



# Standard Specification for Room Heaters, Pellet Fuel-Burning Type<sup>1</sup>

This standard is issued under the fixed designation E1509; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

## 1. Scope

1.1 This specification covers performance requirements, test methods, and marking requirements for automatic feed, pellet fuel-burning room heaters that are intended to burn wood pellets or other suitable solid fuel. These room heaters shall be drafted by forced or natural means.

1.2 Exhaust venting systems and associated externally mounted draft inducers are not evaluated by this specification unless they are part of an engineered system provided as part of the room heater. Parts specifically evaluated and determined to be acceptable for use with pellet fuel-burning room heaters are required to be specified in the room heater manufacturer's instructions and are to be used in evaluating the room heater.

1.3 Pellet fuel-burning room heaters covered by this specification are intended for installation in accordance with the applicable requirements of NFPA 211 and in accordance with the applicable building and mechanical codes.

1.4 Pellet fuel-burning room heaters covered by this specification are acceptable for use in manufactured homes when installed in accordance with the Manufactured Home Construction and Safety Standards published by the Department of Housing and Urban Development (HUD). See 24 CFR 3280.

1.5 The terms "product" or "room heater," as used in this specification, refer to all pellet fuel-burning room heaters or any part thereof covered by the requirements of this specification, unless specifically noted otherwise.

1.6 No information provided in this specification is intended to prevent the use of other methods or devices, provided that sufficient technical data are submitted to the authority having jurisdiction to demonstrate that the proposed method or device is equivalent in quality, strength, fire endurance, effectiveness, durability, and safety to that prescribed in this specification.

1.7 The notes incorporated into this specification are not prescriptive requirements. They are given for clarification and informational purposes only.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.54 on Solid Fuel Burning Appliances.

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1.8 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.9 The following safety hazards caveat pertains only to the test methods portion, Section 10, of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

C1057 Practice for Determination of Skin Contact Temperature from Heated Surfaces Using a Mathematical Model and Thermesthesiometer

D3211 Test Method for Relative Density of Black Smoke (Ringelmann Method) (Withdrawn 1990)<sup>3</sup>

E136 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C

E631 Terminology of Building Constructions

### 2.2 ASME Standard:<sup>4</sup>

ASME B36.10M Welded and Seamless Wrought Steel Pipe

### 2.3 U.S. Code of Federal Regulations—Housing and Urban Development:<sup>5</sup>

24 CFR 3280 Manufactured Home Construction and Safety Standards

### 2.4 Federal Communications Commission:<sup>5</sup>

47 CFR Part 15, Subpart B FCC Regulations

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

<sup>4</sup> Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

<sup>5</sup> Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://dodssp.daps.dla.mil>.

2.5 *NFPA Standards:*<sup>6</sup>

**NFPA 70** National Electrical Code

**NFPA 211** Chimneys, Fireplaces, Vents and Solid-Fuel Burning Appliances

2.6 *UL Standards:*<sup>7</sup>

**UL 103** Chimneys, Factory-Built, Residential Type and Building Heating Appliance

**UL 181** Factory Made Air Ducts and Connectors

**UL 641** Low-Temperature Venting Systems, Type L

**UL 907** Fireplace Accessories

**UL 969** Marking and Labeling Systems

**UL 1482** Room Heaters, Solid Fuel Type

2.7 *ULC Standards:*<sup>8</sup>

**ULC S609** Low Temperature Vents, Type L

**ULC S629M** 650°C Factory-Built Chimneys

2.8 *ICES Standards:*<sup>9</sup>

**ICES-003** Digital Apparatus

2.9 *PFI Standards:*<sup>10</sup>

**PFI Standard** Specification for Residential/Commercial Densified Fuel, June 1, 2011

### 3. Terminology

3.1 *Definitions*—Terms used in this test method are defined in Terminology **E631**.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *chimney*—one or more passageways, vertical or nearly so, for conveying flue gases to the outside atmosphere to which the appliance exhaust is capable of being connected.

3.2.2 *combustible material*—material made of or surfaced with wood, compressed paper, plant fibers, plastics, or other material that will ignite and burn, whether flameproofed or not, or whether plastered or unplastered.

3.2.3 *combustion air control*—a valve or plate or motor speed control, operated manually or automatically, that regulates the draft or flow of flue gases or inlet combustion air.

3.2.4 *connector pipe*—a flue pipe that is part of the exhaust venting system that ducts combustion products from the room heater to a chimney.

3.2.5 *exhaust venting system*—a flue pipe, either horizontal, vertical, or a combination of horizontal and vertical, that ducts combustion products from the room heater to the outside.

3.2.5.1 *Discussion*—An exhaust venting system consists of a listed vent system, or connector pipe and a listed factory-built chimney, or a masonry chimney, or an engineered vent system provided as part of the pellet fuel-burning room heater.

3.2.6 *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.

3.2.7 *grate*—a frame for supporting the fuel within a room heater.

3.2.7.1 *Discussion*—The grate in a pellet fuel-burning room heater is also referred to as a burn pot or fire pot.

3.2.8 *hearth*—the floor area within the fire chamber of a room heater.

3.2.9 *hopper*—an on-unit fuel reservoir that is gravity feeding through a bottom outlet to a controllable pellet fuel feed assembly.

3.2.10 *listed*—equipment or materials included in a list, published by an organization acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of the production of listed equipment or materials and whose listing states either that the equipment or material meets the appropriate standards or has been tested and found to be suitable for use in a specified manner.

3.2.11 *noncombustible material*—a material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat. Materials reported as passing the test, when tested in accordance with Test Method **E136**, shall be considered noncombustible materials.

3.2.12 *pellet fuel*—a solid processed biomass fuel of specified size and composition capable of being fed to the room heater combustion system at a controlled rate.

3.2.13 *room heater, pellet fuel type*—a closed combustion, exhaust venting system connected, pellet fuel-burning room heater incorporating a fuel feed control mechanism.

### 4. Materials

4.1 The materials used shall be free of defects that will affect the performance and maintainability of individual components of the overall assembly.

4.2 A room heater and an exhaust venting system, if provided, shall be made of noncombustible corrosion-resistant materials. Metals shall not be used in combinations that have the potential to cause galvanic action at any location within the assembly.

4.3 The minimum metal thickness of room heater nondecorative parts, including any coatings, shall comply with the requirements given in **Table 1**.

4.4 Aluminum alloys containing more than 1 % magnesium shall not be used if the reflectivity of the material is employed to reduce fire risk.

**TABLE 1** Minimum Metal Thickness

	in.	mm
Aluminum-coated steel Type T1-40 (Regular, 0.40 oz/ft <sup>2</sup> (0.12 kg/m <sup>2</sup> ))	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	0.30
Steel, uncoated or painted	0.042	1.07

<sup>6</sup> Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, <http://www.nfpa.org>.

<sup>7</sup> Available from Underwriters Laboratories (UL), 333 Pfingsten Rd., Northbrook, IL 60062-2096, <http://www.ul.com>.

<sup>8</sup> Available from Underwriters' Laboratories of Canada, 7 Crouse Road, Scarborough, ON Canada M1R3A9, <http://www.ul.com/canada>.

<sup>9</sup> Available from Industry Canada Web Service Centre, Industry Canada, C.D. Howe Building 235 Queen Street, Ottawa, Ontario K1A 0H5, Canada.

<sup>10</sup> Available from Pellet Fuels Institute (PFI), 1901 North Moore Street, Suite 600, Arlington, VA 22209, <http://pelletheat.org>.

4.5 The fire chamber and other parts of the room heater that are in contact with flue gases and are visible after installation 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-in. (1.07-mm) thick unprotected or painted steel.

NOTE 1—Cast iron and unprotected and painted sheet steel complying with the requirements of Footnotes *K* and *L* of Table 2 comply with the requirements of 4.5.

4.6 If required, chimney connectors shall be of materials and thicknesses complying with the requirements of NFPA 211 and applicable building and mechanical codes.

4.7 Thermal insulation material shall be of metal or mineral base. Asbestos materials shall not be used.

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

4.8.1 The products resulting from the combustion or volatilization of any combustible binder shall be discharged to the exhaust venting system.

4.8.2 Insulating material shall remain in the intended position.

4.8.3 The insulation shall not show evidence of softening, melting, or deterioration in a manner that will inhibit its function or create a hazard.

4.9 Thermal insulation, other than firebox refractory materials, shall be protected from contact with combustion products.

4.10 Thermal insulation that is not self-supporting shall be applied to solid surfaces so that the insulation does not sag in any way that will interfere with the function of the insulation. 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 (−17.8°C).

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

4.12 Friable materials shall not be used in air handling compartments unless contained suitably.

## 5. Construction Requirements

### 5.1 General:

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

5.1.2 A joint in a metal surface of a fire chamber or flue gas passageway in a room heater shall be secured mechanically by being welded, lock-seamed, riveted, or bolted. A joint shall be fastened together securely such that it does not rely solely on a cement compound for tightness.

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

5.1.3.1 *Exception*—If an assembly or component part is intended to be cut to length or to be fitted by the installer, means shall be provided 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 is acceptable if the drilling operation does not weaken the assembly or drill into the fire chamber, and the size of the required drill bit is specified and instructions describe the locations to be drilled clearly, such as by the use of templates, drawings, descriptions, or the like.

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

5.1.4.1 *Exception*—If fire chamber materials are packaged and shipped with the heater, the installation instructions shall provide for a description of the method of placement of this material, and the heater shall be marked with an adhesive-backed warning marking indicating that the material is to be installed before firing.

5.1.5 Two or more parts or subassemblies that are required or intended to bear a definite relationship to each other shall be arranged and constructed so as to permit them to be incorporated into the complete assembly without need for alteration or alignment and only in the correct relationship with each other, or they shall be assembled and shipped from the factory as a single component.

