side wall is to be placed perpendicular to the back wall. The floor and walls are to extend at least 4 feet beyond the room heater.

8.9 The side, back walls, and ceiling are each to consist of one thickness of 3/4 inch (19 mm) thick plywood.

8.10 The test structure is to include a 3/4 inch (19 mm) thick plywood ceiling located 8 feet (2.4 m) above the floor and extending not less than 4 feet (1.2 m) beyond the room heater. The chimney connector is to connect to the simulated chimney at the ceiling or wall. Where the chimney pierces the ceiling or wall, an opening having a diameter 8 inches (205 mm) larger than the diameter of the chimney is to be cut and the chimney centered in the opening. The ring thus formed is to be sealed with gypsum wallboard or equivalent mineral board material at least 3/8 inch (9.5 mm) thick, placed on the exterior surface of the ceiling. The joint between the chimney connector and the ring shall not have a through opening (total eccentricity) greater than 1/8 inch (3.2 mm) wide. Temperatures on the surfaces surrounding the chimney connector are to be determined at points located 2 inches (50 mm) from the outer edge of the ring.

8.11 The room heater and chimney connector is to be installed in the test structure at the minimum clearances specified by the installation instructions. Legs or other support members are to be adjusted to position the room heater at the minimum allowable distance above the floor. For a room heater with a horizontal flue outlet at its rear, the installation that provides the specified clearance to the chimney connector or the back of the room heater determines the minimum clearance specified for its test installation.

8.12 The area to be covered by the floor protector is to be as specified in the installation instructions.

Exception: The unit is to be tested without a floor protector at the manufacturer's request, and the installation instructions shall describe the floor protector to be used in the final installation.

8.13 Where a thermally insulating floor protector is specified, the R-Value of the floor protector shall be determined per the Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus, ASTM C518, or the Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus, ASTM C177.

8.14 The room heater is to be connected to a simulated chimney by:

a) A black or blued-steel chimney connector pipe of the same nominal diameter as the collar or adaptor provided on the room heater; or

b) The chimney connector provided as part of the heater.

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The thickness shall be 0.023 – 0.028 inch (0.58 – 0.71 mm). The chimney connector is to be run vertically or horizontally, or both, to the chimney at the clearances specified by the installation instructions.

8.15 The simulated chimney is to consist of black or blued-steel pipe of the same size as the chimney connector, and shall have a thickness of 0.023 – 0.028 inch (0.58 – 0.71 mm). The chimney is to originate at the point where the chimney connector exits the test structure and is to terminate 15 feet (4.6 m) above the floor of the test structure.

Exception: In lieu of the simulated chimney, and at the option of the manufacturer, the room heater is to be tested with a factory-built chimney and ceiling support specified by the manufacturer, when:

a) The chimney complies with the Standard for Factory-Built Chimneys for Residential Type and Building Heating Appliances, UL 103, and

b) Both the installation instructions and marking on the product specify the chimney with which the room heater is to be used.

8.16 The room heater is to be installed and tested with the feed door opening either parallel or perpendicular to the rear wall of the test structure or in a corner when such installation produces higher temperatures on the test structure and is included in the manufacturer's installation instructions. See Figure 8.2.

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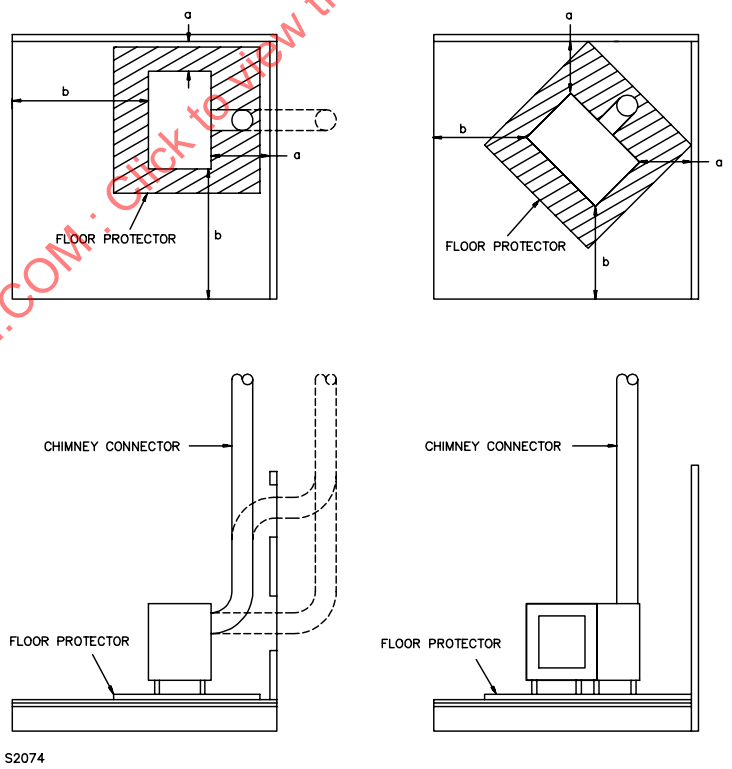
Figure 8.2

Typical fire test installations



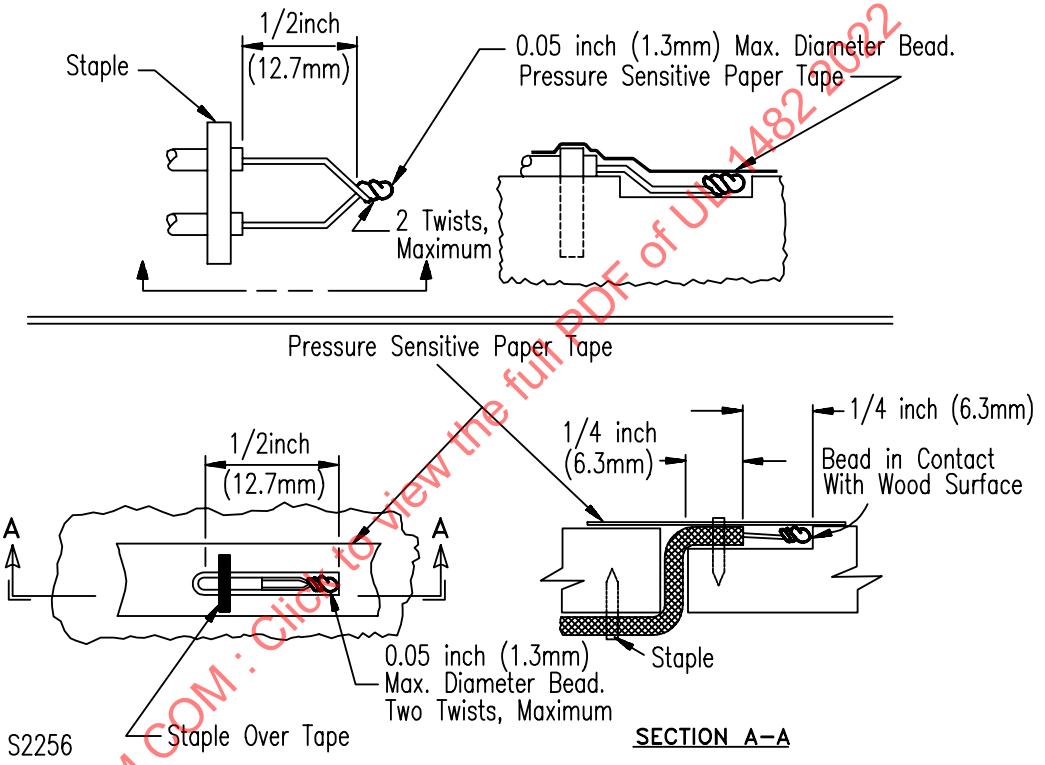
8.17 All wall, floor, and ceiling surfaces of the test structure are to be painted flat black.

9 Temperature Measurement

9.1 During all tests the inlet flue-gas temperature to the simulated chimney section is to be determined by a thermocouple, such as illustrated by Figure 9.1. The thermocouple is to be a Type K (chromel-alumel) of 24 AWG (0.21 mm^2) to 18 AWG (0.82 mm^2) wire, and with an untwisted welded bare lead junction not more than 0.050 inch (1.27 mm) in diameter. The thermocouple is to be positioned in the center line of the chimney connector, 6 inches (152 mm) below the connection to the simulated chimney.

Figure 9.1

Flue-gas thermocouple and support bracket



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9.2 Temperatures of other than flue gases and metal surfaces are to be measured using either Type K (chromel-alumel) or Type J (iron-constantan) thermocouples of wire not larger than 24 AWG (0.21 mm^2).

9.3 Temperatures of metal surfaces other than handles and electrical components are to be measured using Type J (iron-constantan) or Type K (chromel-alumel) thermocouples of 18 AWG (0.82 mm ^{2}) to 24 AWG (0.21 mm^2) wire.

9.4 The thermocouple wire insulation is to have a temperature use rating higher than the temperatures to which it is subjected during these tests.

9.5 The ambient temperature is to be determined by using a thermocouple that is shielded by being located centrally within a vertically oriented 6 inch (152 mm) length of aluminum-painted 2 inch (50 mm) steel pipe complying with the Standard for Welded and Seamless Wrought Steel Pipe, ANSI B36.10, open at both ends.

9.6 The shielded thermocouple described in 9.5 is to be located 6 inches (152 mm) away from the side wall, 4 feet (1.2 m) above the floor, and a distance in front of the unit that is equal to at least the minimum

clearance of the unit from the back wall (as specified by the manufacturer) and not less than 7 feet (2.1 m) from the back wall.

9.7 When a room heater is intended to take combustion or cooling air from the outside of a building, the ambient temperature of the space outside of the test structure, and within the test room, is to be measured by means of a shielded thermocouple located on the same horizontal plane as the opening provided for the admission of outside combustion or cooling air and 3 feet (0.9 m) from the opening. This temperature is to be maintained between 60 and 90 °F (16 and 32.2 °C) during all temperature tests.

9.8 The measurement of temperature rises on the room heater and chimney connector parts and on the test structure is to be referenced to the recorded ambient temperatures measured as described in 9.6.

9.9 Thermocouples are to be attached to metal surfaces by screws, rivets, or by silver soldering, brazing or welding of the tip to the metal surface as illustrated by Figure 9.2.

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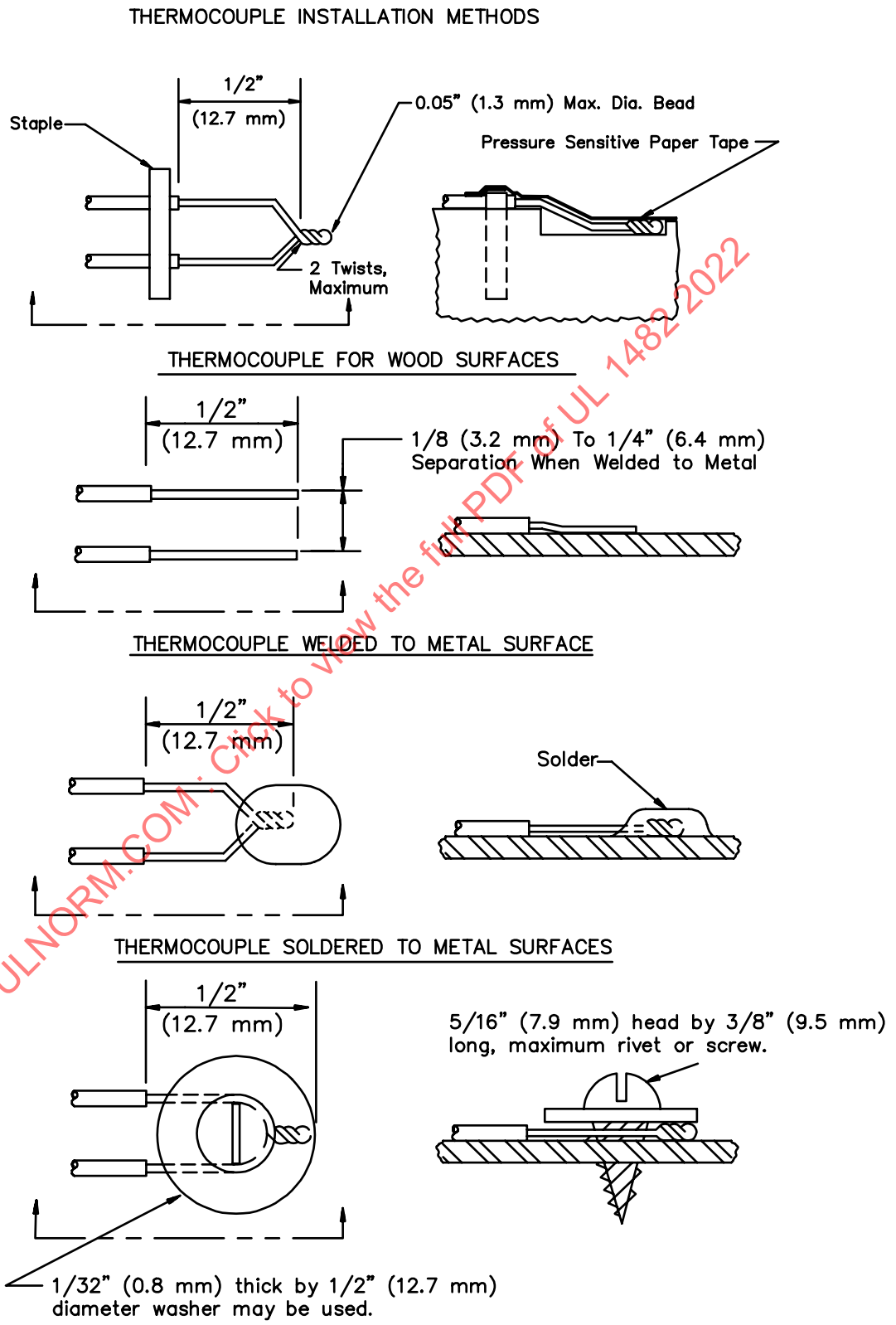
Figure 9.2

Thermocouple installation methods



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9.10 Thermocouples are to be secured to wood surfaces by staples placed over the insulated portion of the wires. The thermocouple tip is to be depressed into the wood so as to be flush with the wood surface at the point of measurement and held in thermal contact with the surface at that point by pressure-sensitive paper tape. See Figure 9.2.

9.11 Thermocouples are to be attached to cement-like material surfaces by having the 1/2 inch (12.7 mm) tip and at least 1 inch (25.4 mm) of the lead wires embedded into the material so as to be flush with the surface of the material. Furnace cement is to be smoothed over such indentations to maintain thermal contact.

9.12 Thermocouples are to be attached to surfaces and electrical components, other than those described in 9.9 – 9.11, by being cemented or taped to the surface in a manner to maintain thermal contact with the surface. Materials and parts whose temperatures are to be measured are included in Table 10.1. Temperatures on electrical conductors are to be measured on the surfaces of the conductor insulation.

9.13 The wiring methods for thermocouple circuitry, including junctions, terminals, switches, plugs, and jacks are to be designed and constructed to provide independent continuous routing of both thermocouple leads to the recording equipment.

9.14 Thermocouples are to be placed on surfaces of the test structure at various locations as required to measure maximum temperatures during tests. A minimum number of typical thermocouple locations are shown in Figure 9.3.

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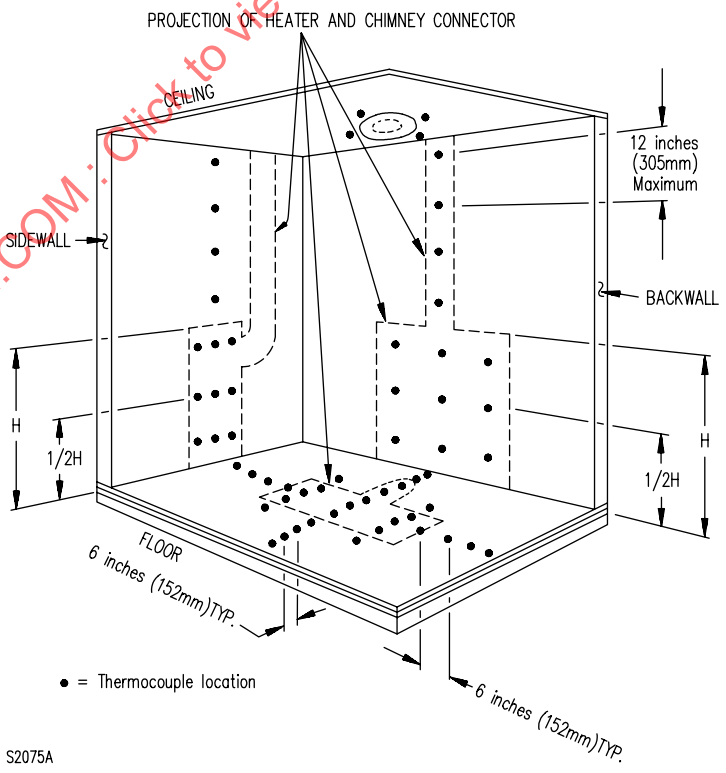
Figure 9.3

Typical thermocouple locations, walls and floor of test structure



9.15 When test enclosure elements are in contact with the room heater or chimney connector parts, thermocouples are to be placed on the heater or on chimney part surfaces at representative points of contact.

Exception: When a point or line contact of a spacer with an enclosure is not greater than 1/8 inch (3.2 mm) diameter or width, thermocouples are to be placed on the test enclosure at points 1/2 inch (12.7 mm) from the center of the point or line contact.