5.1.6 Parts of a room heater, such as support legs, radiation shields, and the like, that are necessary to limit temperatures on adjacent construction shall be factory-attached, or they shall comply with all of the following requirements:

5.1.6.1 The parts shall be shipped with the room heater, or they shall be 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 they are 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.

5.1.6.2 Assembly of the parts shall comply with the requirements given in 5.1.3.

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

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

5.2 *Flue Collar*—A flue collar shall provide for ready attachment of the specified exhaust venting system and fastening of the exhaust venting system by at least two screws or other equivalent mechanical methods.

5.3 *Radiation Shield and Baffle*—If provided, a radiation shield or a baffle shall be constructed, formed, and supported to provide the intended positioning and to prevent distortion or sagging.

### 5.4 Separable Handle:

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

5.4.2 Storage means shall be provided on the device for separable handles so that when the handle is stored as intended, the temperatures on the separable handle shall not exceed the specified temperature limits.

*5.5 Combustion Air Duct System:*

5.5.1 The combustion air duct system (if applicable) shall be made of sheet metal not less than 0.016-in. (0.41-mm) thick.

5.5.1.1 *Exception*—Thinner materials are permitted when conforming to UL 181 for Class 0 and Class 1 air ducts and when they have been investigated for the intended application.

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

5.5.3 The air inlet shall prevent material from dropping into the inlet or into the area beneath the dwelling, and it shall also prevent rodents from entering from outside.

NOTE 2—A wire mesh having openings not larger than 0.25 by 0.25 in. (6.4 by 6.4 mm) is acceptable for this purpose.

*5.6 Exhaust Venting System:*

5.6.1 *Products Employing Low-Temperature Type L Vent*—When the room heater is intended to be installed with a Type L vent system, the vent shall be listed to the requirements of UL 641 or ULC S609 and determined suitable for use with solid fuel pellet-burning appliances. The termination shall be designed such that exhaust gases and sparks are not directed toward combustible surfaces and such that the ingress of rain is prevented.

5.6.2 *Products Employing a Chimney*—When a room heater is intended to exhaust to a chimney, the connector pipe from the room heater to the wall thimble or ceiling adapter shall meet the requirements specified in NFPA 211 or the applicable building and mechanical codes. If factory-built, the chimney specified shall be listed to the requirements of UL 103 or ULC S629M or, if masonry, shall meet the construction requirements of the applicable building and mechanical codes. The flue size and height requirements shall not be less than those specified by the manufacturer of the room heater.

*5.6.3 Products Employing an Externally Mounted Draft Inducer:*

5.6.3.1 When a room heater is intended to be installed such that a draft inducer terminates on an exterior wall, the termination shall be designed such that exhaust gases and sparks are not directed toward combustible surfaces.

5.6.3.2 When a room heater is intended to be installed with an externally mounted draft inducer, the exhaust venting system from the room heater to the draft inducer shall be listed to the requirements of UL 641 or ULC S609 and determined to be suitable for use with solid fuel pellet-burning appliances using an externally mounted draft inducer.

5.6.3.3 *Exception*—If a listed vent is not used, the flue connection from the room heater to the draft inducer shall be acceptable if the exhaust venting system is constructed such that the exterior surfaces of the vent do not exceed the temperature limits specified in 7.1.1 and 7.2.1 and the flue gas conduit has corrosion resistance and durability equivalent to Series 300 or 400 stainless steel, unless failure of the conduit will not render the unit unsafe, such as in the case of products of combustion entering the living space.

*5.6.4 Externally Mounted Draft Inducers:*

5.6.4.1 If the manufacturer’s specified periodic maintenance includes removal of the fan unit from the assembly for cleaning, provision for disconnecting power to the motor shall be made within the enclosure.

5.6.4.2 The draft inducer housing shall include provision for connecting an additional outdoor vent system.

*5.7 Fuel Hopper:*

5.7.1 The fuel hopper assembly shall be constructed such that fuel or fuel residue cannot enter areas within the appliance enclosure or come into contact with exterior surfaces of the fire chamber. Fuel hopper sections shall be fastened together securely such that they do not rely solely on a sealing compound or tape for tightness.

5.7.2 A fuel feed mechanism that presents an entrapment or other mechanical hazard and which can be contacted by the accessibility probe as shown in Fig. 1 shall have a fuel hopper lid or door with a direct interlock to the fuel feed motor so that the mechanism is disabled when the hopper is opened. Guards or shields that prevent access to mechanical hazards shall be permanent or require the use of tools for removal. When removable guards or shields are used a cautionary warning shall be included inside the hopper cover with the following wording or equivalent:

“CAUTION: Disconnect electrical power before removing guard(s). Reinstall guard(s) after servicing. Never operate this appliance without the guard(s) in place.”

5.7.3 If provided, the hopper lid/door seal gasketing shall be attached to the lid/door, or the design and construction shall be such that damage to the gasketing during normal operation and filling of the hopper is prevented.

5.8 *Special Tools*—Where special tools are required to remove carbon and slag buildup from the grate (burn pot), they shall be supplied with the room heater.

5.9 *Gasket Materials*—When components require removal, for example, during periodic maintenance, such removal shall not render the gasket or seal incapable of forming a suitable seal when the components are reassembled with a gasket or seal replacement.

5.10 *Glazing Materials*—The glazing used in the room heater shall be either a glass-ceramic or tempered glass with a minimum thickness of 0.197 in. (5 mm). The glazing material shall be able to resist thermal shock. Tempered glass glazing materials shall be able to resist impact.

5.11 *Blower and Pellet Fuel Feed Assemblies*—The following components and features shall meet the construction requirements specified in UL 1482:

- 5.11.1 Enclosure,
- 5.11.2 Mounting of electrical components,
- 5.11.3 Field-installed blower assemblies,
- 5.11.4 Field supply connections,
- 5.11.5 Grounding,
- 5.11.6 Internal wiring,
- 5.11.7 Separation of circuits,
- 5.11.8 Bonding of grounding,
- 5.11.9 Capacitors,
- 5.11.10 Insulating material,

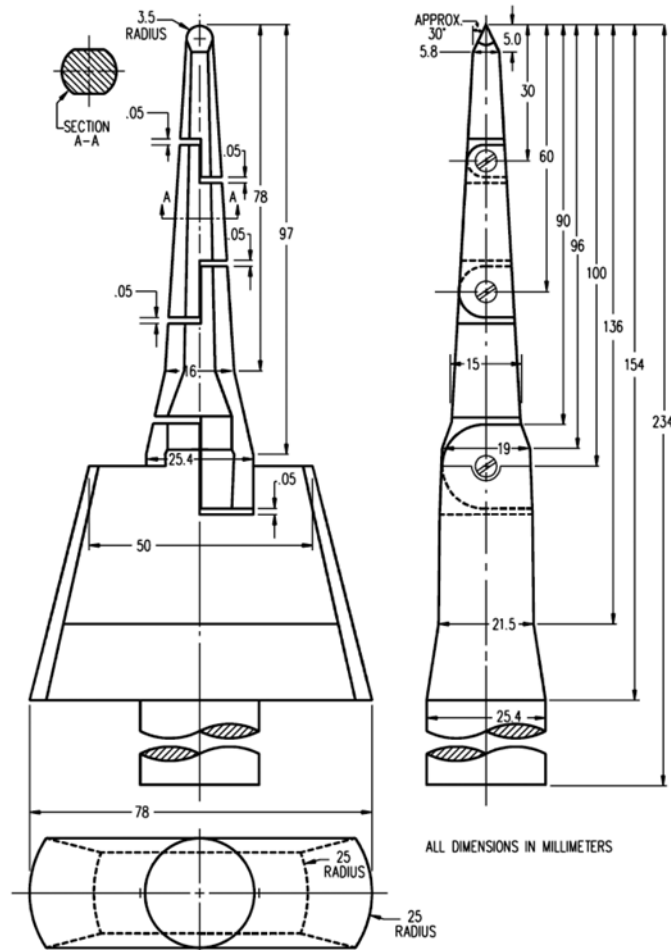


FIG. 1 Accessibility Probe

5.11.11 Motors and motor overcurrent (overload) protection,

5.11.12 Switches and controllers,

5.11.13 Transformers, and

5.11.14 Spacings.

5.12 *Convection Air Blower Filter*—When a filter is provided for the convection air blower, it shall be accessible after installation.

5.13 *Room Heaters for Use in Manufactured Homes:*

5.13.1 Means shall be provided for securing the room heater to the floor of the manufactured home.

5.13.2 The room heater shall not draw combustion air from the interior spaces of manufactured housing.

5.13.3 A room heater and its exhaust venting system shall not void the firestopping required between spaces of a manu-

factured home when the room heater, its exhaust venting system, and the combustion air inlet are installed in accordance with the manufacturer's instructions.

5.14 *Components:*

5.14.1 A mechanical component of a product covered by this specification shall comply with the requirements for that component as specified in the standards listed in Section 2.

5.14.2 *Exception*—A mechanical component need not comply with a specific requirement that (1) involves a feature or characteristic not necessary in the application of the component in the product covered by this specification or (2) is superseded by a requirement in this specification.

TABLE 2 Maximum Temperature Increases

Materials and Components	Column 1		Column 2	
	°C	°F	°C	°F
(A) Motor <sup>A,B,C</sup>				
(1) Class A insulation systems on coil windings of alternating-current motors 7 in. (178 mm) or less in diameter (not including universal motors):				
(a) In open motors:	75	135	115	207
Thermocouple or resistance method				

**TABLE 2** *Continued*

Materials and Components	Column 1		Column 2	
	°C	°F	°C	°F
(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 in. (178 mm) in diameter and of direct-current and universal motors:				
(a) In open motors:	65	117	115	207
Thermocouple method	75	135	115	207
Resistance method				
(b) In totally enclosed motors:	70	126	115	207
Thermocouple method	80	144	115	207
Resistance method				
(3) Class B insulation systems on coil windings of alternating-current motors 7 in. (178 mm) or less in diameter (not including universal motors):				
(a) In open motors:	95	171	140	252
Thermocouple or resistance method				
(b) In totally enclosed motors:	100	180	140	252
Thermocouple or resistance method				
(4) Class B insulation systems on coil windings of alternating-current motors more than 7 in. (178 mm) in diameter and of direct-current and universal motors:				
(a) In open motors:	85	153	140	252
Thermocouple method	95	171	140	252
Resistance method				
(b) In totally enclosed motors:	90	162	140	252
Thermocouple method	100	180	140	252
Resistance method				
(B) Components <sup>C</sup>				
(1) Capacitors:				
(a) Electrolyte types	40	72	(not specified)	
(b) Other types <sup>D</sup>	65	117		
(2) Relay, solenoid, and other coils with:				
(a) ass 105 insulation systems:	65	117	115	207
Thermocouple method	85	153	115	207
Resistance method				
(b) Class 130 insulation systems:	85	153	140	252
Thermocouple method	105	189	140	252
Resistance method				
(3) Transformer enclosure: <sup>B</sup>				
(a) Class 2 transformers	60	108	85	153
(b) Power and ignition transformers	65	117	90	162
(C) Insulated Conductors <sup>C,E,F</sup>				
(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, and 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 footnote <sup>E</sup>		
(D) Electrical Insulation—General <sup>C,F</sup>				
(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 will result 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 <sup>G</sup>				
(1) Aluminum alloys:				
(a) 1100 (2S)	183	330	239	430
(b) 3003 (3S)	239	430	294	530
(c) 2014, 2017, 2024, and 5052 <sup>H</sup>	294	530	350	630
(2) Aluminum-coated steel, heat-resistant type <sup>I</sup>	572	1030	708	1275
(3) Carbon steel—coated with Type A19 ceramic	572	1030	628	1130
(4) Galvanized steel <sup>J</sup>	267	480	350	630
(5) Low-carbon steel, cast iron <sup>K,L</sup>	461	830	517	930
(6) Stainless steel:				
(a) Types 302, 303, 304, 321, and 347	686	1235	767	1380

**TABLE 2** *Continued*

Materials and Components	Column 1		Column 2	
	°C	°F	°C	°F
(b) Type 316	667	1200	748	1345
(c) Type 309S	867	1560	950	1705
(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: <sup>MN</sup>				
(a) Metallic	50	122	not specified	
(b) Glass	78	172		
(c) Plastic <sup>O</sup>	85	185		
(d) Wood	150	302		
(e) Other Materials	<sup>P</sup>			
(2) Internal hopper surface	82	180	150	302

<sup>A</sup> The motor diameter is to be measured in the plane of the laminations of the circle circumscribing the stator frame, excluding lugs, boxes, and the like, used solely for motor cooling, mounting, assembly, or connection.

<sup>B</sup> Ordinarily, 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 two layers, 1/32 in. (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 in. (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 increase measured by a thermocouple shall be allowed to exceed the indicated maximum by the amount noted as follows, provided that the temperature increase 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 in. (178 mm) or less, open type.

(2) 10°C (18°F) for Class B insulation on coil windings of alternating-current motors having a diameter of 7 in. (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 in. (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 in. (178 mm), open type.

<sup>C</sup> Maximum temperature increases are based on an ambient temperature of 25°C or 77°F.

<sup>D</sup> A capacitor that operates at a temperature above a 65°C (117°F) increase shall be judged on the basis of its marked temperature rating.

<sup>E</sup> For standard insulated conductors other than those mentioned, 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 increases are specified, and the maximum allowable temperature increase where Column 2 increases are specified is to be based on the heat-resistant properties of the insulation. Column 2 temperature increases are 15°C (27°F) above Column 1.

<sup>F</sup> 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.

<sup>G</sup> The specified maximum temperature increases apply to parts whose malfunction has the potential to cause the product to be unsuitable for use.

<sup>H</sup> These and other alloys containing more than 1 % magnesium shall not be used when the reflectivity of the material is employed to reduce the risk of fire.

<sup>I</sup> When the reflectivity of aluminum-coated steel is used to reduce fire risk, the maximum allowable temperature increase is 830°F (461°C).

<sup>J</sup> The specified maximum temperature increases shall apply when the galvanizing is required as a protective coating or the reflectivity of the surface is used to reduce fire risk.

<sup>K</sup> The specified maximum temperature increases shall not apply to parts of No. 8 gage (3.86 mm) or heavier steel and 3/16-in. (4.8-mm) thick or heavier cast iron used for the hearth and to other parts of No. 12 gage (2.36 mm) or heavier steel, and 1/8-in. (3.2-mm) thick or heavier cast iron when: (1) the part is not the only enclosure, and (2) malfunction of the part will not expose adjacent combustible construction to the fire in the fire chamber.

<sup>L</sup> The specified maximum temperature increase shall not apply to parts of 1/4 in. (6.4 mm) or heavier steel and 5/16-in. (7.9-mm) thick or heavier cast iron.

<sup>M</sup> Handle temperatures are maximum temperatures, based on an ambient temperature of 70°F or 21°C.

<sup>N</sup> The limitations on operating knobs, handles, and levers does not apply to knobs used for adjusting combustion air inlets or damper handles that do not require adjustment during operation.

<sup>O</sup> Includes plastic with a metal plating not more than 0.005-in. (0.13-mm) thick; and metal with a plastic or vinyl covering not less than 0.005-in. thick.

<sup>P</sup> Other handle materials shall have a limiting temperature determined by the calculation method specified in Practice 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.

5.14.3 A mechanical component shall be used in accordance with its recognized rating established for the intended conditions of use.

## 6. Electrical Requirements

6.1 *Convection and Combustion Blower Assemblies*—Blower assemblies shall comply with the following blower assembly performance requirements specified in UL 1482:

- 6.1.1 Test voltages,
- 6.1.2 Temperature measurements,
- 6.1.3 Input test,
- 6.1.4 Dielectric voltage—withstand test,
- 6.1.5 Leakage current test,
- 6.1.6 Stalled motor test,
- 6.1.7 Strain relief test,
- 6.1.8 Short-circuit test, and
- 6.1.9 Knockout test.

6.2 *Pellet Fuel Feed Assembly*—A motor-driven pellet fuel feed assembly shall comply with all of the above-specified performance requirements for blower assemblies.

6.3 *Electronic Controls or Circuit Boards*—All components used in the control unit shall bear a recognized component marking or the complete assembly shall bear the manufacturer's name, an identification mark, and mark of a laboratory that maintains periodic inspection of the production of equipment and materials and states that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

NOTE 3—Electronic controls and circuits boards must also be evaluated for compliance with 47 CFR Part 15, Subpart B, for the United States and ICES-003 for Canada.

6.4 *Wiring*—Wiring methods shall comply with the requirements of NFPA 70 and UL 1482.

6.5 *Components*:

6.5.1 An electrical or electronic component of a product covered by this specification shall comply with the specified requirements for that component.

6.5.2 *Exception*—An electrical or electronic component need not comply with a specific requirement that (1) involves a feature or characteristic not necessary in the application of the component in the product covered by this specification or (2) is superseded by a requirement in this specification.

6.5.3 An electrical or electronic component shall be used in accordance with its recognized rating established for the intended conditions of use.

6.6 *Electrical Component Temperature Increase:*

6.6.1 Temperature increases shall be measured on the electrical components and enclosures of the blower assemblies and pellet fuel feed assembly when tested in accordance with 10.1.3 and shall not be greater than those specified for the specific component in Column 1 of Table 2.

6.6.2 Temperature increases shall be measured on the electrical components and enclosures of the blower assemblies and pellet fuel feed assembly when tested in accordance with 10.1.4 and shall not be greater than those specified for the specific component in Column 2 of Table 2.

7. Performance Requirements

7.1 *Performance During Maximum Burning Conditions:*

7.1.1 *Maximum Temperature Increase*—Maximum temperature increases above ambient temperature shall not exceed the following limits when tested in accordance with 10.1.3:

7.1.1.1 Temperature of 117°F (65°C) on exposed surfaces of the test structure;

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

7.1.1.3 Temperature of 90°F (50°C) on surfaces of exhaust venting system parts at points of zero clearance to the test structure and air inlet parts at points of zero clearance to the test structure.

7.1.1.4 The maximum values specified in Column 1 of Table 2 for the material used in any part of the room heater and exhaust venting system, if provided as part of the heater.

7.1.2 *Maximum Flue Gas Temperature for Listed Venting Systems:*

7.1.2.1 The maximum temperature of the flue gases entering the chimney shall not exceed 930°F (517°C) above ambient temperature if tested for use with connector pipe and a chimney listed to the requirements of UL 103 or ULC S629M.

7.1.2.2 The maximum temperature of the flue gases entering the exhaust venting system shall not exceed 500°F (260°C) above ambient temperature if tested for use with a venting system listed to the requirements of UL 641 or ULC S609 and determined suitable for use with solid fuel pellet-burning appliances.

7.1.3 *Maximum Room Temperature*—The room temperature shall not increase more than 20°F (11°C) above the value recorded at the beginning of the test.

7.2 *Performance with a Failed Component:*

7.2.1 *Maximum Temperature Increase*—Maximum temperature increases above ambient temperature shall not exceed the following limits when tested in accordance with 10.1.4:

7.2.1.1 Temperature of 140°F (78°C) on exposed surfaces of the test structure;

7.2.1.2 Temperature of 140°F (78°C) on the room heater or exhaust venting system surface at points of zero clearance to the test structure; and

7.2.1.3 Temperature of 140°F (78°C) on the surface beneath a floor protector installed on the area specified for the floor protector.

7.2.1.4 The maximum values specified in Column 2 of Table 2 for the material used in any part of the room heater and of an exhaust venting system provided as part of the heater.

7.2.2 *Maximum Room Temperature*—The room temperature shall not increase more than 20°F (11°C) above the value recorded at the beginning of each failed component test.