9.16 Thermocouples are to be placed between the floor protector and the plywood flooring. Additional thermocouples are to be attached to the plywood flooring beyond the floor protector as shown in Figure 9.3.

9.17 Thermocouples are to be attached to the room heater and chimney connector at various locations as required to measure maximum temperatures during the tests. A minimum number of locations include the following:

a) Hearth and refractory material.

b) Fire chamber – Bottom, sides, back, front, and top.

c) Flue collar.

d) Feed and ash doors.

e) Outer cabinet – Bottom, sides, back, front, and top.

f) Door and control handles or knobs.

g) Legs or support stands.

10 Fire Tests

10.1 A room heater intended to burn wood shall comply with the requirements of the Radiant Fire Test, Section 11; Brand Fire Test, Section 12; and Flash Fire Test, Section 13. A room heater that incorporates an integral grate shall be tested with the grate installed in its intended location during these tests.

10.2 A room heater intended to burn coal shall comply with the requirements of the Fire Tests for Coal Heaters, Section 14.

10.3 When a room heater intended to burn wood does not incorporate a grate, the Radiant Fire Test, Section 11, is to be conducted using a basket grate (see 11.1 – 11.4) and the Brand Fire Test, Section 12, and Flash Fire Test, Section 13, are to be conducted using andirons (see 12.1).

10.4 When a room heater is intended to be used with wood only, the Brand Fire Test, Section 12, and Flash Fire Test, Section 13, are to be conducted with the brands on the hearth when the unit bears the visible marking, "DO NOT USE GRATE OR ELEVATE FIRE – BUILD WOOD FIRE DIRECTLY ON HEARTH."

10.5 The surface temperature on the largest amount of material employed in a handle or knob for use on a room heater shall not exceed the temperature specified in Table 10.1 during the Radiant and Brand Fire Tests, Sections 11 and 12.

Exception: The temperature limitation does not apply to knobs used for adjusting combustion air inlets or damper handles that do not require adjustment during operation.

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Table 10.1
Maximum temperature rises

Materials and components	Column 1 Degrees C	Column 1 Degrees F	Column 2 Degrees C	Column 2 Degrees F
A. MOTORS[a,b,m]				
1. Class A insulation systems on coil windings of alternating-current motors 7 inches (178 mm) or less in diameter (not including universal motors):				
a. In open motors;				
Thermocouple or resistance method	75	135	115	207
b. In totally enclosed motors;				
Thermocouple or resistance method	80	144	115	207
2. Class A insulation systems on coil windings of alternating-current motors more than 7 inches (178 mm) in diameter and of direct-current and universal motors:				
a. In open motors;				
Thermocouple method	65	117	115	207
Resistance method	75	135	115	207
b. In totally enclosed motors;				
Thermocouple method	70	126	115	207
Resistance method	80	144	115	207
3. Class B insulation systems on coil windings of alternating-current motors 7 inches (178 mm) or less in diameter (not including universal motors):				
a. In open motors;				
Thermocouple or resistance method	95	171	140	252
b. In totally enclosed motors;				
Thermocouple or resistance method	100	180	140	252
4. Class B insulation systems on coil windings of alternating-current motors more than 7 inches (178 mm) in diameter and of direct-current and universal motors:				
a. In open motors;				
Thermocouple method	85	153	140	252
Resistance method	95	171	140	252
b. In totally enclosed motors;				
Thermocouple method	90	162	140	252
Resistance method	100	180	140	252
B. COMPONENTS[m]				
1. Capacitors:				
a. Electrolytic types[c]	40	72	Not specified	
b. Other types[d]	65	117	Not specified	
2. Relay, solenoid, and other coils with:				
a. Class 105 insulation systems;				
Thermocouple method	65	117	115	207
Resistance method	85	153	115	207
b. Class 130 insulation systems				
Thermocouple method	85	153	140	252

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Table 10.1 Continued on Next Page

Table 10.1 Continued

Materials and components	Column 1 Degrees C	Column 1 Degrees F	Column 2 Degrees C	Column 2 Degrees F
Resistance method	105	189	140	252
3. Transformer enclosure:[b]				
a. Class 2 transformers	60	108	85	153
b. Power and ignition transformers	65	117	90	162
C. INSULATED CONDUCTORS[e,f,m]				
1. Appliance wiring material				
75 °C rating	50	90	65	117
80 °C rating	55	99	70	126
90 °C rating	65	117	80	144
105 °C rating	80	144	95	171
200 °C rating	175	315	200	360
250 °C rating	225	405	250	450
2. Flexible cord – Types SO, ST, SJO, SJT, HSJ, HSJO				
60 °C rating	35	63	60	108
75 °C rating	50	90	65	117
90 °C rating	65	117	80	144
105 °C rating	80	144	95	171
3. Other types of insulated wires	See note e			
D. ELECTRICAL INSULATION – GENERAL[f,m]				
1. Class C electrical insulation material	Not specified			
2. Class (180) electrical insulation material	As determined by test			
3. Fiber used as electrical insulation or cord bushings	65	117	90	162
4. Phenolic composition used as electrical insulation or as parts where malfunction results in a risk of fire or electric shock	125	225	150	270
5. Thermoplastic material	25 °C or 77 °F less than its temperature rating			
6. Varnished cloth insulation	60	108	85	153
E. METALS[g]				
1. Aluminum alloys –				
a. 1100 (2S)	183	330	239	430
b. 3003 (3S)	239	430	294	530
c. 2014, 2017, 2024, 5052[h]	294	530	350	630
2. Aluminum-coated steel, heat-resistant type[i]	572	1030	708	1275
3. Carbon steel – Coated with Type A19 ceramic	572	1030	628	1130
4. Galvanized steel[j]	267	480	350	630
5. Low-carbon steel, cast iron[k,l]	461	830	517	930
6. Stainless steel –				
a. Types 302, 303, 304, 321, 347	686	1235	767	1380
b. Type 316	667	1200	748	1345
c. Type 309S	867	1560	950	1705

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Table 10.1 Continued on Next Page

Table 10.1 Continued

Materials and components	Column 1		Column 2	
	Degrees		Degrees	
	C	F	C	F
d. Types 310, 310B	894	1610	975	1755
e. Type 430	728	1310	808	1455
f. Type 446	961	1730	1042	1875
F. GENERAL				
1. Operating knobs, handles, and levers[o]				
a. Metallic	50	122	Not specified	
b. Glass	78	172	Not specified	
c. Plastic[n]	85	185	Not specified	
d. Wood	150	302	Not specified	
e. Other materials[p]	See note p		Not specified	

[a] The motor diameter is to be measured in the plane of the laminations of the circle circumscribing the stator frame, excluding lugs and boxes used solely for motor cooling, mounting, assembly, or connection.

[b] Coil or winding temperatures are to be measured by thermocouples unless the coil is inaccessible for mounting of these devices (for example, a coil immersed in sealing compound) or unless the coil wrap includes thermal insulation or more than 2 layers, 1/32 inch (0.8 mm) maximum, of cotton, paper, rayon, or the like. For a thermocouple-measured temperature of a coil of an alternating-current motor, having a diameter of 7 inches (178 mm) or less, the thermocouple is to be mounted on the integrally applied insulation on the conductor. At a point on the surface of a coil where the temperature is affected by an external source of heat, the temperature rise measured by a thermocouple is not prohibited from exceeding the indicated maximum by the amount noted below, when the temperature rise of the coil, as measured by the resistance method, is not more than that specified in the table.

1) 5 °C (9°F) for Class A insulation on coil windings of alternating-current motors having a diameter of 7 inches (178 mm) or less, open type.

2) 0 °C (18°F) for Class B insulation on coil windings of alternating-current motors having a diameter of 7 inches (178 mm) or less, open type.

3) 15 °C (27°F) for Class A insulation on coil windings of alternating-current motors having a diameter of more than 7 inches (178 mm), open type.

4) 20 °C (36°F) for Class B insulation on coil windings of alternating-current motors having a diameter of more than 7 inches (178 mm), open type.

[c] For an electrolytic capacitor which is physically integral with or attached to a motor, the temperature rise on insulating material integral with the capacitor enclosure is to be not more than 65 °C (117°F).

[d] A capacitor that operates at a temperature higher than a 65 °C (117°F) rise is to be judged on the basis of its marked temperature rating.

[e] For standard insulated conductors other than those specified, reference shall be made to the National Electrical Code; the maximum allowable temperature rise in any case is 25 °C or 77 °F less than the temperature rating of the insulation in question where Column 1 temperature rises are specified, and the maximum allowable temperature rise where Column 2 rises are specified is to be based on the heat-resistant properties of the insulation. Column 2 temperature rises are 15 °C (27°F) above Column 1.

[f] The limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to compounds that have been investigated and found to have special heat-resistant properties.

[g] The specified maximum temperature rises apply to parts whose malfunction causes the product to be not capable of use.

[h] These and other alloys containing more than 1 percent magnesium shall not be used when the reflectivity of the material is employed to reduce the risk of fire.

[i] When the reflectivity of aluminum coated steel is employed to reduce the risk of fire, the maximum allowable temperature rise is 830 °F (461 °C).

[j] The specified maximum temperature rises shall apply when the galvanizing is required as a protective coating or the reflectivity of the surface is employed to reduce the risk of fire.

[k] The specified maximum temperature rises shall not apply to parts of 0.152 inch (3.86 mm) thick or heavier steel and 3/16 inch (4.8 mm) thick or heavier cast iron employed for the hearth and to other parts of 0.093 inch (2.36 mm) thick or heavier steel, and 1/8 inch (3.2 mm) thick or heavier cast iron when:

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Table 10.1 Continued on Next Page

Table 10.1 Continued

Materials and components	Column 1		Column 2	
	Degrees		Degrees	
	C	F	C	F
1) The part is not the only enclosure; and				
2) Malfunction of the part does not expose adjacent combustible construction to the fire in the fire chamber.				
[l] The specified maximum temperature rise shall not apply to parts of 1/4 inch (6.4 mm) or heavier steel and 5/16 inch (7.9 mm) thick or thicker cast iron.				
[m] Maximum temperature rises are based on an ambient temperature of 25 °C or 77°F.				
[n] Includes plastic with a metal plating not more than 0.005 inch (0.13 mm) thick; and metal with a plastic or vinyl covering not less than 0.005 inch (0.13 mm) thick.				
[o] Temperatures are maximum temperatures, based on an ambient temperature of 70 °F or 21°C.				
[p] Other handle materials shall have a maximum absolute temperature determined by the calculation method specified in the Standard Practice for Determination of Skin Contact Temperature from Heated Surfaces Using a Mathematical Model and Thermesthesiometer, ASTM C1057, such that the temperature limit does not result in a tissue temperature of greater than 50 C at a tissue depth of 0.008 cm with a contact time of 5 seconds.				

10.6 Temperatures of the flue gases are to be recorded at regular intervals not exceeding 1 minute for the duration of the temperature tests.

10.7 When a room heater is provided with an ash drawer, the heater is to be operated during the Radiant, Brand, and Flash Fire Tests, Sections 11 – 13, with the ash door in any position, including an open position, that develops the maximum temperatures.

Exception No. 1: The ash door is to be closed during the tests when the heater is provided with an interlock arrangement that closes the ash removal door when the fuel loading door is closed.

Exception No. 2: The ash door is to be closed during these tests when a marking as follows is provided on the ash door: "CAUTION" and the following or equivalent wording: "Risk of Excessive Temperatures. Keep Ash Door Closed During Firing of the Heater."

10.8 During the Radiant, Brand, and Flash Fire Tests, Sections 11 – 13, thermostatic controls, adjustable flue-gas dampers, air inlets, and similar devices, are to be adjusted to produce the maximum temperatures.

10.9 For a coal burning heater, the draft at the flue collar is to be established at the maximum draft specified in the manufacturer's instructions.

10.10 A barometric draft regulator used in conjunction with a coal burning heater is to be permitted to operate during the fire tests.

10.11 When the mechanism of the thermostatic control is accessible, the control is to be bypassed when bypassing produces higher temperatures.

10.12 With reference to the requirements of 10.11, a control is determined accessible when:

a) Access to the control mechanism is gained by the use of simple hand tools, such as flat blade or Phillips head screwdrivers, hand pliers, wrenches, and similar tools; or

b) The control is modified or its purpose defeated by mechanical means such as by connection of a piece of wire to bypass its operating characteristics.

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10.13 Throughout the fire tests, there shall be no evidence of spillage of products of combustion, or flame from the room heater. Intermittent or sporadic wisps of smoke (smoking not over 15 seconds at a time) is not to be regarded as spillage.

Exception: When the unit is fueled through an opening in the top of the unit that is intended to be open only when fuel is added, light intermittent or sporadic flickers of flame not exceeding 6 inches (152 mm) above the opening are permitted.

10.14 With reference to the requirements of 10.13, the following method is to be used in observing spillage of flame from room heaters other than the top loading type:

a) Any time the door is opened for fueling the unit for the Brand and Flash Fires Tests, Sections 12 and 13, flame spillage is to be observed.

b) When the maximum temperatures have been attained during the Brand Fire Test, Section 13, the air inlets are to be adjusted to that point of their operating range that creates maximum flame spillage. The feed door then is to be opened at a moderate rate 2 minutes after fuel is added and similarly reopened 2 minutes after every subsequent fuel loading until it is evident that there is no spillage of flame from the unit.

11 Radiant Fire Test

11.1 When an integral grate is not provided, a basket grate is to be constructed of 3/8 inch (9.5 mm) square steel bar stock spaced 1 inch (25.4 mm) apart on centers as illustrated in Figure 11.1. The grate is to be open at the back for placement within the fire chamber as illustrated in Figure 11.2.

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Figure 11.1

General form of charcoal basket grate

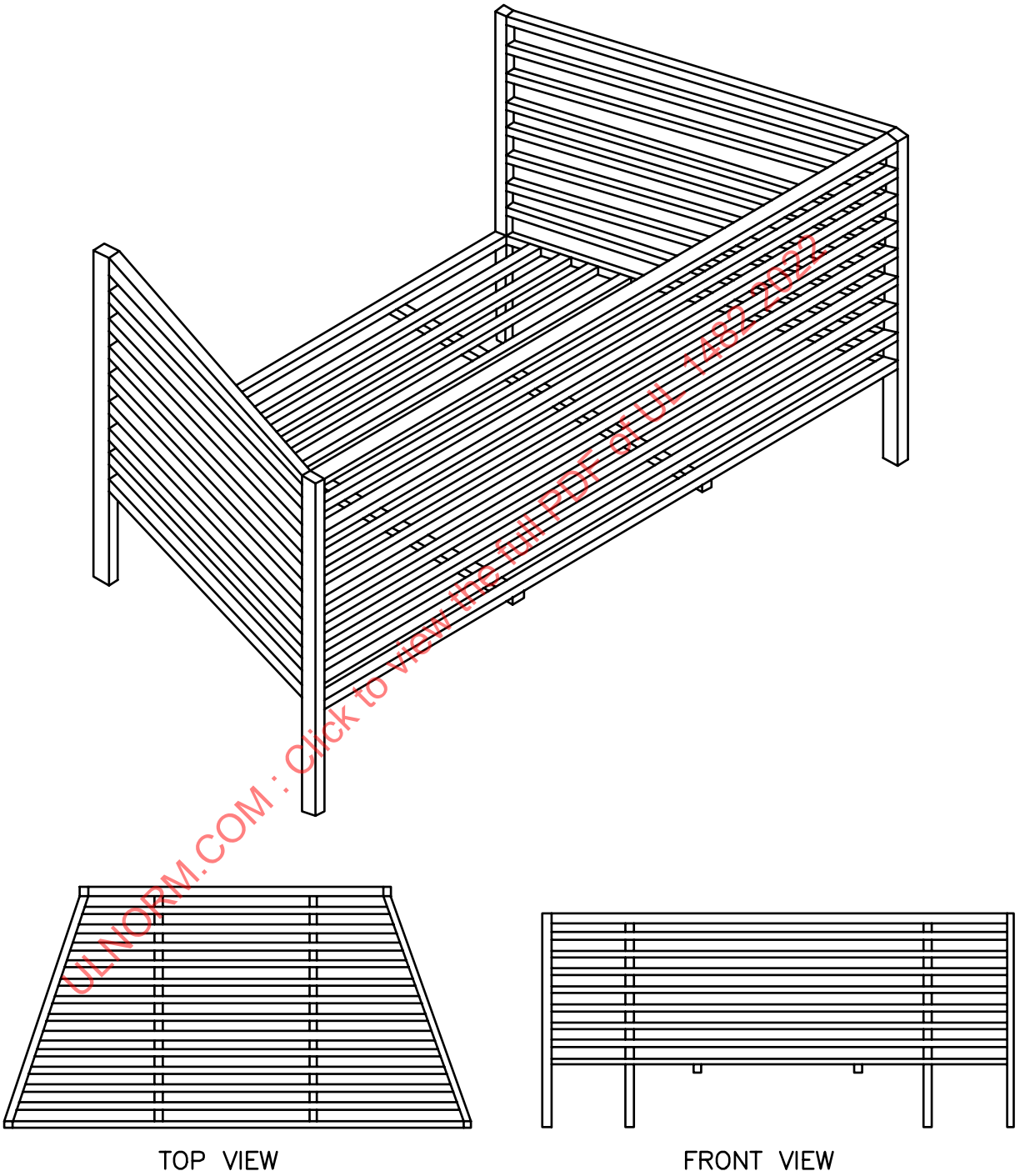

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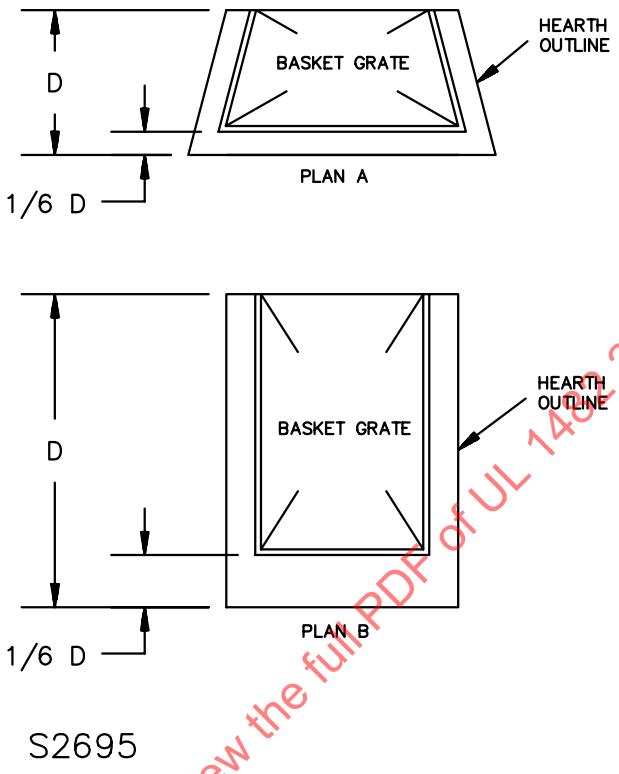
Figure 11.2

Typical relationship of grate to hearth



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11.2 The basket grate is to have an inside surface area in the plan view equal to two-thirds of the total hearth area. In the plan view, the shape of the basket grate is to conform closely to the shape of the hearth, as shown in Figure 11.2. The dimensions are to be such that when placed in position the front inside edge of the basket grate is located back from the feed door opening a distance equal to one-sixth of the maximum fire chamber depth. The inside depth of the basket grate is to be 6 inches (150 mm) and the basket grate is to stand on legs that support the inside bottom of the basket grate 4 inches (100 mm) above the hearth.