7.3 *Combustion Products Leakage:*

7.3.1 *Carbon Monoxide Under Negative Pressure*—Carbon monoxide concentration (ppm) above the ambient concentrations in the test enclosure at the beginning of each test shall not exceed the limits specified in Table 3. Limits are specified in terms of maximum instantaneous concentration and levels not to be exceeded for specific periods of time.

7.3.2 *Carbon Monoxide With Door Unlatched*—Carbon monoxide concentrations shall not exceed 100 ppm during maximum burning conditions with the door unlatched when tested in accordance with 10.1.3.

7.4 *Operational Capability:*

7.4.1 *Convection Blower Speed Control*— If a convection blower speed control is provided, the room heater shall remain operating (that is, not trip overheat sensors), and not exceed any temperature limitation, when the convection blower speed control is set to its lowest setting and the pellet fuel feed control is set to its highest setting.

7.4.2 *Spillage*—There shall be no ongoing spillage of products of combustion or flame from the heater during all testing conditions.

NOTE 4—Intermittent or sporadic wisps of smoke (smoking not over 15 s at a time) is not to be regarded as ongoing spillage.

7.4.3 *Continued Service*—Following completion of the tests described in Section 10, a pellet fuel-burning room heater shall be acceptable for further intended service by meeting the following criteria:

7.4.3.1 No part has become damaged or distorted permanently to an extent that it will not continue to function as intended.

TABLE 3 Carbon Monoxide Concentration Limits (Increase From Initial Concentration)

Test condition	Maximum CO	Not to Exceed
Door latched—Normal Shutdown	50 ppm	35 ppm for more than 1 h
Maximum Burn—Combustion	400 ppm	100 ppm for more than ½ h
Blower Disabled—Door Latched		
Maximum Burn—Door Latched—Vent Blocked	250 ppm	50 ppm for more than 1 h
Power Failure from Maximum Burn—Door Latched	250 ppm	100 ppm for more than ½ h



7.4.3.2 Other than ordinary 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.

7.4.3.3 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 assembly.

7.4.3.4 Cracks are not observable in porcelain enamel used as required protective coating (see 4.5) when the surface is examined under a microscope of 60× magnification.

7.4.3.5 The reflectivity of a surface has not been impaired when the reflectivity of that surface is used to reduce fire risk.

7.4.3.6 The effectiveness of insulating material has not been reduced.

7.4.4 *Visible Smoke*—There shall be no visible smoke at the exhaust venting system termination, once the room heater has been operating for 15 min, during all normal operating conditions.

NOTE 5—Emissions with an opacity greater than 20 %, when measured using the Ringelmann Smoke Chart, (see Test Method D3211) is considered visible smoke.

7.4.5 *Burnback to Fuel Hopper*—There shall be no burnback to the fuel hopper when the heater is tested in accordance with 10.1.5.

NOTE 6—Indications of burnback include smoke within the fuel hopper or smoldering or charred pellet fuel.

7.5 *Physical Integrity:*

7.5.1 *Glazing*—The glazing of a pellet fuel-burning room heater shall not crack, break, or become dislodged when the heater is tested in accordance with 10.2.1 and 10.2.2.

7.5.2 *Rain Protection*—The cap of an exhaust venting system specified for use with the room heater, when tested in accordance with 10.2.3, shall not allow the ingress of rain to exceed 2 % of that which could enter the conduit or passage-way if unprotected by a cap.

NOTE 7—Caps listed for installation with and used with a venting system listed to the requirements of UL 641 or ULC S609, and determined to be suitable for use with solid fuel pellet-burning appliances, do not require retesting to the requirements of this specification. Roof assemblies (terminations) listed for installation with and used with factory-built chimneys listed to the requirements of UL 103 or ULC S629M do not require retesting to the requirements of this specification.

7.6 *Mechanical Integrity:*

7.6.1 *Stability*—When the pellet fuel-burning room heater is tipped in any direction, the product of the minimum force in pounds force (Newtons) 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 lbf degrees (667 N degrees) or more when tested in accordance with 10.3.1.

7.6.2 *Post-Drop Test Integrity*—Ceramic materials shall not break away, become dislodged, or show cracks more than 1/64-in. (0.4-mm) wide; welds shall not break, and the room heater assembly shall not be damaged to the extent that it is unacceptable for further use when tested in accordance with 10.3.2.

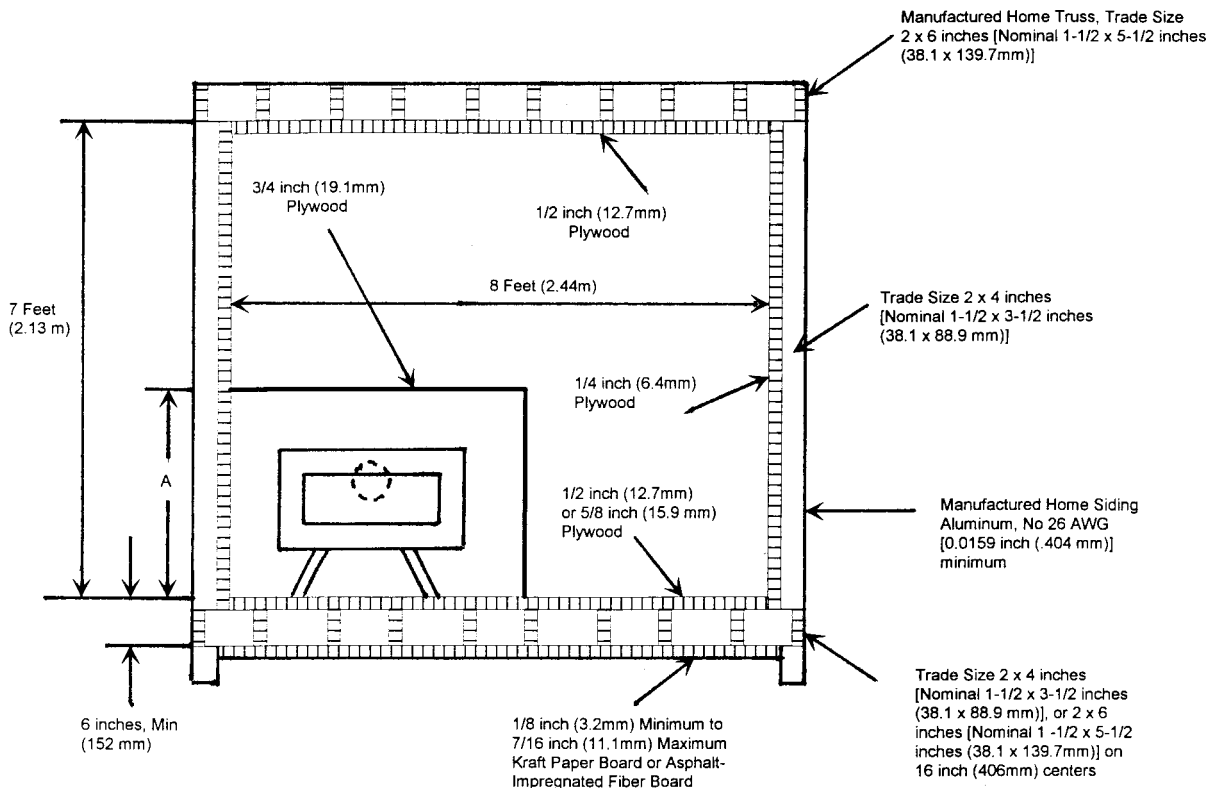


FIG. 2 Combined Conventional Home and Manufactured Home Test Structure (Shown with Optional Alcove Test Enclosure); Installation with a Direct Exhaust Venting System and Optional Alcove Enclosure

**8. Test Structure**

8.1 The room heater to be tested shall be installed in a structure similar to that illustrated in Figs. 2 and 3 constructed to accommodate the product as it is to be tested.

8.2 The test structure shall be erected within a room having ventilation capable of maintaining carbon monoxide buildup to less than 50 ppm throughout the duration of any test. The room shall be free of drafts, and the exhaust venting system is to exhaust into the same space, or into a space freely communicating with the space, from which the combustion air is taken.

8.3 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 maximum burning conditions test (see 10.1.3) and at the beginning of the test for each failed condition during the component failure test (see 10.1.4).

8.4 Ventilating, combustion, or cooling air openings into the room heater shall be sealed unless the following conditions occur:

8.4.1 The openings are more than 1.5 in. (38 mm) above the floor and are not closable during normal operation.

8.4.2 The openings are not susceptible to being blocked by the user to overcome a nuisance, for example, in the event of downdrafts, a cold room, or an overheated room; and

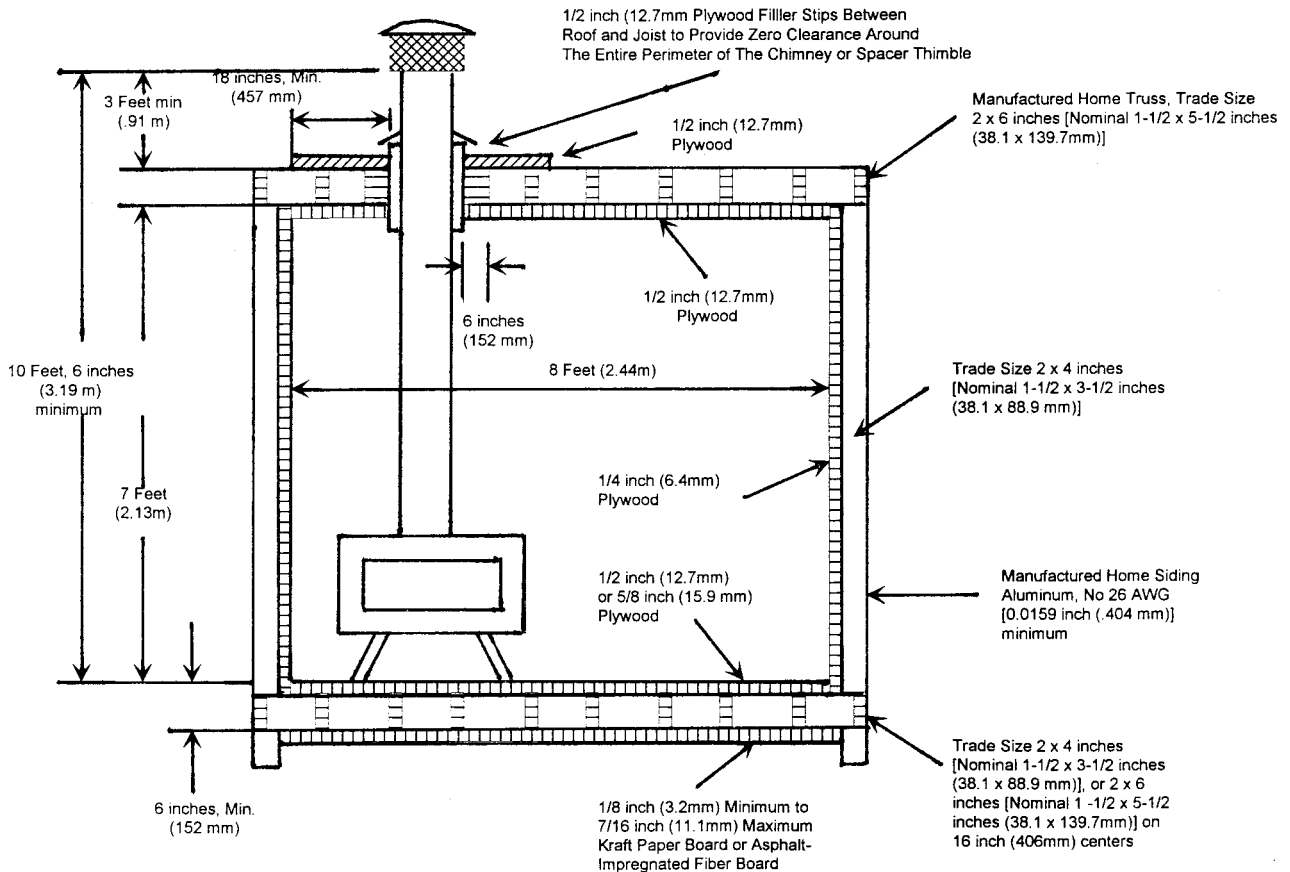
8.4.3 The air is drawn from the room in which the room heater is installed and is discharged into the same room.

8.5 The test structure shall consist of three walls, a floor, and a ceiling, and it is to have inside dimensions of 7 ft (2.1 m) high by 8 ft (2.4 m) wide by 8 ft (2.4 m) deep. See Fig. 2 for structural details. For room heaters intended for use in an alcove, the optional test arrangement shown in Fig. 2 shall be used.

8.6 The exhaust venting system of the room heater shall pass through the ceiling/roof or wall of the test structure in accordance with the vent manufacturer's instructions for installation and clearance. When an exhaust venting system penetrates the roof, the space between the attic/roof framing and the outer surface of the thimble shall be filled with 0.5-in. (12.7-mm) thick plywood sheets, with each sheet having an outer dimension such that it fits at zero clearance to the framing, and a hole centered to accommodate the thimble at zero clearance. When an exhaust venting system penetrates the wall, the space between the wall framing the outer surface shall be filled similarly with plywood sheets.

8.7 If the room heater is equipped with a combustion air inlet that penetrates the floor, a 0.375-in. (9.5-mm) thick plywood bottom board extending at least 8 in. (193 mm) from each side of the air inlet is to be applied to the bottom of the floor joist.

8.8 The room heater and exhaust venting system shall be installed in the test structure at the minimum clearances



**FIG. 3 Combined Conventional Home and Manufactured Home Test Structure; Installation with a Chimney or Type L Vertical Vent**

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 exhaust venting system or the back of the room heater determines the minimum clearance that shall be specified for its test installation.

8.9 The area to be covered by the floor protector shall be as specified in the installation instructions.

8.9.1 *Exception*—A floor protector is not required for the test when the manufacturer requests that the unit be tested without a floor protector, but the installation instructions shall describe the floor protector to be used in the final installation.

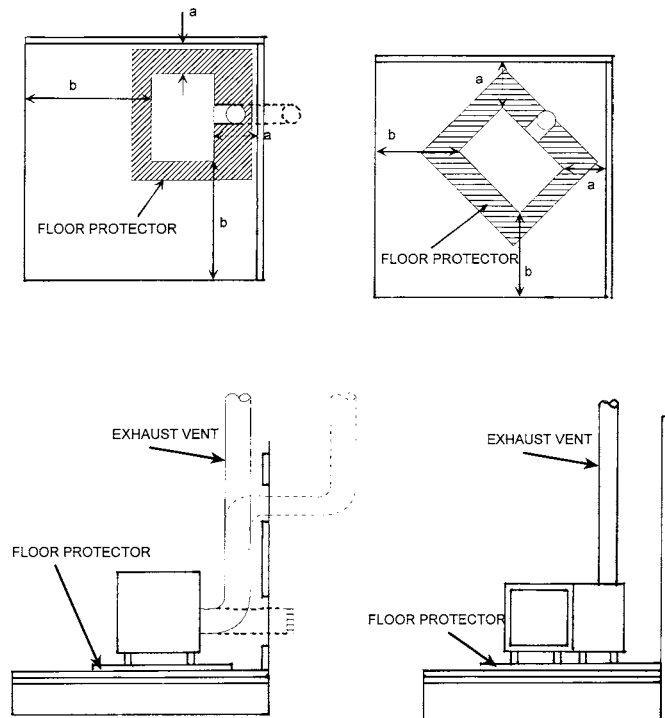


FIG. 4 Typical Fire Test Installations

8.10 The room heater shall 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, if such installation may produce higher temperatures on the test structure. See Fig. 4. For a room heater with sides that reach different temperatures, or where the exhaust venting system exits nearer one side, the insulated wall of the test structure shall be located adjacent to the hottest side.

8.11 All wall, floor, and ceiling surfaces of the test structure shall be painted flat black.

8.12 A room heater intended for installation in a manufactured home shall be installed and tested using the parts specified in the installation instructions provided with the room heater.

9. Temperature Measurement

9.1 During all tests, the inlet flue-gas temperature to the exhaust venting system shall be determined by a thermocouple,

such as that illustrated in Fig. 5. The thermocouple shall be a Type K (chromel-alumel), of No. 24 AWG (0.21-mm<sup>2</sup>) to No. 18 AWG (0.82-mm<sup>2</sup>) wire, and with an untwisted welded bare lead junction not more than 0.050 in. (1.27 mm) in diameter. The thermocouple shall be positioned in the center line of the exhaust venting system, 6 in. (152 mm) downstream from the connection to the room heater, or at a point at which the exhaust gases have been determined to be mixed fully.

9.2 The temperatures of other than flue gases and metal surfaces shall be measured using either Type K (chromel-alumel) or Type J (iron-constantan) thermocouples of wire not larger than No. 24 AWG (0.21 mm<sup>2</sup>).

9.3 The temperatures of metal surfaces other than handles and electrical components shall be measured using Type J

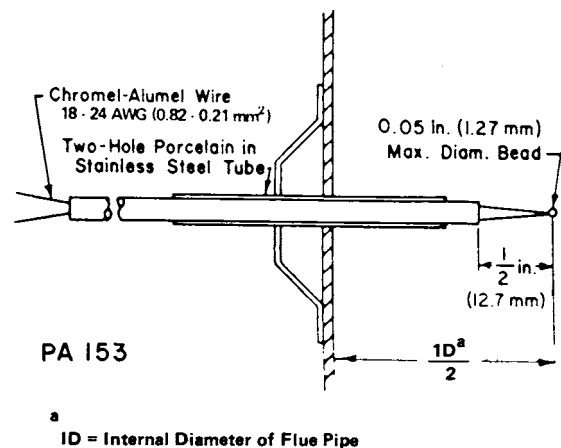


FIG. 5 Flue Gas Thermocouple and Support Bracket

(iron-constantan) or Type K (chromel-alumel) thermocouples of No. 18 AWG (0.82-mm<sup>2</sup>) to No. 24 AWG (0.21-mm<sup>2</sup>) wire.

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

9.5 The ambient temperature shall be determined by using a thermocouple that is shielded by being located centrally within a vertically oriented 6-in. (152-mm) length of aluminum-painted 2-in. (51-mm) steel pipe (ASME B36.10), open at both ends. The shielded thermocouple shall be located 6-in. (152-mm) away from the side wall, 4-ft (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) but not less than 7 ft (2.1 m) from the back wall.

9.6 If 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, but within the test room, shall 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 ft (0.9 m) from the opening. This temperature shall be maintained between 60 and 90°F (15.6 and 32.2°C) during all temperature tests.

9.7 The measurement of temperature increases on the room heater and exhaust venting system parts and on the test structure shall be referenced to the recorded ambient temperatures measured as described in 9.6.

NOTE 8—Listed vent system parts installed in accordance with the vent manufacturer's instructions and the terms of their listing do not require temperature increase measurement, provided that the maximum flue gas temperature does not exceed the limits given in 7.1.2.

9.8 Thermocouples shall be attached to metal surfaces by screws or rivets or by silver soldering, brazing, or welding of the tip to the metal surface, as illustrated in Fig. 6.

9.9 Thermocouples shall be secured to wood surfaces by staples placed over the insulated portion of the wires. The thermocouple tip shall be depressed into the wood such that it is 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, as illustrated in Fig. 6.

9.10 Thermocouples shall be attached to cement-like material surfaces by having the 0.5-in. (12.7-mm) tip and at least 1 in. (25.4 mm) of the lead wires embedded into the material so as to be flush with the surface of the material. Furnace cement shall be smoothed over such indentations to maintain thermal contact.