11.3 With reference to 11.2, when the configuration or size of the room heater so requires, the height of both the legs and the fuel-containing portion of the basket grate are to be reduced in equal proportions as required to obstruct no more than 75 percent of the height of the door opening.

11.4 When the grate is an integral part of the room heater or when the fire is intended to be built directly on the hearth, the entire area of the grate or hearth is to be loaded to the fuel depth prescribed for the Radiant Fire Test, Section 11. For purposes of the Radiant Fire Test, a separate front retaining grate constructed of 3/8 inch (10 mm) square steel bar stock spaced 1 inch (25 mm) apart on centers shall be constructed to maintain the 6 inch (150 mm) fuel depth.

11.5 The integral-type or basket-type grate is to be loaded to a depth of 6 inches (150 mm) with charcoal briquettes[a] formed in the shape of a 2.0- by 1.9-inch (50- by 48-mm) square pillow having rounded edges and a maximum thickness of 1.2 inches (30 mm). The briquettes shall have a count weight of 17 per pound (38/kg), a heat content (dry basis) of 11,500 Btu per pound (26,750 J/kg), and a moisture content of 5 percent.

[a] A briquette capable of being used for this test is manufactured by the Kingsford Company, Pleasanton, CA 94566.

11.6 After ignition, additional briquettes are to be added at 7-1/2 minute intervals and at each interval the fire is to be poked or stirred prior to the addition of fuel in an effort to maintain a 6 inch (150 mm) bed of fuel burning at maximum intensity. Poking and stirring are to be accomplished by inserting a flat bar of steel at the midpoint of the grate at one end and sliding it through the fire bed, and then inserting the bar at the bottom of the grate at the other end and sliding in the opposite way through the fire bed. Ashes in the ash pan or on the hearth underneath a basket grate are to be removed after each addition of fuel.

11.7 Temperatures at all points of measurement are to be recorded at intervals not exceeding 30 minutes until it is apparent the maximum temperatures have been attained. Maximum temperatures are attained when three successive readings taken at 30-minute intervals show no change or show a decrease.

11.8 When the room heater is fired as described in 11.5 – 11.7 the maximum temperature rise above ambient temperature shall not exceed:

a) 117 °F (65 °C) on exposed surfaces of the test structure; and

b) 90 °F (50 °C) on unexposed surfaces of the test structure, such as beneath the heater, beneath the floor protector, or behind a wall-mounted shield.

11.9 The temperature rise of any part of the room heater and of a chimney connector provided as part of the heater shall not exceed the maximum values specified in Table 10.1, Column 1, for the material employed.

11.10 The temperature of the flue gases entering the chimney shall not exceed 1000 °F (538 °C)

Exception: The temperature of the flue gases are permitted to exceed 1000 °F (538 °C) when the temperature does not exceed 1400 °F (760 °C) for a cumulative period not exceeding 12-1/2 percent of the test duration.

12 Brand Fire Test

12.1 When the room heater does not incorporate an integral grate and the design is such that a grate is used to support the fuel, the Brand Fire Test, Section 12 is to be conducted both with and without andirons.

Exception: The Brand Fire Test is to be conducted without andirons when the room heater bears the marking specified in 10.4.

12.2 When andirons are used in this test, they are to be constructed as illustrated in Figure 12.1.

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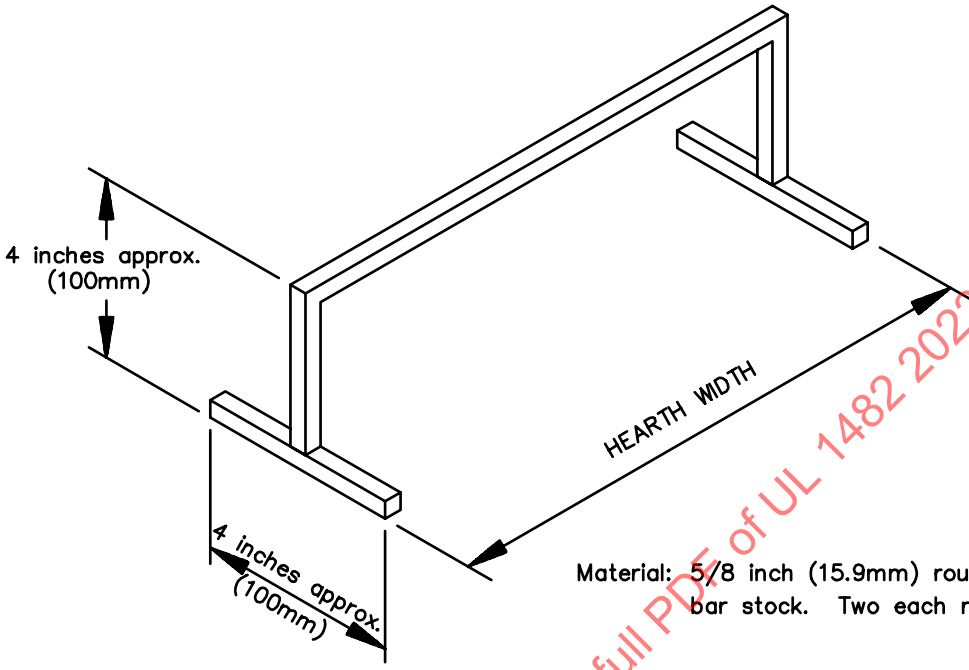
Figure 12.1

Andiron



12.3 The firebrands are to be constructed as illustrated in Figure 12.2, and are to employ strips of dry (moisture content of between 5 and 10 percent) Douglas fir finished to 3/4 by 3/4 inch (19.1 by 19.1 mm), weighing 0.020 ±0.002 pounds per cubic inch (554.0 ±55.4 kg/mm^3) and spaced 1 inch (25.4 mm) apart on centers.

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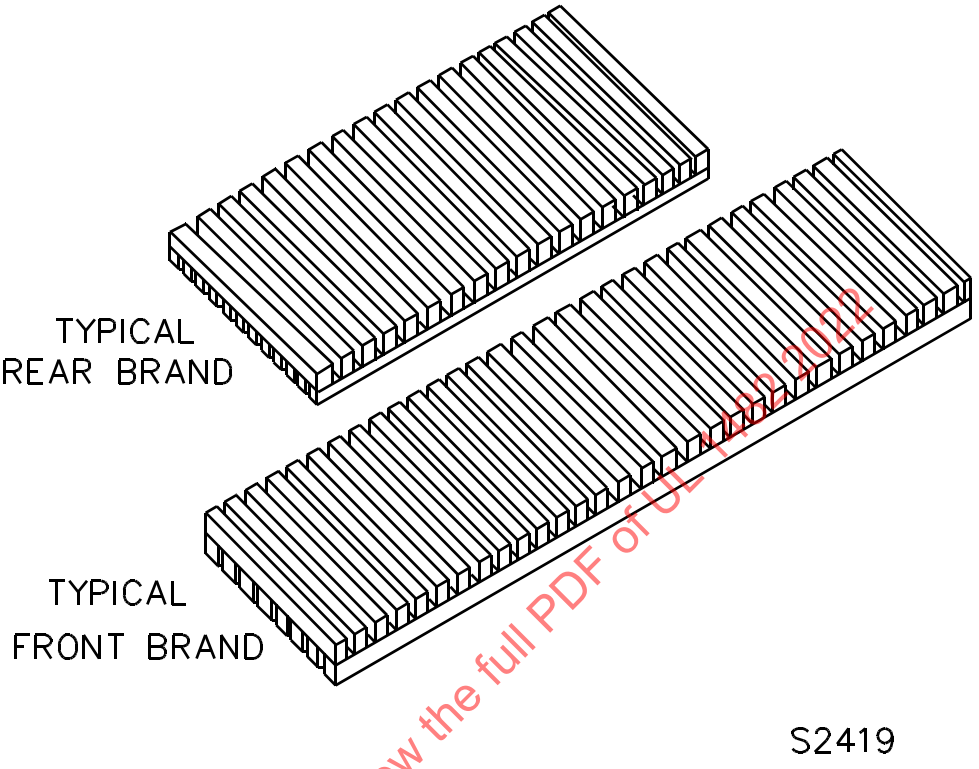
Figure 12.2

Brands



12.4 Each brand is to have an area in the plan view equal to one-third of the total grate or hearth area. Their dimensions are to be such that the front edge of the brand when located as illustrated in Figure 12.3 is to be one-sixth of the maximum grate or hearth depth back from the feed door of the room heater combustion chamber. When required by the configuration of the unit, two individual brands are to be used whose total area is equal to one-third of the grate or hearth area. When the fire chamber of the room heater has sloping sides, the area used for each brand is to be one-third of the average of the maximum and minimum areas as determined on horizontal planes of the fire chamber.

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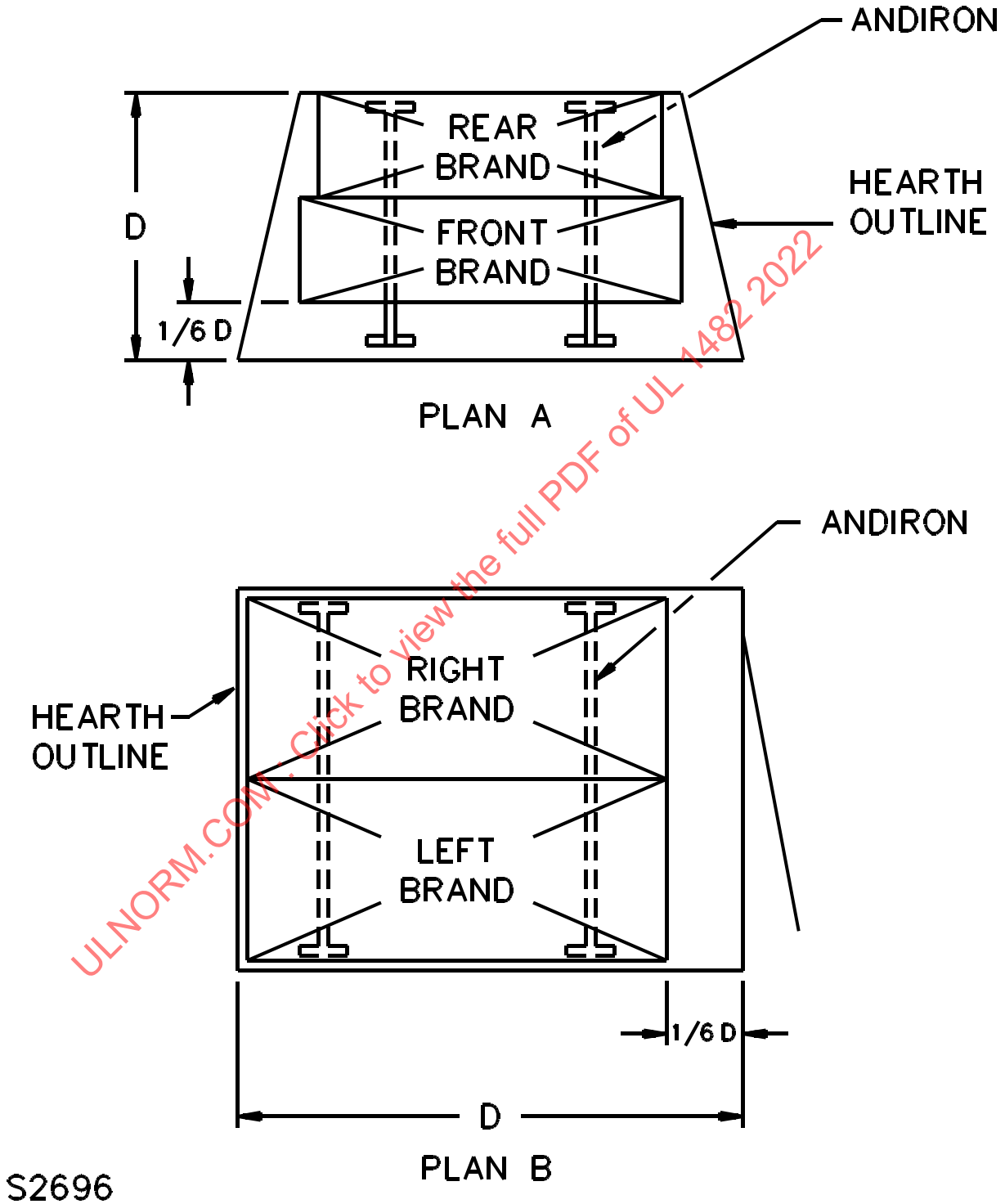
Figure 12.3

Typical relation of brands to grate or hearth



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12.5 The brands are to be placed on the grate or hearth area as illustrated in Figure 12.3.

12.6 Room heaters having fire chambers or fire chamber openings of unconventional configurations, that is, conical, parabolic, or round, are to use brands that comply with the intent of 12.3 – 12.5.

12.7 Room heaters of unconventional configurations or constructions are to be tested using a quantity of brands consistent with the intent of these requirements. The quantity of brands to be used is to be such that the brands do not extend into the combustion chamber above the highest point of the combustion chamber opening.

12.8 After ignition, one brand is to be added every 7-1/2 minutes, alternating front and rear or right and left, with the long strips placed downward. Embers are to be levelled, and ashes are not to be removed from the hearth. When an ash pan is provided, ashes are to be removed from the ash pan at 15 minute intervals.

Exception No. 1: A slower feed rate is to be used when greater temperature rises are produced.

Exception No. 2: When embers build up to a level of one-half of the fire chamber opening height, a slower feed rate is to be used to maintain a fuel bed not exceeding this height.

12.9 Temperatures at all points of measurement are to be recorded at intervals not exceeding 30 minutes until it is apparent the maximum temperatures have been attained. Maximum temperatures are attained when three successive readings taken at 30 minute intervals show no change or show a decrease.

12.10 When the room heater is fired as described in 12.1 – 12.8, the maximum temperature rise above ambient temperature shall not exceed:

a) 117 °F (65 °C) on exposed surfaces of the test structure; and

b) 90 °F (50 °C) on unexposed surfaces of the test structure, such as beneath the room heater, beneath the floor protector, or behind the wall mounted shield.

12.11 The temperature rise of any part of the room heater and chimney connector, when provided as part of the room heater, shall not exceed the maximum specified in Column 1 of Table 10.1 for the material employed.

12.12 The temperature of the flue gases entering the chimney shall not exceed 1000 °F (538 °C).

Exception: The temperature of the flue gases are permitted to exceed 1000 °F when the temperature does not exceed 1400 °F (760 °C) for a cumulative period not exceeding 12-1/2 percent of the test duration.

12.13 When a buildup of coals occurs within the unit during the test, the coals are to be levelled prior to the addition of the next brand.

13 Flash Fire Test

13.1 This test is to be conducted as a continuation of the Brand Fire Test, Section 12. The embers remaining from the Brand Fire Test are to be removed to a plane level with the top of the grate or andirons when a grate or andirons are used.

13.2 Eight brands are to be stacked on the grate or andirons, four in front (left) and four in the rear (right) with the long strips placed downward. Each stack of four brands is to be tied together with wire not larger than 18 AWG (0.82 mm^2).