9.11 Thermocouples shall be attached to surfaces and electrical components, other than those described in 9.8-9.10, 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, and parts whose temperatures are to be measured, are included in Table 2. Temperatures on electrical conductors are to be measured on the surfaces of the conductor insulation.

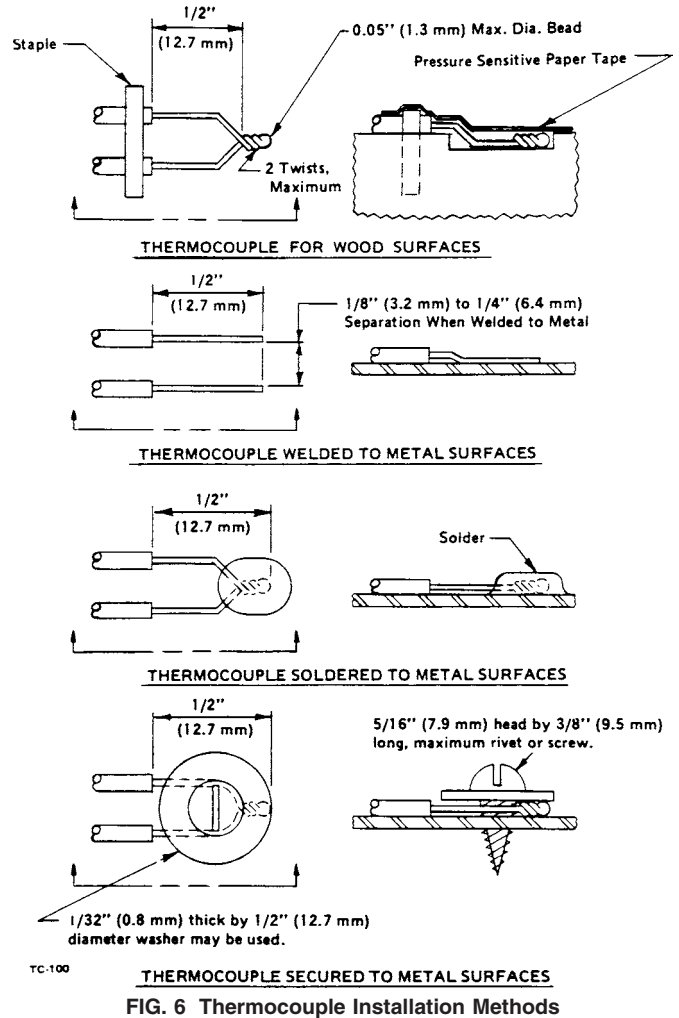


FIG. 6 Thermocouple Installation Methods

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

9.13 Thermocouples shall be placed on surfaces of the test structure at locations that will measure maximum temperatures during tests. A minimum number of typical thermocouple locations are shown in Fig. 7.

9.14 For test structure elements that are in contact with the room heater or exhaust venting system parts, thermocouples shall be placed on the heater or on exhaust venting system part surfaces at representative points of contact.

NOTE 9—Listed vent system parts installed in accordance with the manufacturer's instructions and the terms of their listing do not require the installation of thermocouples, provided that the maximum flue gas temperature does not exceed the requirements given in 7.1.2.

9.15 Thermocouples shall be placed between the floor protector and plywood flooring. Additional thermocouples shall be attached to the plywood flooring beyond the floor protector, as shown in Fig. 7.

9.16 Thermocouples shall be attached to the room heater and exhaust venting system at locations that will measure

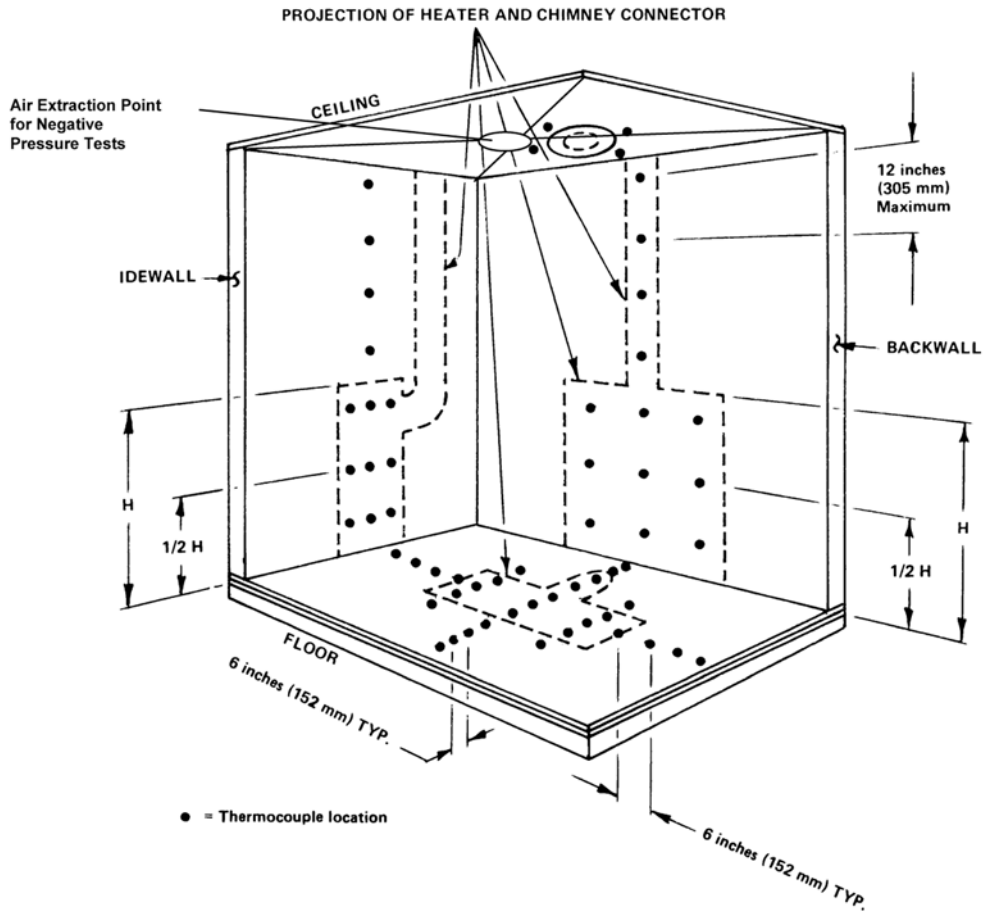


FIG. 7 Typical Thermocouple Locations for Walls and Floors of Test Structure (Right Wall Not Shown)

maximum temperatures during the tests. A minimum number of locations include the following:

- 9.16.1 Hearth and refractory material;
- 9.16.2 *Fire chamber*—Bottom, sides, back, front, and top;
- 9.16.3 *Exhaust Venting System*—Flue gas passages;
- 9.16.4 Feed and ash doors;
- 9.16.5 Fuel feed assembly;
- 9.16.6 *Outer Cabinet*—Bottom, sides, back, front, and top;
- 9.16.7 Door and control handles or knobs;
- 9.16.8 Legs or support stands;
- 9.16.9 All surfaces of the fuel hopper;
- 9.16.10 All electric motors;
- 9.16.11 Internal wiring, connection strips, and terminal blocks; and
- 9.16.12 Other electric components such as switches, controls, and sensors.

## 10. Test Methods

### 10.1 Fire Tests:

10.1.1 *General*—Prior to conducting the following tests, install the pellet fuel-burning room heater in the test structure (see Section 8) and prepare instrumentation for temperature measurement (see Section 9).

10.1.2 The wood pellet fuel to be used in the following tests shall comply with the PFI Standard for the grade(s) specified by the appliance manufacturer.

### 10.1.3 Maximum Burning Conditions Test:

10.1.3.1 *Significance*—The purpose of this test is to ensure that the room heater does not produce an unsafe condition (see 7.1) when operated at the maximum achievable burning rate.

10.1.3.2 *Procedure*—Fill the storage hopper with the specified wood pellet fuel (see 10.1.2). Following the manufacturer's instructions, ignite the room heater. Adjust the pellet feed rate, adjustable combustion air controls, thermostatic controls, and the like to produce the maximum temperatures. Record temperatures at all points of measurement at intervals not exceeding 30 min until the maximum temperatures have been attained. Maximum temperatures are considered to have been attained when three successive readings taken at 30-min intervals show no change or show a decrease. Record the temperature of the flue gases entering the exhaust venting system at intervals not exceeding 10 min.

### 10.1.4 Component Failure Test:

10.1.4.1 *Significance*—The purpose of this test is to ensure that the room heater does not produce an unsafe condition (see 7.2) in the event that a motor-driven component or its control circuitry fail.

10.1.4.2 *Procedure*—Fill the storage hopper with the specified wood pellet fuel (see 10.1.2). Following the manufacturer's instructions, ignite the room heater. Adjust the pellet feed rate, adjustable combustion air controls, thermostatic controls, and the like to the same settings as were used to produce the

maximum temperatures in the maximum burning conditions test (see 10.1.3). Bypass room heater controls to permit one of the component motors to run individually at maximum speed. Record temperatures at all points of measurement for each condition at intervals not exceeding 10 min until the maximum temperatures have been attained. Maximum temperatures are considered to have been attained when three successive readings taken at 10-min intervals show no change or show a decrease. Restore the heater controls to the original condition, and continue bypassing motors individually to achieve their maximum speed and measuring the resulting temperatures until all motors have been bypassed individually. Restore the heater controls to the original condition, and then render the component motors and blowers inoperative, both individually and in combination. Record temperatures at all points of measurement for each condition at intervals not exceeding 10 min until it is apparent that the maximum temperatures have been attained. Maximum temperatures are considered to have been attained when three successive readings taken at 10-min intervals show no change or show a decrease.