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13.3 Each brand is to have an area in the plan view equal to one-third of the total hearth or grate area. The dimensions are to be such that the front edge of the front brand when located as illustrated in Figure 12.3 is to be one-sixth of the maximum grate depth back from the feed door of the room heater combustion chamber.

13.4 Room heaters having fire chambers or fire chamber openings of unconventional configurations, that is, conical, parabolic, or round are to use brands that comply with the intent of 12.3 and 12.4.

13.5 Room heaters of unconventional configurations or constructions are to be tested using a quantity of brands consistent with the intent of these requirements. The quantity of brands to be used is to be such that the brands do not extend into the combustion chamber above the highest point of the combustion chamber opening.

13.6 Temperatures at all points of measurement are to be recorded at intervals not exceeding 5 minutes until it is apparent the maximum temperatures have been attained.

13.7 When the room heater is fired as described in 13.1 – 13.5, the maximum temperature rises shall not exceed 140 °F (78 °C) above ambient temperature on the following surfaces:

a) Test structure;

b) Room heater or chimney connector parts at points of zero clearance to the test structure; and

c) Beneath a floor protector installed on the area specified for the floor protector.

13.8 The temperature rise of any part of the product shall not exceed the maximum value specified in Column 2 of Table 10.1 for the material employed.

13.9 The temperature of the flue gases entering the chimney shall not exceed 1400 °F (760 °C).

Exception: The temperature of the flue gases are permitted to exceed 1400 °F (760 °C) when the temperature does not exceed 1700 °F (927 °C) for a cumulative period not exceeding 10 minutes of the test duration.

14 Fire Tests for Coal Heaters

14.1 Coal fire test

14.1.1 A room heater intended to burn coal is to be loaded to one-half the full depth of the fuel charging chamber volume with the size and type of coal specified by the manufacturer's instructions. The fuel charging chamber is to be identified as the volume of the chamber below the lower level of the feed door opening. However, when a room-heater's fuel charging chamber is intended to contain fuel above the lower level of the feed door (for example, in the case of a heater whose door serves both to feed the unit and to remove the ashes), the charging chamber is to be loaded to a depth that complies with the intent of this test procedure.

14.1.2 After ignition, coal is to be added to the heater at the rate required to maintain the fuel level at the one-half-full depth until maximum temperatures are attained.

14.1.3 The first fuel loading after ignition is to occur at 30 minutes and subsequent loadings are to be increased or decreased (as required) so that the volume of the fuel consumed between loadings is an equivalent volume to one-half the intended fuel depth. During this test, the heater is to be loaded at intervals of not less than 15 minutes nor more than 60 minutes, according to the following:

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a) When one-half of the intended fuel depth is consumed in 30 minutes, fuel is to be added at 30-minute intervals.

b) When less than one-half of the intended fuel depth is consumed in 30 minutes, the loading interval is to be increased to 45 minutes. When less than one-half the intended fuel depth is consumed in 45 minutes, the interval is to be increased to 60 minutes.

c) When more than one-half of the intended fuel depth is consumed in 30 minutes, the loading interval is to be reduced to 15 minutes.

d) The subsequent fuel loading intervals are to be maintained at 15, 30, 45, or 60 minutes, according to the determinations in (a), (b), or (c).

14.1.4 Ashes in the ash pan or on the hearth underneath the grate are to be removed after each fuel loading operation.

14.1.5 The coals are to be shaken at each fuel loading interval by use of an integral mechanism or by manually slicing with a flat bar of steel through the coals.

14.1.6 After maximum temperatures are obtained with the fuel depth specified in 14.1.2, the fuel depth is to be increased to the full fuel charging chamber volume and the test sequence repeated until the maximum temperatures are obtained for the full fuel depth.

14.1.7 When the room heater is operated as described in 14.1.1 – 14.1.6, the maximum temperature rise above ambient temperature shall not exceed:

a) 117 °F (65 °C) on exposed surfaces of the test structure; and

b) 90 °F (50 °C) on unexposed surfaces of the test structure, such as beneath the room heater, beneath the floor protector or behind the wall-mounted shield.

14.1.8 The temperature rise on any part of the room heater, and on a chimney connector when provided as part of the room heater, shall not exceed the maximum values specified in Column 1 of Table 10.1 for the material employed.

14.1.9 The temperature of the flue gases entering the chimney shall not exceed 1000 °F (538 °C).

Exception: The temperature of the flue gases are permitted to exceed 1000 °F (538 °C) when the temperature does not exceed 1400 °F (760 °C) for a cumulative period not exceeding 12-1/2 percent of the test duration.

14.1.10 After completion of the coal fire test specified in 14.1.1 – 14.1.9, the test is to be repeated using a size or type of coal different from that specified by the manufacturer.

14.2 Abnormal radiant fire test

14.2.1 A room heater not incorporating an integral coal storage hopper and intended to burn coal is to be loaded to a depth of 6 inches (150 mm) or to one-half the volume of the coal loading chamber, whichever is the greater depth, with charcoal briquettes formed in the shape of a 2.0- by 1.9-inch (50- by 48-mm) square pillow having rounded edges and a maximum thickness of 1.2 inches (30 mm). The briquettes are to have a count weight of 17 per pound (38 kg), a heat content (dry basis) of 11,500 Btu per pound (26,750 J/kg), and a moisture content of 5 percent.

14.2.2 When the room heater is operated as described in 11.6 and 11.7, the maximum temperature rises shall be not more than 140 °F (77.8 °C) above ambient temperature on the following surfaces:

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a) Test structure;

b) Room heater or chimney connector parts at points of zero clearance to the test structure; and

c) Beneath a floor protector applied to the area prescribed for such a protector.

14.2.3 The temperature rise on any part of the room heater, and on a chimney connector when provided as part of the room heater, shall not exceed the maximum values specified in Column 2 of Table 10.1 for the material employed.

14.2.4 The temperature of the flue gases entering the chimney shall not exceed 1400 °F (760 °C).

Exception: The temperature of the flue gases are permitted to exceed 1400 °F (760 °C) when the temperature does not exceed 1700 °F (927 °C) for a cumulative period not exceeding 10 minutes of the test duration.

14.3 Abnormal brand fire test

14.3.1 When a room heater not incorporating an integral coal storage hopper and intended to burn coal is operated as described in 12.3 – 12.8, the maximum temperatures shall be not more than 140 °F (77.8 °C) above ambient temperature on the following surfaces:

a) Test structure;

b) Room heater or chimney connector parts at points of zero clearance to the test structure; and

c) Beneath a floor protector applied to the area prescribed for such a protector.

14.3.2 Each fire brand for the coal burning heater is to have an area equal to one-third the grate area or one-third the largest wall area of the fire chamber, whichever area is greater.

14.3.3 The temperature rise on any part of the coal burning room heater, and on a chimney connector provided as part of the room heater, shall not exceed the maximum values specified in Column 2 of Table 10.1 for the material employed.

14.3.4 The temperature of the flue gases entering the chimney shall not exceed 1400 °F (760 °C).

Exception: The temperature of the flue gases are permitted to exceed 1400 °F (760 °C) when the temperature does not exceed 1700 °F (927 °C) for a cumulative period not exceeding 10 minutes of the test duration.

15 Glazing Test

15.1 General

15.1.1 Glazing employed in a heater intended to burn wood shall not crack, break, become dislodged, or sustain a loss of strength, when the heater is subjected to the Radiant Fire Test, Section 11; Brand Fire Test, Section 12; and the Flash Fire Test, Section 13.

15.1.2 Glazing employed in a heater intended to burn coal shall not crack, break, become dislodged, or sustain a loss of strength, when the heater is subjected to the Abnormal Radiant Fire Test (see 14.2.1 – 14.2.4); Coal Fire Test (see 14.1.1 – 14.1.10); and the Abnormal Brand Fire Test (see 14.3.1 – 14.3.4).

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15.1.3 When the glazing material is shielded from the room by a screen or wire mesh having openings less than 1/4 by 1/4 inch (6.4 by 6.4 mm) and the screen is secured to the frame, the glazing is permitted to crack or break when:

a) Subjected to the Radiant Fire Test, Section 11 or Abnormal Radiant Fire Test, 14.2.1 – 14.2.4, as applicable; Brand Fire Test, Section 12 or Coal Fire Test, 14.1.1 – 14.1.10, as applicable; Flash Fire Test, Section 13 or Abnormal Brand Fire Test, 14.3.1 – 14.3.4, as applicable; and

b) Tested as described in 15.2.1 – 15.3.1, and the screen is not damaged (torn, dislodged, or punctured) by these tests. When the glazing cracks or breaks, the heater is to be subjected to these tests with the glazing material both in place (intact) and with one glazing panel removed.

15.2 Impact test

15.2.1 Glazing shall withstand, without cracking or breaking, the impact described in 15.2.2:

a) Prior to the Radiant Fire Test, Section 11 or Brand Fire Test, Section 12 (whichever test is conducted first), for a heater intended to burn wood, or prior to the Abnormal Radiant Fire Test, 14.2.1 – 14.2.4 or the Coal Fire Test, 14.1.1 – 14.1.10, for a heater intended to burn coal, and with the glazing at room temperature;

b) During the Radiant Fire Test or Abnormal Radiant Fire Test, as applicable, and while at the maximum temperature developed during that test;

c) Following the Radiant Fire Test or Abnormal Radiant Fire Test, as applicable, and after being permitted to cool to room temperature;

d) During the Brand Fire Test or Coal Fire Test, as applicable, and while at the maximum temperature developed during the test;

e) Following the Flash Fire Test or Abnormal Brand Fire Test, as applicable, and after being permitted to cool to room temperature.

15.2.2 An impact is to be applied to the center of the glazing panel by means of a 1.18 pounds-mass (0.54 kg), 2 inch (50.8 mm) diameter steel sphere swung through a pendulum arc from a height (h) of 16.25 inches (413 mm). The at-rest suspension point of the steel sphere is to be 1 inch (25.4 mm) in front of the plane of the panel. See Figure 15.1.

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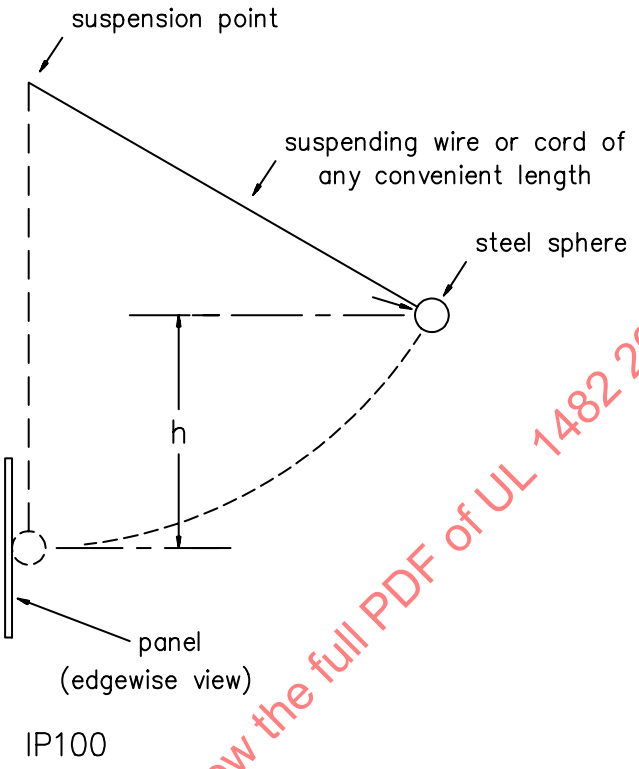
Figure 15.1

Impact test



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15.3 Water shock test

15.3.1 For a heater intended to burn wood, while at the maximum temperature developed during the Radiant Fire Test, Section 11, or for a heater intended to burn coal, while at the maximum temperature developed during the Abnormal Radiant Fire Test, 14.2.1 – 14.2.4, each glazing panel shall withstand, without cracking or breaking, the application of:

a) A wet cloth, fully saturated with water at room temperature, wiped across the surface of each glazing panel; and

b) Three misted water sprays, projected across the surface of each glazing panel from a household cleaning bottle with a gun-type nozzle, applied after the panel is dried and again attains the maximum temperature under the heated condition.

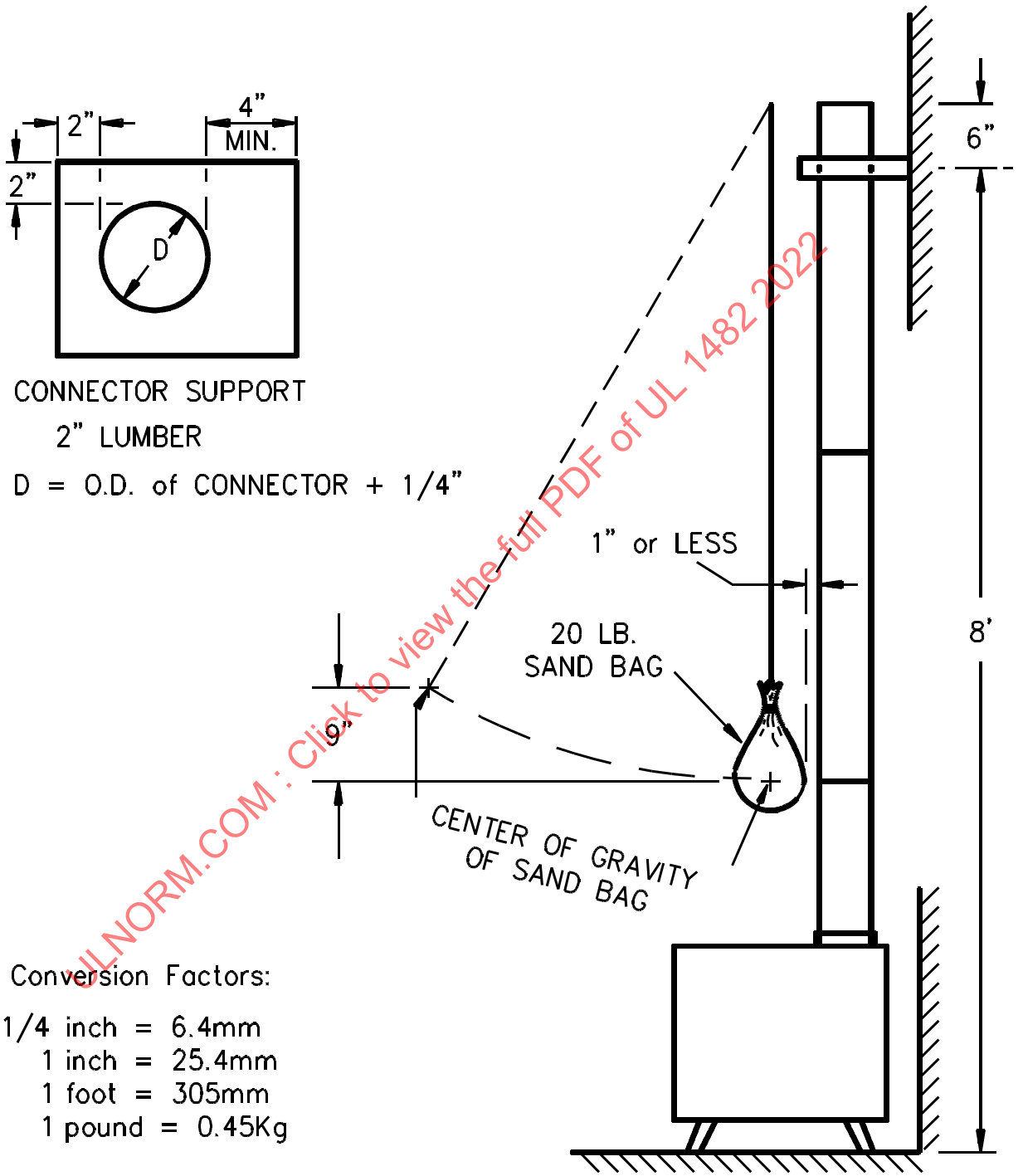
16 Mechanical Tests

16.1 Strength tests – chimney connector

16.1.1 When furnished as part of the assembly, a chimney connector shall not break, disassemble, or become damaged to the extent that it is not capable of further use as a result of three impacts of a sand bag applied as described in 16.1.3 – 16.1.5. The impact is to be applied to chimney connector sections installed as illustrated in Figure 16.1. Tests are to be made on samples of each size section and arrangement intended to be joined together. When cemented joints are included in an assembly, the cement is to be allowed to dry before a test is conducted.

Figure 16.1

Strength test of chimney connector parts



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16.1.2 A chimney connector furnished as part of the assembly shall not break, disassemble, or become damaged to the extent that it is not capable of further use after being subjected to a longitudinal force of 100 pounds (445 N) applied as described in 16.1.6 and 16.1.7.

16.1.3 With reference to the requirements in 16.1.1, the impact is to be produced by a pendulum consisting of a rope suspending a cloth bag filled with sand to a weight of 20 pounds (9.1 kg). The bag is to be formed by tightly drawing up all sides and corners of a flat section of canvas around the sand and tying the excess canvas. The bag is to have an at-rest position with not more than 1 inch (25.4 mm) distance between the edge of the bag and the surface of the chimney connector. The point of impact is to be on the same horizontal plane as the center of gravity of the bag. The distance of swing is to be that required to raise the center of gravity of the bag 9 inches (230 mm), measured vertically, above its at-rest position.

16.1.4 The length of the pendulum shall vary, based on the intended point of impact.

16.1.5 The three impacts are to be made successively at the following points:

a) At the level of a joint.

b) At the level halfway above the first joint tested and the next joint.

c) At the same level as in (b), and rotated around the axis of the chimney by 90 degrees from the impact point in (b).

16.1.6 With reference to the requirements in 16.1.2, tests are to be made on a number of assemblies, as required to provide for representative samples of each size or part intended to be field-joined together, including the connection to the heater. The force is to be exerted on the assembly in a direction tending to pull the assembly apart.

16.1.7 Two or more companion parts are to be joined in accordance with the manufacturer's instructions. A longitudinal force of 100 pounds (445 N) is to be applied by gripping the flue-gas conveying conduit. The force then is to be applied by gripping the outer jacket or casing.

16.2 Stability test

16.2.1 When a room heater is tipped in any direction, the product of the minimum force in pounds (N × 0.23) required to tip the room heater and the angle in degrees through which the room heater is tilted before falling of its own accord shall be 150 pounds-force·degrees (667 N·degrees) or more.

16.2.2 The room heater is to be placed on a level floor or platform. When leveling means are provided, the heater is to be raised to the highest position allowed by the leveling means.

16.2.3 The tipping angle is to be the angle included within the plane of the base of the heater and the plane of the floor, when the heater is tipped to the least tipped position from which it falls on its side when released.

16.2.4 The tipping force is to be the maximum horizontal force exerted in any direction at the topmost point of any part of the unrestrained heater before any part of the base is raised from the floor.

16.2.5 The heater base or legs are to be blocked at the near side so that the heater does not slide in the direction of the applied force. Using a spring scale or equivalent for indicating force in pounds or newtons, the force is to be applied at the top center of each side of the heater until it starts to tip. The force required to initiate tipping is to be recorded. The tipping force is to be continued until the least tipped position is reached from which the heater tips over when not restrained. The heater is to be held in that position and the tipping angle is to be measured.

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ROOM HEATERS FOR USE IN MOBILE HOMES

INTRODUCTION

17 General

17.1 A room heater for use in mobile homes shall comply with all requirements elsewhere in this standard unless otherwise specified.

CONSTRUCTION

18 Chimney

18.1 A chimney shall comply with the Standard for Factory-Built Chimneys for Residential Type and Building Heating Appliances, UL 103.

18.2 The chimney shall be attached directly to the room heater and shall extend at least 3 feet (0.9 m) above the part of the roof through which it passes. The top of the chimney is to be at least 2 feet (0.6 m) above the highest required elevation of any part of the mobile home within 10 feet (3 m) of the chimney.

18.3 All roof-chimney terminations shall be able to be readily removed at or below an elevation of 13-1/2 feet (4.1 m) above ground level and reinstalled without the use of special tools or instructions. The chimney assembly shall be provided with a mechanical securement means to secure the chimney to the ceiling support box.

18.4 When the chimney exits the mobile home at a location other than through the roof, and exits at a point 7 feet (2.1 m) or less above the ground level on which the mobile home is positioned, a guard or method of enclosing the chimney shall be provided at the point of exit for a height up to 7 feet.

18.5 With reference to the requirements of 18.4, openings in a chimney guard shall not permit:

a) The entrance of a 3/4 inch (19.1 mm) diameter rod; and

b) Contact with the chimney by a 1/2 inch (12.7 mm) diameter rod inserted through the opening a distance of 4 inches (102 mm).

19 Spark Arrester

19.1 The chimney shall be provided with a spark arrester secured to the chimney. The net free area of the arrester above the chimney outlet shall be not less than four times the net area of the chimney outlet, and the vertical height of the arrester above the chimney outlet shall be not less than one-half the diameter of the chimney flue. Openings shall not permit the passage of a sphere having a diameter larger than 1/2 inch (12.7 mm), and shall permit the passage of a sphere having a diameter of 3/8 inch (9.6 mm).

20 Combustion Air Inlet

20.1 The cross sectional area of the combustion air inlet shall be not less than 50 percent of the cross sectional flue area. This inlet shall conduct the combustion air directly from outside the mobile home to the connection to the draft inlet of the fire chamber assembly.

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PERFORMANCE

21 Test Structure

21.1 The test structure is to consist of three walls, a floor and a ceiling, and is to have inside dimensions of 7 feet (2.1 m) high by 8 feet (2.4 m) wide by 8 feet deep. Interior surfaces of the walls, ceiling, and floor are to be painted flat black. See Figure 21.1 for structural details. When a chimney penetrates the roof of the mobile home, the space between the attic/roof framing and the outer surface of the thimble is to be filled with 1/2 inch (12.7 mm) thick plywood sheets, with each sheet having:

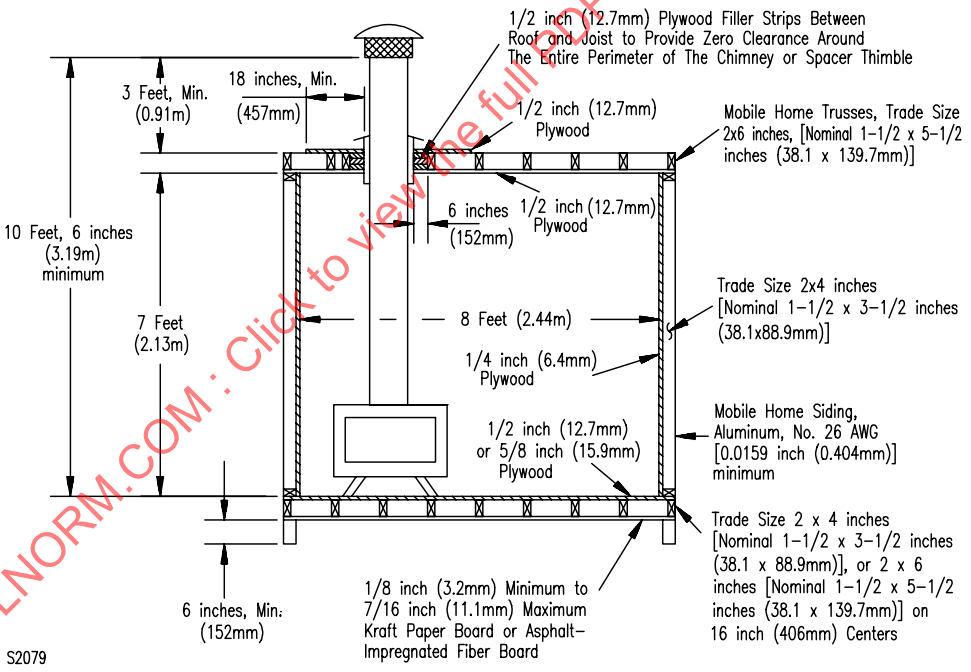
a) An outer dimension such that it fits at zero clearance to the framing; and

b) A hole centered to accommodate the thimble at zero clearance.

When a chimney penetrates the wall of the mobile home, the space between the wall framing and the outer surface of the mobile home is to be similarly filled with plywood sheets.

Figure 21.1

Mobile home test structure



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22 Test Method

22.1 The chimney of the room heater shall pass through the ceiling/roof or wall of the mobile home test structure at zero clearance. This is to be accomplished by a thimble or by the inherent construction of the chimney or room heater. The construction shall not void the firestopping required for a concealed space when installed in accordance with the manufacturer's installation instructions.

22.2 When the unit is equipped with an air inlet that penetrates the floor, a 3/8 inch (9.5 mm) thick plywood bottom board extending at least 8 inches (193 mm) from each side of the air inlet is to be applied to the bottom of the floor joist.

22.3 A room heater intended for use in mobile homes shall comply with the test requirements in Sections 10 – 17.

22.4 In addition to the temperature requirements specified in Radiant Fire Test, Section 11, and Brand Fire Test, Section 12, when a heater intended for use in mobile homes is tested as described in Sections 11 and 12, the maximum temperatures shall be not more than 90 °F (50 °C) above ambient temperature on surfaces:

a) Of chimney parts at points of zero clearance to the test structure; and

b) Air inlet parts at points of zero clearance to the test structure.

22.5 As a continuation of the Radiant Fire Test, Section 11, the basket grate is to be fully loaded with charcoal briquettes. The test structure is to be closed and sealed on all sides. Reading stations for monitoring carbon monoxide (CO) concentrations are to be located as shown in Figure 22.1. The reading stations are to be located in a vertical plane perpendicular to and horizontally centered in relation to the plane of the room heater opening.

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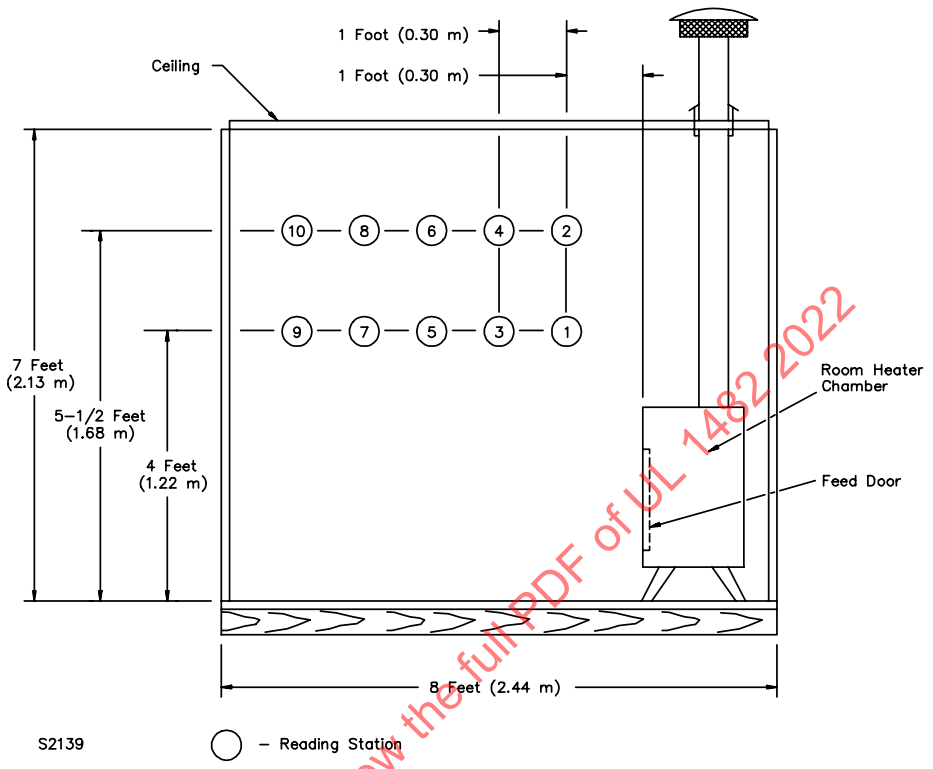
Figure 22.1

Location of carbon monoxide reading stations



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22.6 The CO concentration readings are to be recorded at intervals not exceeding 5 minutes until it is apparent that the maximum readings have been attained or the fuel has burned down. Maximum readings are considered to have been attained when three successive readings taken at 5 minute intervals show no change or show a decrease.

22.7 The CO concentration during the test shall not exceed 50 parts per million at any reading station during the entire test.

23 Drop Test

23.1 At the conclusion of the fire tests, see Sections 11 – 13, the room heater shall withstand the successive impacts described in 23.2. Ceramic materials shall not break away, become dislodged or show cracks more than 1/64 inch (0.4 mm) wide; welds shall not break and the room heater assembly shall not be damaged to the extent that it is not capable of further use.

23.2 The room heater is to be raised 1 inch (25.4 mm) and dropped on a 3/4 inch (19.1 mm) thick sheet of plywood laid over a concrete floor. This test is to be repeated ten times.

INSTALLATION

24 General

24.1 Means shall be provided for securing the room heater to the floor of the mobile home.

24.2 A chimney, spark arrester, combustion air inlet, and chimney termination shall be tested using the parts specified in the installation instructions provided with the room heater.

24.3 A room heater and its chimney shall not void the firestopping required between spaces of a mobile home when the room heater, its chimney, and the combustion air inlet are installed in accordance with the manufacturer's instructions.

BLOWER ASSEMBLY

INTRODUCTION

25 General

25.1 A room heater that includes a blower assembly shall comply with the requirements of the preceding sections of this standard and shall, in addition, comply with the requirements hereafter.

25.2 The positioning of the blower shall not produce a negative pressure at joints in the heating chamber, flues, or combustion air passages.

25.3 Electrical circuits are classified as follows:

a) High-Voltage Circuit – A circuit involving a potential of not more than 250 volts and having circuit characteristics in excess of those of a low-voltage circuit.

b) Low-Voltage Circuit – A circuit involving a potential of not more than 30 volts ac (42.4 peak or dc) and supplied by a primary battery or by a standard Class 2 transformer or other transforming device, or by a combination of transformer and fixed impedance having output characteristics in compliance with what is required for a Class 2 transformer. A circuit derived from a source of supply classified as a high-voltage circuit, by connecting resistance in series with the supply circuit as a means of limiting the voltage and current, is not identified as a low-voltage circuit.

CONSTRUCTION

26 Enclosure

26.1 General

26.1.1 An electrical enclosure shall be formed and assembled so that it has the strength and rigidity to resist the abuses to which it shall be subjected in intended use without total or partial collapse and subsequent reduction of spacings, loosening or displacement of parts, or other conditions that render it not capable of further use. An enclosure for individual electrical components, an outer enclosure, and combinations of the two are to be evaluated in determining compliance with this requirement.

26.1.2 Among the factors to be taken into consideration when evaluating an enclosure are:

a) Mechanical strength;

b) Resistance to impact;

c) Moisture-absorptive properties;

d) Flammability;

e) Resistance to distortion at temperatures to which the material shall be subjected under conditions of use; and

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f) Resistance to corrosion.

For a nonmetallic enclosure or part of an enclosure all of the above are determined to be factors with respect to aging.

26.1.3 The enclosure shall be constructed to reduce the risk of mechanical damage to wiring and electrical components.

26.1.4 The enclosure shall be constructed to reduce the risk of the emission of molten metal, burning insulation, flaming particles, and similar materials, through openings onto flammable material, including surfaces over which the room heater or blower assembly is mounted.

26.1.5 Unless it is determined that malfunction of an electrical component does not result in a risk of fire, components, such as controls, solenoids, relays, and switches shall be individually enclosed except at terminals.

Exception: Electrical parts within the outer cabinet are not required to be individually enclosed when the assembly complies with the following:

a) Their construction and their location with respect to openings in the outer cabinet do not result in the emission of flame or molten metal through openings in the cabinet or it is demonstrated that malfunction of the component does not result in a risk of fire;

b) There are no openings in the bottom of the compartment in which the part is located that permit dropping of molten metal on flammable material; and

c) The part is not in proximity to flammable material other than electrical insulation.

26.1.6 Sheet metal complying with Table 26.1 or Table 26.2, whichever applies, is capable of being used for the individual enclosure of electrical components.

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Table 26.1
Minimum thickness of sheet metal for electrical enclosures – carbon steel or stainless steel

Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness in inches (mm)			
Maximum width[b]		Maximum length[c]		Maximum width[b]		Maximum length					
Inches	(cm)	Inches	(cm)	Inches	(cm)	Inches	(cm)	Uncoated (MSG)		Metal coated (GSG)	
4.0	(10.2)	Not limited		6.25	(15.9)	Not limited		0.020	(0.51)	0.023	(0.58)
4.75	(12.1)	5.75	(14.6)	6.75	(17.1)	8.25	(21.0)	(24)		(24)	
6.0	(15.2)	Not limited		9.5	(24.1)	Not limited		0.026	(0.66)	0.029	(0.74)
7.0	(17.8)	8.75	(22.2)	10.0	(25.4)	12.5	(31.8)	(22)		(22)	
8.0	(20.3)	Not limited		12.0	(30.5)	Not limited		0.032	(0.81)	0.034	(0.86)
9.0	(22.9)	11.5	(29.2)	13.0	(33.0)	16.0	(40.6)	(20)		(20)	
12.5	(31.8)	Not limited		19.5	(49.5)	Not limited		0.042	(1.07)	0.045	(1.14)
14.0	(35.6)	18.0	(45.7)	21.0	(53.3)	25.0	(63.5)	(18)		(18)	
18.0	(45.7)	Not limited		27.0	(68.6)	Not limited		0.053	(1.35)	0.056	(1.42)
20.0	(50.8)	25.0	(63.5)	29.0	(73.7)	36.0	(91.4)	(16)		(16)	
22.0	(55.9)	Not limited		33.0	(83.8)	Not limited		0.060	(1.52)	0.063	(1.60)

Table 26.1 Continued on Next Page

Table 26.1 Continued

Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness in inches (mm)			
Maximum width[b]		Maximum length[c]		Maximum width[b]		Maximum length					
Inches	(cm)	Inches	(cm)	Inches	(cm)	Inches	(cm)	Uncoated (MSG)		Metal coated (GSG)	
25.0	(63.5)	31.0	(78.7)	35.0	(88.9)	43.0	(109.2)	(15)		(15)	
25.0	(63.5)	Not limited		39.0	(99.1)	Not limited		0.067	(1.70)	0.070	(1.78)
29.0	(73.7)	36.0	(91.4)	41.0	(104.1)	51.0	(129.5)	(14)		(14)	
33.0	(83.8)	Not limited		51.0	(129.5)	Not limited		0.080	(2.03)	0.084	(2.13)
38.0	(96.5)	47.0	(119.4)	54.0	(137.2)	66.0	(167.6)	(13)		(13)	
42.0	(106.7)	Not limited		64.0	(162.6)	Not limited		0.093	(2.36)	0.097	(2.46)
47.0	(119.4)	59.0	(149.9)	68.0	(172.7)	84.0	(213.4)	(12)		(12)	
52.0	(132.1)	Not limited		80.0	(203.2)	Not limited		0.108	(2.74)	0.111	(2.82)
60.0	(152.4)	74.0	(188.0)	84.0	(213.4)	103.0	(261.6)	(11)		(11)	
63.0	(160.0)	Not limited		97.0	(246.4)	Not limited		0.123	(3.12)	0.126	(3.20)
73.0	(185.4)	90.0	(228.6)	103.0	(261.6)	127.0	(322.6)	(10)		(10)	

[a] A supporting frame is a structure of angle or channel or a folded rigid section of sheet metal that is rigidly attached to and has the same outside dimensions as the enclosure surface and that has torsional rigidity to resist the bending moments that shall be applied via the enclosure surface when it is deflected. Construction that has equivalent reinforcing shall be accomplished by designs that produce a structure that is as rigid as one built with a frame of angles or channels. Construction without supporting frame includes single sheet with single formed flanges (formed edges), a single sheet that is corrugated or ribbed, and an enclosure surface loosely attached to a frame, for example, with spring clips.