10.1.4.3 *Exception*—The controller need not be bypassed if a motor speed controller is used that limits the maximum fuel delivery rate and can fail only in a manner that prevents the feed motor from operating.

#### 10.1.5 *Negative Pressure Tests:*

10.1.5.1 *Significance*—The purposes of these tests are to (1) ensure that the room heater does not permit unsafe carbon monoxide concentrations (see 7.3.1) to accumulate in the space being served by the heater and (2) to ensure that the room heater is not subject to burnback into the fuel hopper.

10.1.5.2 *Procedure*—Conduct the tests while the room heater is operating at maximum burning conditions, with the combustion blower disabled, with the exhaust venting system completely blocked, during a normal shut down, and under power failure conditions. Conduct the tests with the room heater drawing room air for combustion, and also with the room heater drawing outside air for combustion, unless the room heater is intended to draw outside air only. With no combustion in the room heater, seal the flue outlet and outdoor combustion air inlet if applicable with aluminum tape or equivalent. Enclose and seal the test structure fully. Develop a negative pressure of 0.07 in. water column (WC) (17.5 Pa) in the test structure by use of an extraction fan. The extraction outlet shall be located on the center of the test structure ceiling. The maximum extraction flow rate shall not exceed 70 cfm. Remove the flue and inlet seals when the required negative pressure has been achieved. If necessary, readjust the extraction blower speed to achieve a negative pressure of 0.07 in. WC or 70 cfm, whichever occurs first. Start each test condition with the room heater operating at maximum burning conditions. Collect samples of the atmosphere within the test enclosure throughout the test period at a point 4 ft (1.2 m) above the floor and 2 ft (0.6 m) in front of the room heater. Analyze the samples to determine the carbon monoxide concentration. Continue each test until combustion has ceased (applicable only to tests run with failed or blocked components), until the potential for burnback into the fuel hopper has been evaluated and the maximum carbon monoxide

concentration has been reached. Maintain each test condition for a minimum of 2 h even if it appears that combustion has ceased in a shorter time. Prior to evaluating each condition, reestablish maximum burning conditions. If the fuel hopper lid does not incorporate a means to ensure continuous positive closure, such as an audible warning device or a label in accordance with 12.10, repeat the tests with the lid fully open. The required fuel feed motor interlock shall be allowed to function during this test.

#### 10.1.6 *Door Ajar Test:*

10.1.6.1 *Significance*—The purposes of this test are (1) to ensure that the room heater does not permit unsafe concentrations of carbon monoxide (see 7.3.2) to accumulate in the space being served by the heater and (2) to ensure that spillage does not occur (see 7.4.3).

10.1.6.2 *Procedure*—Conduct this test as a continuation of the tests described in 10.1.5. Fill the storage hopper to 25 % capacity with the specified wood pellet fuel (see 10.1.2). Following the manufacturer's instructions, ignite the room heater. Adjust the pellet feed rate, adjustable combustion air controls, thermostatic controls, and the like to produce the maximum burning conditions capacity. Open the unit door not less than 15 degrees. Seal the test enclosure. With the extraction fan off, collect samples of the atmosphere within the test enclosure throughout the test period at a point 4 ft (1.2 m) above the floor and 2 ft (0.6 m) in front of the room heater. Analyze the samples to determine the carbon monoxide concentration. Continue each test until the maximum carbon monoxide concentration has been reached or until combustion has ceased.

10.1.6.3 *Exception*—Units incorporating a separable handle or tool to open the door are exempt from door ajar testing.

## 10.2 *Physical Properties Tests:*

### 10.2.1 *Glazing Water Shock Test:*

10.2.1.1 *Significance*—The purpose of this test is to ensure that the glazing used in the room heater has the necessary resistance to thermal shock conditions.

10.2.1.2 *Procedure*—While at the maximum temperature developed during the maximum burning conditions test (see 10.1.3), apply room temperature water to the surface of each glazing panel in the following manner. Wipe a wet cloth, fully saturated with water, across the surface of each glazing panel. After the panel is dried and again attains the maximum temperature, apply a misted water spray, projected across the surface of each glazing panel from a household cleaning bottle with a gun-type nozzle. After the panel is dried and again attains the maximum temperature, repeat the spray application until each panel has undergone three applications of misted water spray.

### 10.2.2 *Glazing Impact Test (Tempered Glass Only):*

10.2.2.1 *Significance*—The purpose of this test is to ensure that the glazing used in the room heater has the necessary resistance to impact conditions.

10.2.2.2 *Procedure*—Prior to the maximum burning conditions test, while the glazing is at room temperature, apply an impact to the center of the glazing panel by means of a 1.18 pounds-mass (0.54 kg), 2-in. (50.8-mm) diameter steel sphere swung through a pendulum arc from a height (h) of 16.25 in.

(413 mm). The at-rest suspension point of the steel sphere is to be 1 in. (25.4 mm) in front of the plane of the panel. See Fig. 8. Repeat the test during the maximum burning conditions test, while at the maximum temperature developed during the test (see 10.1.3) and following the maximum burning conditions test after permitting to cool to room temperature.

10.2.3 Rain Test:

10.2.3.1 Significance—The purpose of this test is to ensure that an exhaust venting system termination provides adequate protection from the entry of rain.

10.2.3.2 Apparatus—The rain test apparatus is to consist of three spray heads mounted in a water-supply pipe rack. See Fig. 9. Spray heads are to be constructed in accordance with the details illustrated in Fig. 10. The water pressure for all tests shall be maintained at 5 psig (34.5 kPa) at each spray head. The spray is to be directed toward the top and side of the cap. The cap is to be located centrally within the spray pattern, and the top of the cap under test is to be in the same plane at least 3 ft (0.9 m) from the lower spray head outlet.

10.2.3.3 Procedure—Test the vent termination in the orientation specified for its use. Determine the average rate of simulated rainfall in inches per hour over an area 12 in. in diameter, with a water pressure at 5 psig (34.5 kPa), as follows. Use a 12-in. (305-mm) diameter cylindrical container, open at one end and approximately 20-in. (508-mm) deep, to collect the rainfall for 30 min. Multiply the number of inches of rainfall collected during 30 min. by two to determine rainfall in inches per hour. Make arrangements for collecting any water entering the flue gas conduit and any ventilation passageway of the given configuration. The rain test is to cover a period of 1 h.

10.2.3.4 Calculation—The maximum amount of water collected shall not exceed the value obtained by application of the following formula:

$$Q \leq 0.02 \times R \times A$$

IMPACT TEST

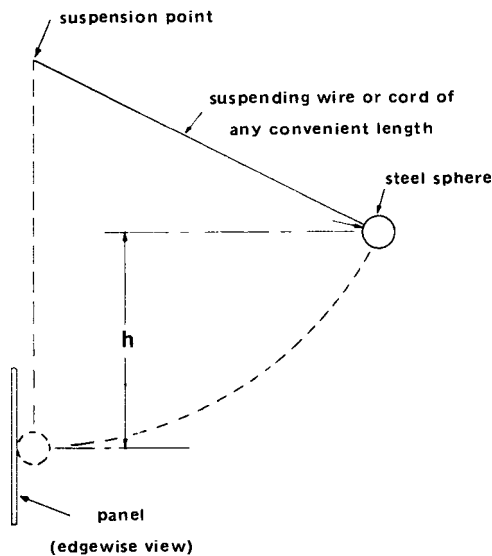


FIG. 8 Impact Test

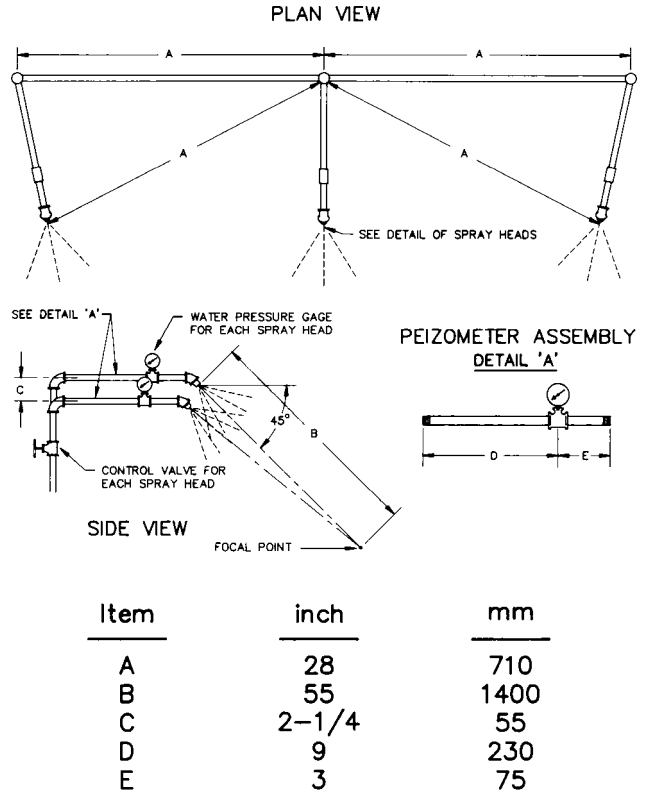


FIG. 9 Rain Test Spray-Head Piping

where:

- Q = volume of water actually collected, in.<sup>3</sup>/h;
- R = rainfall, in./h; and
- A = area of conduit or passageway, in.<sup>2</sup>

10.3 Mechanical Properties Tests:

10.3.1 Stability Test:

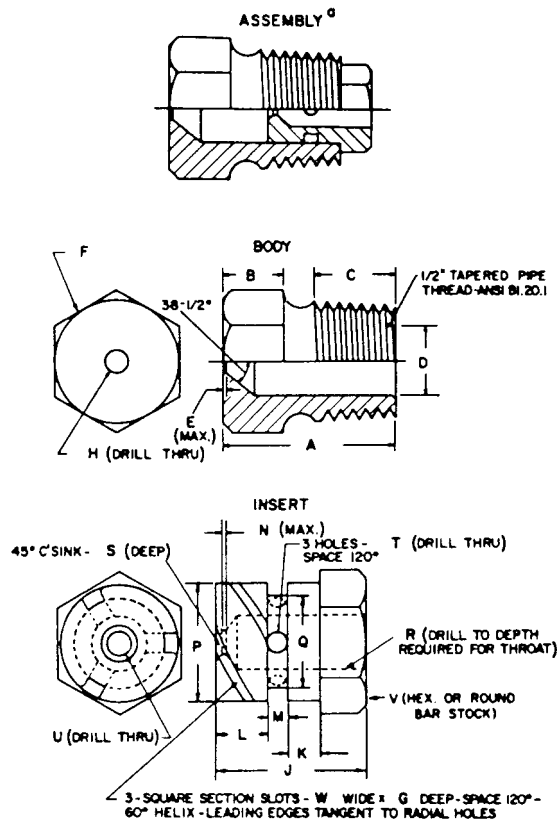
10.3.1.1 Significance—The purpose of this test is to ensure that the room heater is not able to be easily overturned.