[b] The width is the smaller dimension of a rectangular sheet metal piece that is part of an enclosure. Adjacent surfaces of an enclosure shall have supports in common and be made of a single sheet.

[c] For panels that are not supported along one side, for example, side panels of boxes, the length of the unsupported side shall be limited to the dimensions specified unless the side in question is provided with a flange at least 1/2 inch (12.7 mm) wide.

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Table 26.2
Minimum thickness of sheet metal for electrical enclosures – aluminum, copper, or brass

Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness
Maximum width[b]		Maximum length[c]		Maximum width[b]		Maximum length		
Inches	(cm)	Inches	(cm)	Inches	(cm)	Inches	(cm)	inches (mm)
3.0	(7.6)	Not limited		7.0	(17.8)	Not limited		0.023
3.5	(8.9)	4.0	(10.2)	8.5	(21.6)	9.5	(24.1)	(0.58)
4.0	(10.2)	Not limited		10.0	(25.4)	Not limited		0.029
5.0	(12.7)	6.0	(15.2)	10.5	(26.7)	13.5	(34.3)	(0.74)
6.0	(15.2)	Not limited		14.0	(35.6)	Not limited		0.036
6.5	(16.5)	8.0	(20.3)	15.0	(38.1)	18.0	(45.7)	(0.91)
8.0	(20.3)	Not limited		19.0	(48.3)	Not limited		0.045
9.5	(24.1)	11.5	(29.2)	21.0	(53.3)	25.0	(63.5)	(1.14)
12.0	(30.5)	Not limited		28.0	(71.1)	Not limited		0.058
14.0	(35.6)	16.0	(40.6)	30.0	(76.2)	37.0	(94.0)	(1.47)
18.0	(45.7)	Not limited		42.0	(106.7)	Not limited		0.075
20.0	(50.8)	25.0	(63.5)	45.0	(114.3)	55.0	(139.7)	(1.91)

Table 26.2 Continued on Next Page

Table 26.2 Continued

Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness
Maximum width[b]		Maximum length[c]		Maximum width[b]		Maximum length		
Inches	(cm)	Inches	(cm)	Inches	(cm)	Inches	(cm)	inches (mm)
25.0	(63.5)	Not limited		60.0	(152.4)	Not limited		0.095
29.0	(73.7)	36.0	(91.4)	64.0	(162.6)	78.0	(198.1)	(2.41)
37.0	(94.0)	Not limited		87.0	(221.0)	Not limited		0.122
42.0	(106.7)	53.0	(134.6)	93.0	(236.2)	114.0	(289.6)	(3.10)
52.0	(132.1)	Not limited		123.0	(312.4)	Not limited		0.153
60.0	(152.4)	74.0	(188.0)	130.0	(330.2)	160.0	(406.4)	(3.89)

[a] A supporting frame is a structure of angle or channel or a folded rigid section of sheet metal that is rigidly attached to and has the same outside dimensions as the enclosure surface and that has torsional rigidity to resist the bending moments that shall be applied via the enclosure surface when it is deflected. Construction that has equivalent reinforcing shall be accomplished by designs that produce a structure that is as rigid as one built with a frame of angles or channels. Construction without supporting frame includes single sheet with single formed flanges (formed edges), a single sheet that is corrugated or ribbed, and an enclosure surface loosely attached to a frame, for example, with spring clips.

[b] The width is the smaller dimension of a rectangular sheet metal piece that is part of an enclosure. Adjacent surfaces of an enclosure shall have supports in common and be made of a single sheet.

[c] For panels that are not supported along one side, for example, side panels of boxes, the length of the unsupported side shall be limited to the dimensions specified unless the side in question is provided with a flange at least 1/2 inch (12.7 mm) wide.

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26.1.7 When the construction and location of components and the strength and rigidity of the outer cabinet warrant, an individual enclosure thinner than specified in Table 26.1 or Table 26.2, whichever applies, shall be employed.

26.1.8 Sheet metal to which a wiring system is to be connected in the field shall have a thickness not less than 0.032 inch (0.81 mm) when uncoated steel, not less than 0.034 inch (0.86 mm) when galvanized steel, and not less than 0.045 inch (1.14 mm) when nonferrous.

26.1.9 When threads for the connection of conduit are tapped through a hole in an enclosure wall, or when an equivalent construction is employed, there shall be not less than three or more than five threads in the metal, and the construction shall permit a conduit bushing to be attached as intended. When threads for the connection of conduit are not tapped all the way through a hole in an enclosure wall, conduit hub, or similar locations, there shall be not less than 3-1/2 threads in the metal and there shall be a smooth, rounded inlet hole for the conductors that:

a) Affords protection to the conductor equivalent to that provided by a standard conduit bushing; and

b) Has an internal diameter the same as that of the corresponding trade size of rigid conduit.

26.1.10 A knockout in a sheet metal enclosure shall be secured in place, and shall be capable of being removed without deformation of the enclosure to the extent that there shall be no damage to electrical components or reduction in electrical spacings. See 26.1.11.

26.1.11 A knockout or hole for connection of conduit shall be provided with a flat surrounding surface for seating of a conduit bushing and shall be located so that installation of a bushing at any knockout or opening to be used during installation does not result in reduction of spacings between uninsulated live parts and the bushing to less than those required by this standard.

26.1.12 In measuring a spacing between an uninsulated live part and a bushing installed in a knockout, it is to be assumed that a bushing is in place, in conjunction with a single locknut installed on the outside of the enclosure.

26.1.13 A steel enclosure shall resist corrosion by the use of metallic or nonmetallic coatings, such as plating or painting.

26.2 Mechanical protection

26.2.1 Moving parts, such as fan blades, blower wheels, pulleys, belts, or similar devices, which result in injury to persons shall be enclosed or guarded so that the minor dimension of any opening does not exceed the values indicated in 26.2.3. Parts required for guarding shall be secured by means dependent upon tools for removal unless functioning of the room heater requires the guard to be in place. Also see 53.13.

Exception: A moving part is not required to comply when:

a) The part is not contacted through the opening because of the location of fixed components, including baffles;

b) The part is made inoperative, when exposed, through the use of interlocking devices; or

c) The blower assembly must be withdrawn from the enclosure of the room heater to expose the moving part.

26.2.2 Louvers and other openings in the enclosure shall be constructed and located to reduce the risk of unintentional contact with moving parts that result in injury to persons. In determining compliance with these requirements, parts such as covers, panels, or grilles used as part of the enclosure are to be removed unless tools are required for their removal.

26.2.3 The distance from an opening to the moving part shall be as indicated in Table 26.3, and the minor dimension of the opening shall not, in any case, exceed 1 inch (25.4 mm). For an opening having a minor dimension intermediate between two of the values included in the table, the distance from the opening to the moving part shall be not less than that found by appropriate interpolation between the corresponding values in the right column of the table. The minor dimension of the opening is to be determined by the largest hemispherically tipped cylindrical probe that is inserted through the opening with a force of 5 pounds (22.3 N).

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Table 26.3
Dimensions of openings in enclosure

Minor dimensions of opening[a]		Minimum distance from opening to moving part	
Inches	(mm)	Inches	(mm)
1/4	6.4	1/2	12.7
3/8	9.5	1-1/2	38.1
1/2	12.7	2-1/2	63.5
3/4	19.1	4-1/2	114
1	25.4	6-1/2	165

[a] Openings less than 1/4 inch (6.4 mm) are not to be evaluated.

26.3 Electrical protection

26.3.1 Louvers and other openings in the enclosure shall be constructed and located to reduce the risk of unintentional contact with uninsulated live parts. In determining compliance with this requirement, parts such as covers, panels, and grilles used as part of the enclosure are to be removed unless tools are required for their removal or an interlock is provided.

26.3.2 Uninsulated high-voltage live parts shall be located, guarded, or enclosed in compliance with the requirements in 26.3.3 – 26.3.5.

26.3.3 An opening in the enclosure of the product shall not permit entrance of a 1 inch (25.4 mm) diameter rod unless a probe as illustrated in Figure 26.1, inserted into the opening, does not touch any part that involves the risk of electric shock.

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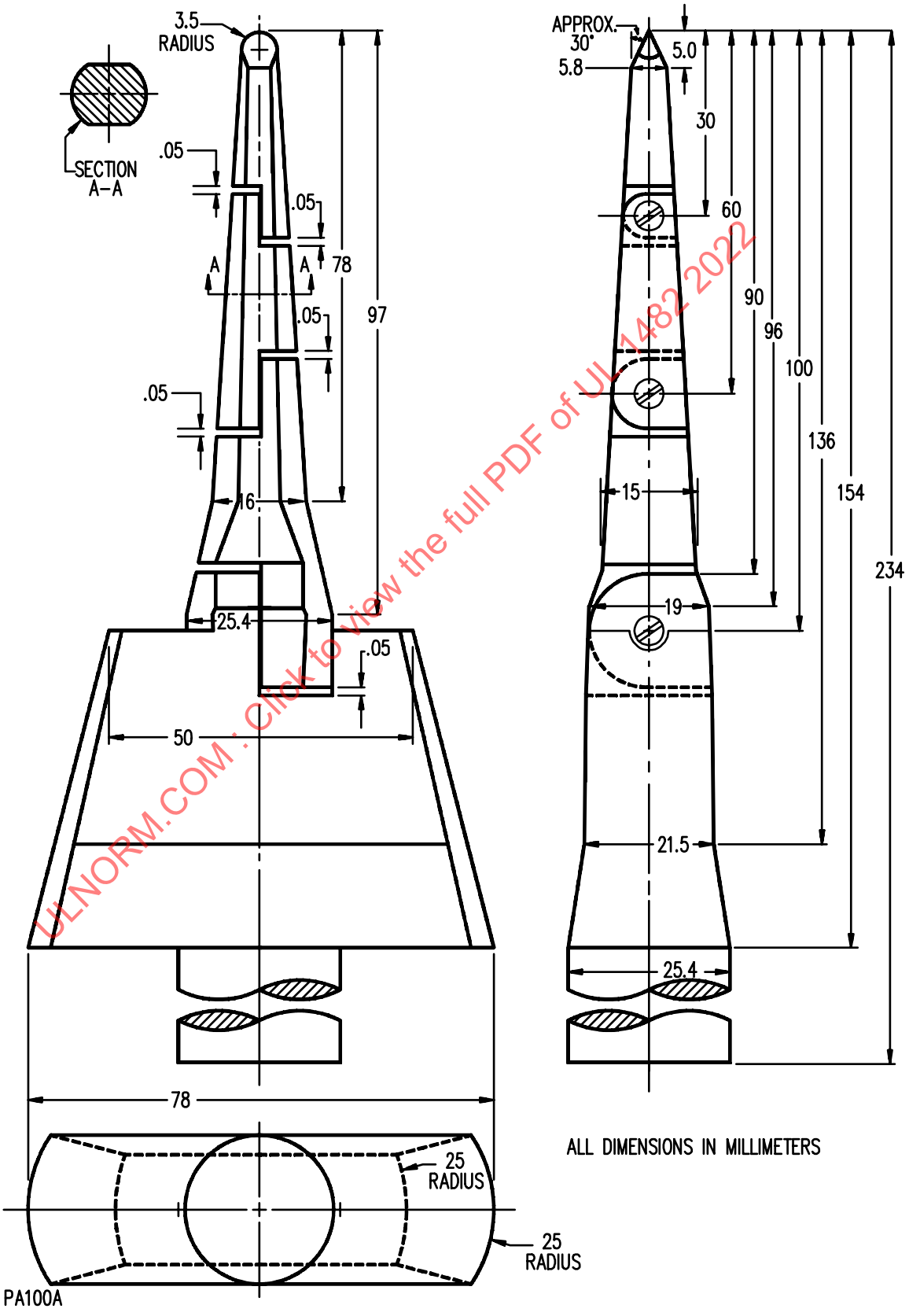
Figure 26.1

Accessibility probe



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26.3.4 With respect to the requirement in 26.3.3, the probe shall be articulated into any configuration and rotated or angled to any position before, during, or after insertion into the opening, and the penetration shall be to any depth allowed by the opening size, including minimal depth combined with maximal articulation.

26.3.5 An opening in an enclosure, as illustrated in Figure 26.2, shall not permit entrance of a 1 inch (25.4 mm) diameter round rod unless, within the enclosure, there is no uninsulated live part or film-coated wire less than:

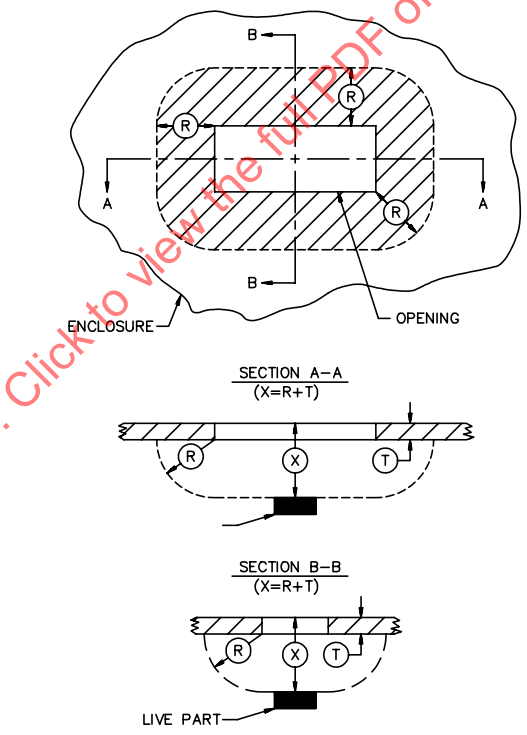
a) R distance from the inside edge of the perimeter of the opening; and

b) X distance from the plane of the opening.

T equals the enclosure thickness, R equals X minus T, and X equals five times the diameter of the largest round rod that is inserted through the opening, and shall be not less than 6-1/16 inches (154 mm).

Figure 26.2

Opening in enclosure



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26.3.6 In addition to the requirements of 26.3.2 – 26.3.5, uninsulated live parts inside the enclosure that are contacted by persons performing operations such as replacing fuses, resetting manual-reset devices, replacing air filters, oiling motors, or other such service operations, shall be located, guarded, or enclosed to reduce the risk of contact unless tools are required to expose the live part. See 53.13.

26.3.7 A fuseholder shall be constructed, installed, or guarded so that adjacent uninsulated high-voltage live parts, other than the screw shell of a plug fuseholder, cartridge fuse clips, or wiring terminals to the fuseholder, is not exposed to contact by persons removing or replacing fuses. A barrier of vulcanized fiber

or similar material employed as a guard for uninsulated high-voltage live parts shall be not less than 1/32 inch (0.8 mm) thick. A separation of less than 4 inches (102 mm) is to be identified as adjacent.

26.4 Doors and covers

26.4.1 Service covers or panels in the outer enclosure shall require the use of tools for removal or shall be provided with an interlocking mechanism when they give access to unenclosed uninsulated live parts or moving parts that result in injury to persons.

26.4.2 An interlocking mechanism that:

a) Is engaged in the closed position of the cover before parts are energized; and

b) Secures the cover in the closed position when engaged

complies with the requirements in 26.4.1.

26.4.3 A hinged panel or cover shall be positioned or arranged so that when it is in an open position it is not subjected to falling or swinging due to gravity or vibration so as to result in a risk of injury to persons from:

a) The panel or cover;

b) Moving parts; or

c) Risk of electric shock from uninsulated live parts.

26.4.4 The assembly shall be arranged so that an overcurrent protective device is capable of being replaced or reset without removing parts other than a service cover(s) or panel(s) and the cover or door enclosing the device.

26.4.5 A required protective device shall be inaccessible from outside the enclosure without requiring the opening of a door or cover.

Exception: The operating handle of a circuit breaker, the reset button of a manually resettable motor protector, and similar parts are not prohibited from projecting outside the enclosure.

26.4.6 An opening in an outer enclosure around a handle, reset button, or other control member shall not be provided unless the clearance between the control member and the edge of the opening is not more than 1/8 inch (3.2 mm) for any setting or position of the control member.

26.4.7 Covers for enclosures of fuses in high-voltage circuits shall be hinged. See 26.4.8. Covers for manual-reset overload protective device enclosures shall be hinged to open the cover to reset the device.

Exception: A hinged cover is not required for extractor type fuses.

26.4.8 A hinged cover shall not depend solely upon screws or other similar means to hold it closed, and shall be provided with a latch or the equivalent. A cover interlocking mechanism as described in 26.4.2 is capable of being used as the sole means for securing the cover or panel.

26.4.9 A spring latch, a magnetic latch, a dimple, or any other mechanical arrangement that holds the door in place and requires some effort on the user's part to open it is identified as a means for holding the door in place as required in 26.4.1.

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26.4.10 A door or cover giving direct access to fuses in other than low-voltage circuits shall shut closely against a 1/4 inch (6.4 mm) rabbet or shall have either turned flanges for the full length of four edges or angle strips fastened to it. Flanges or angle strips shall fit closely with the outside of the wall of the box and shall overlap the edges of the box not less than 1/2 inch (12.7 mm). Constructions include:

a) A construction such as a fuse enclosure located within an outer enclosure; or

b) A flange and rabbet combination that affords the equivalent protection.

27 Mounting of Electrical Components

27.1 A switch, an attachment-plug receptacle, a strain relief bushing, or similar component shall be secured in position and shall be prevented from turning. See 27.2.

Exception No. 1: Compliance is not required when all of the following conditions are met:

a) The switch is of a plunger or other type that does not tend to rotate when operated. A toggle switch is subject to forces that tend to rotate the switch during the operation of the switch;

b) Means of mounting the switch make it so that operation of the switch does not loosen it;

c) The spacings are not reduced below the minimum required values when the switch rotates; and

d) Operation of the switch is by mechanical means rather than direct contact by persons.

Exception No. 2: A lampholder of a type in which the lamp shall not be replaced, such as a neon pilot or indicator light in which the lamp is sealed in a nonremovable jewel, shall not be prevented from turning when rotation does not reduce spacings below the minimum required values. See Spacings, Section 39.

27.2 The means for preventing rotation specified in 27.1 shall consist of more than friction between surfaces. A toothed lock washer that provides both spring takeup and an interference lock is capable of being used as means for preventing the turning of a small stem-mounted switch or other device having a single-hole mounting means.

27.3 An uninsulated current-carrying part and a part that supports a live part shall be secured to the base or mounting surface so that it is prevented from turning or shifting in position when such motion results in a reduction of spacings below the minimum required values. See Spacings, Section 39. Friction between surfaces shall not be relied upon as a means to prevent shifting or turning of a live part, and a lock washer as described in 27.2 meets the intent of the requirement.

27.4 Flammable or electrically conductive thermal or acoustical insulation shall not contact uninsulated live parts.

28 Field-Installed Blower Assemblies

28.1 A room heater having provision for the use of a blower assembly to be attached in the field shall be constructed so that the use of the assembly does not introduce a risk of fire, electric shock, or contact with moving parts that results in injury to persons.

28.2 The room heater shall comply with the requirements of this standard with and without the field-installed blower assembly installed.

28.3 Installation of the field-installed blower assembly by the user shall be restricted to an arrangement that is accomplished by means of receptacles and plug-in connectors.

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Exception: Low-voltage accessories shall be connected by other means, when the installation does not require rearrangement of components or wiring, cutting or splicing of existing wiring, or soldering connections.

28.4 The installation of a field-installed blower assembly by service personnel shall be by means of receptacles, plug-in connectors, insulated wire connectors, or by connection to existing wiring terminals.

28.5 With reference to the requirements in 28.4, an installation shall not require the cutting of wiring or the soldering of connections by the installer. Installations shall not require cutting, drilling, or welding in electrical enclosures or in other areas where such operations damage electrical or room heater components and wiring within the enclosure.

28.6 Strain-relief means shall be provided for the wiring in the field-installed blower assembly when stress is transmitted to the terminal connections during installation.

28.7 All terminals and wiring intended to be field connected shall be identified on the field-installed blower assembly, on the room heater when connections are made between the blower assembly and the room heater, and on the wiring diagram(s).

28.8 Except where it is obvious, the mounting location of the field-installed blower assembly shall be indicated on the room heater. When the mounting location is obvious due to the function of the blower assembly and arrangement of the room heater, and instructions are provided covering the installation and location for the blower assembly, the mounting location of the blower assembly is not required to be indicated on the room heater.

28.9 All mounting brackets, supports, and fasteners required to install the blower assembly shall be provided with the blower or as part of the appliance.

28.10 As part of the investigation, the blower assembly is to be trial-installed to determine that its installation is feasible, that the instructions are detailed and accurate, and that the use of the blower assembly does not introduce a risk of electric shock or unintentional contact with moving parts that results in injury to persons.

29 Field Supply Connections

29.1 Permanently-connected units

29.1.1 As described in 29.1.2 – 29.1.14, field wiring terminals are the terminals to which power supply, control, or equipment grounding connections are made in the field when the room heater is installed as intended.

29.1.2 A blower assembly intended for permanent connection shall have provision for connection to one of the wiring systems in accordance with the National Electrical Code, NFPA 70.

29.1.3 The location of the required terminal box or compartment in which power supply connections are to be made shall permit these connections to be inspected after the unit is installed. The connections shall be accessible without removing parts other than a service cover or panel and the cover of the outlet box or compartment in which the connections are made.

29.1.4 A terminal compartment intended for the connection of a supply raceway shall be secured in position and shall not turn under conditions of intended use.

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29.1.5 A blower assembly shall be provided with field wiring terminals for the connection of field wiring conductors of at least the size required by the National Electrical Code, NFPA 70, corresponding to the rating of the assembly or with leads not less than 6 inches (152 mm) long except as noted in 29.1.15. Branch circuit conductors rated 60 °C (140°F) are to be used.

29.1.6 A field wiring terminal shall be prevented from turning or shifting in position by means other than friction between surfaces. This is accomplished by means such as two screws or rivets; by square shoulders or mortices; by a dowel pin, lug, or offset; or by a connecting strap or clip fitted into an adjacent part.

29.1.7 For 8 AWG (8.4 mm^2) and larger conductors, pressure wire connectors shall be used. For 10 AWG (5.3 mm^2) and smaller conductors, the parts to which wiring connections are made consist of pressure wire connectors, clamps or wire binding screws with cupped washers, terminal plates, or the equivalent to hold the wire in position.

29.1.8 A wire binding screw at a field wiring terminal shall be not smaller than No. 10 (4.8 mm diameter).

Exception: A No. 8 (4.2 mm diameter) screw is not prohibited from being used for the connection of one 14 AWG (2.1 mm^2) and a No. 6 (3.5 mm diameter) screw is not prohibited from being used for the connection of a 16 AWG (1.3 mm^2) or 18 AWG (0.82 mm^2) control circuit conductor.

29.1.9 According to the National Electrical Code, NFPA 70, 14 AWG (2.1 mm^2) is the smallest conductor that the installer is to use for branch circuit wiring and thus is the smallest conductor that is anticipated at a terminal for the connection of a power supply wire.

29.1.10 A terminal plate for a wire binding screw shall be of metal not less than 0.030 inch (0.76 mm) thick for a 14 AWG (2.1 mm^2) or smaller wire and not less than 0.050 inch (1.27 mm) thick for a wire larger than 14 AWG. In either case, there shall be no less than two full threads in the metal.

29.1.11 A terminal plate formed from stock having the minimum required thickness shall have the metal extruded at the tapped hole for the binding screw to provide two full threads.

Exception: Two full threads are not required when a lesser number of threads results in a connection in which the threads do not strip with tightening torque in accordance with the values indicated in the Standard for Wire Connectors, UL 486A-486B.

29.1.12 Upturned lugs or a cupped washer shall be able to retain a conductor of the size used for the field wiring leads under the head of the screw or the washer. A conductor used for the field wiring leads shall be not smaller than 14 AWG (2.1 mm^2).

29.1.13 A wire binding screw shall thread into metal.

29.1.14 A field wiring terminal intended for the connection of a grounded conductor shall be of metal, or plated with, a metal substantially white in color and shall be readily distinguishable from the other terminals, or correct identification of that terminal shall be shown in some other manner, such as on an attached wiring diagram. A lead intended for the connection of a grounded conductor shall be finished to show a white or gray color, shall be readily distinguishable from other leads, and no other lead shall be so identified.

29.1.15 The length of a lead inside an outlet box or wiring compartment shall be 6 inches (152 mm) or more when the lead is intended for field connection to an external circuit.

Exception: The lead shall be less than 6 inches in length when it is evident that the use of a longer lead results in a risk of fire or electric shock.

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29.1.16 Leads intended for connection to an external circuit shall be provided with strain relief when stress on the lead is transmitted to terminals, splices, or internal wiring. See Strain Relief Test, Section 47.

29.1.17 Leads provided for spliced connections to an external high-voltage circuit shall not be connected to wire binding screws or pressure wire connectors located in the same compartment as the splice unless the screws or connectors are rendered unusable for field wiring connections or the leads are insulated at the unconnected ends.

29.2 Cord-connected units

29.2.1 The marked rating of a cord-connected blower assembly shall not exceed 80 percent of the rating of the attachment plug.

29.2.2 A cord-connected blower assembly shall employ grounding-type attachment plugs that comply with the ANSI/NEMA designations in Table 29.1, and be rated for the device.

Table 29.1
Attachment-plug cap rating

Amperes, volts	ANSI/NFPA designation[a]
15, 125	5-15P
20, 125	5-20P
15, 250	6-15P
20, 250	6-20P

[a] As part of the Standard for Wiring Devices – Dimensional Requirements, ANSI/NEMA WD 6

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29.2.3 A cord-connected blower assembly shall employ Type S, SJ, SO, SJO, SJT, SJTO, ST, STO, HSJ, or HSJO power supply cord rated for use at a voltage not less than the rated voltage of the product. The ampacity of the cord as given in the National Electrical Code, NFPA 70, shall be not less than the marked rating of the blower assembly.

29.2.4 The length of a power supply cord measured between any point at which the cord exits the blower assembly or room heater cabinet and the attachment-plug cap face shall be not less than 6 feet (1.8 m) nor greater than 8 feet (2.4 m).

29.2.5 The power supply cord shall be provided with strain relief means so that a stress on the cord is not transmitted to terminals, splices, or internal wiring. When a metallic strain relief means is provided, it shall not contact uninsulated live parts or reduce spacings within the enclosure when the cord is moved inward. The cord shall not be subject to damage by moving parts when it is moved inward. See Strain Relief Test, Section 47.

29.2.6 The edges of the entry hole for the power supply cord, including the cord entry hole in a bushing, shall be smooth and rounded without burrs, fins, or sharp edges that damage the cord insulation. The power supply cord shall be routed to prevent damage to the cord insulation.

30 Grounding

30.1 General

30.1.1 A grounding means shall be provided for all equipment containing parts that require grounding. See Bonding for Grounding, Section 33.

30.1.2 The following are means for grounding:

a) In a blower assembly intended to be permanently connected, an equipment grounding terminal.

b) In a cord-connected blower assembly, an equipment grounding conductor in the cord.

30.2 Permanently-connected units

30.2.1 The equipment grounding terminal shall be able to secure a conductor of the size intended for the particular application in accordance with the National Electrical Code, NFPA 70.

30.2.2 A soldering lug, a push-in connector, a screwless connector, or a quick-connect or similar friction-fit connector shall not be used for the grounding terminal intended for the connection of field supply connections or for the grounding wire in a supply cord.

30.2.3 A wire binding screw intended for the connection of an equipment grounding conductor shall have a green-colored head that is hexagonal, slotted, or both. A pressure wire connector intended for connection of such a conductor shall be plainly identified such as by being marked "G," "GR," "Ground," or "Grounding," the grounding symbol illustrated in Figure 30.1, or by a marking on a wiring diagram provided on the room heater. The wire binding screw or pressure wire connector shall be secured to the frame or enclosure of the room heater and shall be located so that it is not removed during intended service operations, such as replacing fuses, resetting manual-reset devices or oiling motors. The wire binding screw or pressure wire connector shall be provided with a cupped head or cupped washer, or equivalent, of a size adequate to retain the equipment grounding conductor in place.

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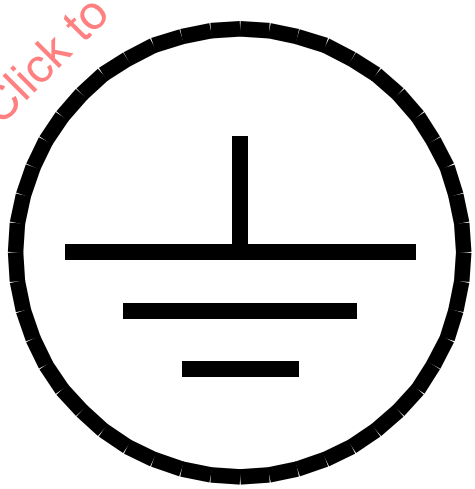
Figure 30.1

Grounding symbol



30.2.4 When a pressure wire connector intended for grounding is located where it is mistaken for a neutral conductor of a grounded supply, it shall be identified by a marking EQUIPMENT GROUND or with a green color identification, or both.

30.3 Cord-connected units

30.3.1 On a cord-connected room heater, the grounding conductor of the flexible cord shall be finished with a continuous green color or with a continuous green color with one or more yellow stripes, and no other conductor shall be so identified.

30.3.2 The grounding conductor shall be secured to the frame or enclosure of the room heater by a positive means, such as described in 33.8, that is not removed during any servicing operation not involving the power supply cord. The grounding conductor shall be connected to the grounding blade of the attachment plug.

31 Internal Wiring

31.1 General

31.1.1 For the purpose of these requirements, internal wiring is all the interconnecting wiring beyond the wiring terminals or leads intended for field wiring connections, and does not include the power supply cord even though some of it:

a) Is not completely enclosed; or

b) Is in the form of flexible cord.

31.1.2 The internal wiring of a blower assembly shall consist of wires of adequate size for the particular application with respect to:

a) The temperature and voltage to which the wiring is subjected;

b) Its exposure to oil or grease; and

c) Other conditions of service to which it subjected.

A conductor, other than an integral part of a component, shall be not smaller than 18 AWG (0.8 mm^2).

31.1.3 There is no temperature limit applicable to a conductor (except as noted in Table 10.1) provided with beads of noncarbonizable material or the equivalent.

31.1.4 Insulated wire employed for internal wiring shall be standard building wire, fixture wire, flexible cord, or appliance wiring material intended for the particular application as described by these requirements.

31.1.5 Wire types for internal wiring include rubber insulated conductors, such as Types RH, RHH, and RHW; and thermoplastic insulated conductors such as Types TW, THHN, THW, THWN, and MTW.

31.1.6 Fixture wires for internal wiring include rubber insulated conductors, such as Types RFH-2, SF-2, SFE-2, FF-2, and FFH-2; and thermoplastic insulated conductors, such as Types TF, TFF, TFN, and TFFN.

31.1.7 Flexible cords for internal wiring include Types HPN, HS, HSJ, HSJO, HSO, S, SJ, SJO, SJT, SJTO, SO, ST, STO, SP-2, SP-3, SPT-2, and SPT-3.

31.1.8 Appliance wiring material having thermoplastic insulation not less than 2/64 inch (0.8 mm) thick for 18 – 10 AWG (0.82 – 5.3 mm^2), 3/64 inch (1.2 mm) thick for 8 AWG (8.3 mm^2), and 4/64 inch (1.6 mm) thick for 6 – 2 AWG (13.3 – 33.6 mm^2) is capable of being used for internal wiring.

31.1.9 Appliance wiring material having rubber, neoprene, or thermoplastic insulation with properties equivalent to the jacket of Types SJ, SJO, SJTO, or SJT cord, with an insulation thickness not less than 4/64 inch (1.59 mm) for 18 – 16 AWG (0.82 – 1.31 mm^2), 5/64 inch (1.93 mm) for 14 – 10 AWG (2.08 – 5.3 mm^2), is capable of being used for internal wiring where permitted by 31.2.6.

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31.1.10 Parallel-conductor appliance wiring material of the integral type shall not be ripped more than 3 inches (76 mm) unless the minimum wall thickness of the conductor insulation after ripping is at least 0.058 inch (1.47 mm) in thickness. When the material has conductor insulation not less than 0.028 inch (0.71 mm) after ripping and is within a separate metal enclosure, the length of rip is not limited.

31.2 Methods

31.2.1 The wiring and connections between separate sections of a blower assembly shall be protected or enclosed, except that a flexible cord shall be employed for external interconnections, or for internal connections that are exposed during servicing when flexibility of the wiring is essential for servicing.

31.2.2 Internal wiring that is exposed through an opening in the enclosure of a room heater is protected as required in 31.2.1 when evaluated as though it were film-coated wire and the wiring complies with the requirements in 26.3.1 – 26.3.5. Internal wiring within an enclosure meets the intent of the requirement even though it is touched with the probe, when it is protected or guarded so that it shall not be grasped or hooked in a manner that subjects the wire to stress.

31.2.3 When the wiring of a blower assembly is located so that it is in proximity to combustible material or is subjected to mechanical damage, it shall be in metal-clad cable, rigid metal conduit, electrical metallic tubing, metal raceway, or shall otherwise be protected.

31.2.4 Except as indicated in 31.2.5 – 31.2.7, wiring in a compartment through which air, to or from the heated space, is circulated shall be in metal-clad cable, rigid metal conduit, flexible metal conduit, electrical metallic tubing, metal raceway, or shall otherwise be protected.

31.2.5 Lengths not exceeding 4 inches (102 mm), except as noted in 31.2.6, of unenclosed wiring of the types specified in 31.1.5, 31.1.6, and 31.1.8, or equivalent, shall be employed when they are enclosed within the unit enclosure and when they are supported to prevent damage from air movement.

31.2.6 Flexible cords, as specified in 31.1.7, or equivalent appliance wiring material, see 31.1.9, without limitation on length, shall be employed when protected as described in 31.2.5.

31.2.7 Neoprene or thermoplastic insulated appliance wiring material having 1/32 inch (0.33 mm) thick minimum conductor insulation is not required to be provided with protective enclosures or additional insulation as indicated in 31.2.4 when all of the following conditions are met:

a) Wiring is not subject to movement by air or vibration.

b) Where practicable, individual leads are bunched together to form a cable.

c) Wiring is secured to fixed panels or other surfaces at frequent intervals to assure proper routing and to reduce hooking of slack during routine service, such as replacing air filters, oiling motors, replacing fuses, adjusting the settings of controls, and similar service.

d) Wiring is located in a compartment that is provided with a complete base pan or similar bottom closure.

e) Wiring shall not be contacted through openings in the outer enclosure or cabinet when evaluated in accordance with 26.3.1 – 26.3.5.

31.2.8 Wiring shall be protected from sharp edges (including male screw threads), burrs, fins, moving parts, and other features that abrade the insulation on conductors. Clamping means shall have smooth, rounded surfaces.

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31.2.9 A hole in a sheet metal wall within the overall enclosure of a blower assembly through which insulated wires pass shall be provided with a smooth, rounded bushing or shall have smooth, rounded surfaces upon which the wires bear, to prevent abrasion of the insulation. Bushings shall be fabricated from materials such as ceramic, phenolic, cold molded composition or fiber. A flexible cord used for external interconnection as specified in 31.2.1 shall be provided with bushings and strain relief in accordance with 31.2.11 – 31.2.14 unless the construction is such that the cord is protected from stress or motion.

31.2.10 Insulated wires shall be bunched and passed through a single opening in a metal wall within the enclosure of a blower assembly.

31.2.11 Strain relief shall be provided to prevent a mechanical stress on a flexible cord from being transmitted to terminals or splices.

31.2.12 Means shall be provided to prevent the flexible cord or lead from being pushed into the enclosure through the cord-entry hole when such displacement results in:

a) Stress being transmitted to terminals, splices or other internal wiring

b) Live uninsulted parts being contacted;

c) Reducing the spacings within the enclosure;

d) The cord being subjected to damage from moving parts or to a temperature greater than its temperature rating, when moved inward; or

e) Subjecting the supply cord, lead, or other internal connections or components to mechanical damage.

To determine compliance, the supply cord or lead shall be tested in accordance with Section 48, Push-Back Relief Test.

31.2.13 At a point where a flexible cord passes through an opening in a wall, barrier, or enclosing case, there shall be a bushing or the equivalent secured in place, and the bushing shall have a smooth, rounded surface against which the cord bears. The heat and moisture-resistant properties of the bushing material shall be capable of being used for the particular application.

31.2.14 A smoothly rounded hole in the wall or barrier is capable of being used in lieu of a separate bushing.

31.2.15 A splice or connection shall be mechanically secure. A soldered connection shall be made mechanically secure before being soldered.

31.2.16 A splice shall be located within the unit enclosure. It shall be secured to a fixed member or located in a separate enclosure when it is subjected to flexing motion, or vibration due to air movement or is moved during service operations, such as replacing fuses or oiling motors.

31.2.17 A splice shall be provided with electrical insulation equivalent to that of the conductors when spacings between the splice and other metal parts are not maintained. Thermoplastic tape wrapped over sharp ends of wires does not meet the intent of the requirement.

31.2.18 The means of connecting stranded internal wiring to a wire binding screw shall prevent loose strands of wire:

a) From contacting other live parts that are not always of the same polarity as the wire; and

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b) From contacting dead metal parts.

This shall be accomplished by use of pressure terminal connectors, soldering lugs, crimped eyelets, soldering all strands of the wire, or other similar means.

31.2.19 A splicing device such as a pressure-type wire connector shall be employed when it complies with the Standard for Wire Connectors, UL 486A-486B.

31.2.20 A quick-connecting assembly shall form a secure electrical connection, such as by detents in the mating parts, and shall be rated for the current involved. Securement of connections shall be determined by engagement/disengagement tests as specified in the Standard for Electrical Quick-Connect Terminals, UL 310.

32 Separation of Circuits

32.1 Unless provided with insulation rated for the highest voltage involved, insulated conductors of different circuits, for example, internal wiring that includes wires in a wiring compartment, shall be separated from each other by barriers or shall be physically segregated, and shall be separated or segregated from uninsulated live parts connected to different circuits.

32.2 Segregation of insulated conductors shall be accomplished by clamping, routing, or other means to provide for separation from insulated or uninsulated live parts of a different circuit.

32.3 Field-installed conductors of any circuit shall be either segregated or separated by barriers from field-installed and factory-installed conductors connected to any other circuit unless the conductors of both circuits are insulated for the maximum voltage of either circuit.

32.4 Except at wiring terminals, field-installed conductors of a high-voltage circuit or a low-voltage circuit with Class 1 National Electrical Code, NFPA 70, wiring shall be segregated or separated by barriers:

a) From uninsulated live parts connected to a different circuit; and

b) From any uninsulated live parts of electrical components, such as a motor overload protective device, or other protective device, where short-circuiting or grounding results in impaired operation of the room heater.

32.5 Field-installed conductors of a low-voltage circuit with Class 2 National Electrical Code, NFPA 70, wiring shall be segregated or separated by barriers as follows:

a) From insulated live parts connected to a high-voltage circuit; and

b) From wiring terminals and any other uninsulated live parts of low-voltage electrical components, such as a motor overload protective device, or other protective device, where short-circuiting or grounding results in operation of the room heater that increases the risk of fire or electric shock.

32.6 When a barrier is used to provide separation between the wiring of different circuits, it shall be of metal or of a rigid insulating material secured in place.

33 Bonding for Grounding

33.1 Exposed or accessible noncurrent-carrying metal parts that become energized, and that are contacted by the user or by service personnel during service operations performed while the equipment is energized, shall be electrically connected to the point of connection of an equipment ground.

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33.2 Except as indicated in 33.3, uninsulated metal parts of cabinets, electrical enclosures, motor frames and mounting brackets, controller mounting brackets, capacitors, and other electrical components, are to be bonded for grounding when they are contacted by the user or serviceman.

33.3 The following metal parts as described below are not required to be grounded:

a) Adhesive-attached metal-foil markings, screws, or handles that are located on the outside of enclosures or cabinets and isolated from electrical components or wiring by grounded metal parts.

b) Isolated metal parts, such as magnet frames and armatures, and small assembly screws that are separated from wiring and uninsulated live parts.

c) Panels and covers that do not enclose uninsulated live parts, when insulated parts and wiring are separated from the panel or cover.

d) Panels and covers that are insulated from electrical components and wiring by an attached insulating barrier of vulcanized fiber, varnished cloth, phenolic composition, or similar material not less than 1/32 inch (0.8 mm) thick.

33.4 When a component, such as a switch, becomes separated from its intended grounding means for purposes of testing or adjustment while the equipment is energized, it shall be provided with a grounding conductor not requiring removal for such service.

33.5 Splices shall not be employed in wire conductors used for bonding.

33.6 Metal-to-metal hinge bearing members are identified as means for bonding a door for grounding.

33.7 A separate bonding conductor shall be of material rated for use as an electrical conductor. Ferrous metal parts in the grounding path shall be protected against corrosion by enameling, galvanizing, plating, or equivalent means. A separate bonding conductor or strap shall:

a) Be protected from mechanical damage, such as by being located within the confines of the outer enclosure or frame; and

b) Not be secured by a removable fastener used for any purpose other than bonding for grounding, unless the bonding conductor will not be omitted after removal and replacement of the fastener.

33.8 The bonding shall be by a positive means, such as by clamping, riveting, bolted or screwed connection, or by welding, soldering, or brazing with materials having a softening or melting point greater than 454 °C (850°F). The bonding connection shall penetrate nonconductive coatings, such as paint or vitreous enamel. Bonding around a resilient mount shall not depend on the clamping action of rubber or similar material, except as indicated in 33.10.

33.9 A bolted or screwed connection that incorporates a star washer or serrations under the screwhead is capable of being used for penetrating nonconductive coatings where required for compliance with the requirements in 33.8.

33.10 A connection shall not depend upon the clamping action exerted by rubber or similar materials unless:

a) It complies with the requirements in 33.12 under any degree of compression permitted by a variable clamping device; and

b) It complies after exposure to the effects of oil, grease, moisture, and thermal degradation that occur in service.

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The effect of assembling and disassembling such a clamping device for maintenance purposes is to be evaluated. The clamping device shall be capable of being reassembled in its intended position.

33.11 When bonding depends on screw threads, two or more screws or two full threads of a single screw shall engage the metal.

33.12 When the adequacy of a bonding connection is not capable of being determined by examination, or when a bonding conductor is smaller than required by 33.13 – 33.15, the bonding is to be evaluated to determine that the connecting means does not open while carrying for 2 minutes twice the current equal to the rating of the branch circuit overcurrent device required to protect the equipment.

33.13 The size of a conductor or strap employed to bond an electrical enclosure or motor frame shall be based on the rating of the branch circuit overcurrent device to which the equipment is connected. Except as indicated in 33.12, the size of the conductor or strap shall be in accordance with Table 33.1.

Table 33.1
Bonding wire conductor size

Rating of overcurrent device, amperes	Size of bonding conductor[a]			
	Copper wire		Aluminum wire	
	AWG	(mm^2)	AWG	(mm^2)
15	14	2.1	12	3.3
20	12	3.3	10	5.3
30	10	5.3	8	8.4

[a] Or equivalent cross-sectional area.

33.14 A bonding conductor to a component or electrical enclosure is not required to be larger than the size of the conductors supplying power to the component or components within the enclosure.

33.15 All exposed dead metal parts that become energized shall be electrically connected to the bonding conductor of the power supply cord(s).

33.16 The grounding conductor of a power supply cord shall be attached to the grounding blade of an attachment-plug cap of the grounding type and shall be connected within the confines of the frame or enclosure of the blower assembly by means of a screw that shall not be removed during servicing not involving the power supply cord. The grounding conductor shall be arranged so that an external pull on the power supply cord does not transmit stress to the grounding connection on the frame or enclosure before the high-voltage connections are broken.

34 Capacitors

34.1 A motor starting or running capacitor shall be housed within an enclosure or container to reduce the risk of:

a) Mechanical damage of the plates; and

b) The emission of flame or molten material resulting from malfunctioning of the capacitor.

The container shall be of metal providing the strength and protection not less than that of uncoated steel having a thickness of 0.020 inch (0.51 mm).

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Exception: The individual container of a capacitor shall be of sheet metal having a thickness less than that specified above or shall be of material other than metal when the capacitor is mounted within the enclosure of the blower assembly or within an enclosure that houses other parts of the blower assembly.

34.2 When the container of an electrolytic capacitor is metal, the container shall be identified as a live part and shall be provided with moisture-resistant electrical insulation to isolate it from dead metal parts and to reduce the risk of a person contacting it during servicing operations. The insulating material shall be not less than 1/32 inch (0.8 mm) thick.

34.3 A capacitor employing a liquid dielectric medium more combustible than askarel shall be protected against expulsion of the dielectric medium when tested in accordance with the applicable performance requirements of this standard, including faulted overcurrent conditions based on the circuit in which it is used. See Short-Circuit Test, Section 48.

Exception: When the available fault current is limited by other components in the circuit, such as a motor start winding, the capacitor shall be tested using a fault current less than the test current specified in Table 49.1 and not less than the current established by dividing the circuit voltage by the impedance of the other component(s).

35 Insulating Material

35.1 Material for the mounting of uninsulated live parts shall be porcelain, phenolic composition, or similar material.

35.2 Vulcanized fiber shall be used for insulating bushings, washers, separators, and barriers, and not as the sole support for uninsulated live parts where shrinkage, current leakage, or warpage introduces a risk of electric shock. Polymeric materials shall not be used for the sole support of uninsulated live parts unless they are found to have adequate mechanical strength and rigidity, resistance to heat, resistance to flame propagation, dielectric withstand and other factors involved with conditions of actual service. All of these are factors with respect to thermal aging.

36 Motors and Motor Overcurrent (Overload) Protection

36.1 All motors shall be protected by self-impedance, an integral thermal protector, overcurrent protective devices, or by combinations thereof.

36.2 Overcurrent protective devices as referred to in 36.1 are those complying with the requirements of the National Electrical Code, NFPA 70, as follows:

a) A separate overcurrent device responsive to motor current. This device shall be rated or specified to trip at no more than the following percent of the motor full-load current rating:

1) Motors with a marked service factor not less than 1.15 – 125 percent.

2) Motors with a marked temperature rise not over 40 °C – 125 percent.

3) All other motors – 115 percent.

Each winding of a multispeed motor is to be evaluated separately and the motor is to be protected at all speeds.

b) When the values specified for motor running overcurrent protection do not correspond to the standard sizes or ratings of fuses or magnetic or thermal overload protective devices, the next higher size of rating shall be used, and not higher than the following percent of motor full-load current rating:

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1) Motors with a marked service factor not less than 1.15 – 140 percent.

2) Motors with a marked temperature rise not over 40 °C – 140 percent.

3) All other motors – 130 percent.

36.3 An integral thermal protective device shall comply with the:

a) Standard for Overheating Protection for Motors, UL 2111;

b) Standard for Thermally Protected Motors, UL 1004-3; or

c) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2 Particular Requirements for Thermal Motor Protectors, UL 60730-2-2; in conjunction with the Standard for Thermally Protected Motors, UL 1004-3 (to evaluate the motor-protector combination).

36.4 Separate overcurrent devices, except when included as part of a magnetic motor controller, shall be assembled as part of the blower assembly, and be readily identifiable as such after assembly to the room heater. Such protection shall not include means for manually interrupting the motor circuit when such interruption allows operation of the blower assembly that increases the risk of fire or electric shock.

36.5 Motors, such as direct-drive fan motors, that are not normally subjected to overloads and that are determined to be protected against overheating due to locked-rotor current by a thermal or overcurrent protective device shall not be used unless it is determined that the motor does not overheat under conditions of intended use.

36.6 Impedance protected motors shall comply with the Standard for Electric Motor-Operated Appliances, UL 73, or the Standard for Impedance Protected Motors, UL 1004-2.

36.7 Fuses shall not be used as motor overload protective devices unless the motor is protected by the largest size fuse which is inserted in the fuseholder.

Exception: A smaller size fuse is be used when the following marking is provided on the unit and is visible at the access to the fuseholder: "Use ___ amp fuse." A paper sticker, ink stamp, or similar material is capable of being used for this marking.

36.8 Fuseholders shall comply with the Standard for Fuseholders – Part 1: General Requirements, UL 4248-1, and the applicable Part 2 (e.g. UL 4248-9).

36.9 Circuit breakers shall comply with the Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures, UL 489.

Exception: Circuit breakers used in telecommunications circuitry that comply with the Standard for Circuit Breakers For Use in Communications Equipment, UL 489A, need not comply with UL 489.

36.10 Circuit breakers having integral ground fault circuit interrupter capability for protection against electrical shock shall additionally comply with the Standard for Ground-Fault Circuit-Interrupters, UL 943.

36.11 Supplementary protectors shall comply with the Standard for Supplementary Protectors for Use in Electrical Equipment, UL 1077.

36.12 Fusing resistors shall comply with the Standard for Fusing Resistors and Temperature-Limited Resistors for Radio- and Television-Type Appliances, UL 1412.

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36.13 A fan or blower motor shall be constructed for continuous duty.

36.14 Motors having openings in the enclosure or frame shall be installed or shielded to prevent particles from falling out of the motor onto combustible material located within or under the assembly.

36.15 The requirement in 36.14 necessitates the use of a barrier of noncombustible material under an open type motor unless:

a) The structural parts of the motor of the blower assembly, such as the bottom enclosure, provide the equivalent of such a barrier; or

b) The motor overload protection device provided with a single-phase motor is such that no burning insulation or molten material falls to the surface that supports the blower assembly when the motor is energized under each of the following fault conditions, as applicable to the particular type of motor:

1) Open main winding,

2) Open starting winding,

3) Starting switch short-circuited, and

4) Capacitor shorted, permanent split capacitor type; or

c) The motor is provided with a thermal motor protector (a protective device that is sensitive to temperature and current) that prevents the temperature of the motor windings:

1) From becoming higher than 125 °C (257°F) under the maximum load under which the motor runs without causing the protector to cycle, and

2) From becoming higher than 150 °C (302°F) with the rotor of the motor locked. See Stalled Motor Test, Section 46.

d) The motor complies with the requirements for impedance-protected motors, and the temperature of the motor winding does not exceed 150 °C (302°F) during the first 72 hours of operation with the rotor of the motor locked. See Stalled Motor Test, Section 46.

36.16 The barrier specified in 36.15 shall be horizontal, shall be located as indicated in Figure 36.1, and shall have an area not less than that described in that illustration. Openings for drainage and ventilation shall be employed in the barrier, when such openings do not permit molten metal or burning insulation to fall on combustible material.

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