10.3.1.2 Procedure—Place the room heater on a level floor or platform. If means for leveling are provided, raise the heater to the highest position allowed by leveling means. 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 will fall on its side when released. 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. Block the heater base or legs at the near side so that the heater will not slide in the direction of the applied force. Using a spring scale or equivalent for indicating force in pounds or Newtons, apply the force at the top center of each side of the heater until it starts to tip. Record the force required to initiate tipping. Continue the tipping force until the least-tipped position is reached from which the heater will tip over if not restrained. Hold the heater in that position and measure the tipping angle.

10.3.2 Drop Test:

10.3.2.1 Significance—The purpose of this test is to ensure that the room heater can withstand successive impacts without damage to the extent that it is unacceptable for further use.

RAIN-TEST SPRAY HEAD



Item	inch	mm	Item	inch	mm
A	1-7/32	31.0	N	1/32	0.80
B	7/16	11.0	P	.575	14.61
C	9/16	14.0	Q	.576	14.63
D	.578	14.68	R	.453	11.51
E	.580	14.73	R	.454	11.53
F	1/64	0.40	S	1/4	6.35
G	c	c	T	1/32	0.80
H	.06	1.52	T	(No. 35) <sup>b</sup>	2.79
H	(No.9) <sup>b</sup>	5.0	U	(No. 40) <sup>b</sup>	2.49
J	23/32	18.3	V	5/8	16.0
K	5/32	3.97	W	0.06	1.52
L	1/4	6.35			
M	3/32	2.38			

<sup>a</sup> Nylon Rain-Test Spray Heads are available from Underwriters Laboratories Inc.

<sup>b</sup> ANSI B94.11 Drill Size.

<sup>c</sup> Optional – To serve as wrench grip.

FIG. 10 Rain Test Spray-Head

10.3.2.2 Procedure—After completion of the fire tests (see 10.1), raise the room heater 1 in. (25.4 mm) and drop it on a 0.75-in. (19.1-mm) thick sheet of plywood laid over a concrete floor. Repeat this test ten times in succession.

11. Precision and Bias

11.1 No statement is made concerning either the precision or bias of the test methods described in Section 10 since the result states merely whether there is conformance to the criteria for acceptance specified in the requirements.

12. Product Marking

12.1 General:

12.1.1 Markings on a room heater shall be permanent and, unless otherwise required to be placed at a specific location, shall be grouped together and located where they will be visible and legible after the room heater is installed. The markings specified in 12.2.8, 12.2.9, 12.2.11, and 12.2.13 shall be visible while adding fuel to the room heater fuel hopper.

12.1.2 Exception—Locations within a compartment used to operate an appliance and provided with doors or panels intended to be opened or removed without requiring the use of a tool are considered visible.

12.1.3 A marking required to be permanent shall be molded; die-stamped; paint-stenciled, stamped, or etched metal that is secured permanently to the room heater or stamped indelibly on a pressure-sensitive label. Ordinary usage, handling, and storage of the product are considered in determining the permanence of the marking. Adhesive attached marking and labeling systems shall comply with the requirements for marking and labeling systems given in UL 969.

12.2 Mark each room heater with the following information:

12.2.1 The manufacturer's or private labeler's name or identifying symbol and address.

12.2.2 A distinctive type or model designation.

12.2.3 Minimum clearances from the chimney connector and from the sides and back of the room heater to combustible materials. These clearances are to be in written and diagrammatic form.

12.2.4 The type and dimensions of floor protection. The dimensions shall be in diagrammatic form.

12.2.5 The type of exhaust venting systems to be used with the room heater.

12.2.6 A statement referencing the manufacturer's installation instructions for precautions required for passing an exhaust venting system through a combustible wall or ceiling and reference to a local building code for details.

12.2.7 Identification of the listing laboratory.

12.2.8 The phrase "Inspect and Clean Exhaust Venting System Frequently," or an equivalent.

12.2.9 The phrase "Install and Use Only in Accordance With (manufacturer's or private labeler's name) Installation and Operating Instructions," or an equivalent.

12.2.10 The phrase "Contact Local Building or Fire Officials About Restrictions and Installation Inspection in Your Area."

12.2.11 The phrase "For Use With Only." (Specify the fuel or fuels for which the room heater has been tested, for example, wood pellet fuel, pea coal (anthracite), pelletized peanut husks, corn kernels, and pelletized agricultural biomass.)

12.2.12 The phrase "Do Not Connect This Unit to a Chimney Fuel Serving Another Appliance."



12.2.13 The phrase “Keep Viewing and Ash Removal Doors Tightly Closed During Operation,” or an equivalent, as applicable.

12.2.14 The date of manufacture (at least by quarter and year), which may be in an established or otherwise traceable code.

12.2.15 The input rating.

12.3 Mark each individual part or assembly, such as a blower assembly, a section of exhaust venting system, and the like required as part of the assembly, with the following information:

12.3.1 The manufacturer’s or private labeler’s name or identifying symbol.

12.3.2 A distinctive type or model designation.

12.4 Include the following statement on a room heater for use in mobile homes: “Room Heater, Pellet Fuel-Burning Type, Also For Use In Mobile Homes.”

12.5 Mark a room heater with its electrical rating, if applicable, in volts (volts and alternating current), amperes or watts, and frequency in hertz; and with information concerning the routing of power supply cords and the orientation and location of motors.

12.6 Mark room heater controls so as to indicate position (that is, off/on, high/medium/low, minimum/maximum, and open/closed).

12.7 Mark a room heater with other use information, if applicable, for the specific heater.

12.8 Include the permanent label shown in Fig. 11 on the room heater. The letters in the word “CAUTION” shall be not less than 0.25-in. (6.4-mm) high, with the remaining letters of the label being not less than 0.125-in. (3.2-mm) high. The outline, crossed logs, and fire are all to be printed in a bright red color on a contrasting background. The outline shall be at least 1 in.<sup>2</sup> (25.4 mm<sup>2</sup>).

12.9 Attach the label described in 12.8 to the front of the heater, as it is intended to be installed, and ensure that it is legible when viewed from a point 5 ft (1.5 m) directly in front of the heater and 5 ft or less above the floor.

12.9.1 *Exception*—The label described in 12.8 is permitted to be attached to the rear of the heater if (1) the heater is provided with means for observing the fuel-burning process within the heater (such as by incorporating a closed-window type port) from a point 5 ft (1.5 m) in front of the heater and at a vertical distance of 1 to 5 ft (0.3 to 1.5 m) above the floor

or (2) the heater is constructed without an outer cabinet (radiant type) and its design indicates clearly that the heater is intended to burn solid fuel.

12.10 Include the following permanent label on the fuel hopper lid/door for units that require that the hopper lid/door remain closed: “CAUTION: Operate this unit only with the fuel hopper lid closed. Failure to do so may result in emission of products of combustion from the hopper under certain conditions. Maintain hopper seal in good condition. Do not overfill the hopper.” The letters in the word “CAUTION” shall be not less than 0.25 in. (6.4 mm) high, with the remaining letters of the label being not less than 0.125 in. (3.2 mm) high.

12.11 If the construction of a blower assembly necessitates disassembly for the purposes of cleaning or similar servicing by the user, and if such disassembly involves the possibility of exposure of persons to contact with enclosed or protected live parts, moving parts that may cause injury to persons, or hot parts, mark a room heater plainly with the appropriate statement(s) indicated as follows:

12.11.1 “CAUTION” and the following or equivalent wording: “Moving Parts May Cause Injury. Do not Operate Unit with Removed.” (Specify the appropriate part.)

12.11.2 “CAUTION” and the following or equivalent wording: “Hot Parts. Do Not Operate Unit With Removed.” (Specify the appropriate part.)

12.11.3 “DANGER” and the following or equivalent wording: “Risk of Electric Shock. Disconnect Power Before Servicing Unit.”

NOTE 10—When applying this requirement, it is assumed that parts, such as fronts, grilles, and the like, will be removed periodically.

12.12 Ensure that the warning markings indicated in 12.11 and 12.15 are located such that they are visible before or immediately upon removal of a cover, panel, or the like that encloses or protects the moving part, hot part, or live part. The marking shall not be on the back of a removable cover or panel.

12.13 With respect to the requirement given in 12.12, if the marking is located on a removable panel or cover, the replacement of the panel or cover, or its means of attachment, shall not obscure the warning.

12.14 Unless correct field wiring connections are obvious, attach a wiring diagram to each permanently connected blower assembly and pellet fuel-feed assembly in order to show the intended method of making field wiring connections. A paper sticker glued or shellacked, or both, to an accessible cover is acceptable.

12.15 Mark a blower assembly, or other part or accessory assembly intended for field installation in or on a room heater, with the designation of the product with which it is intended to be used. Mark the associated room heater with an indication of the catalog number or equivalent designation of such an accessory and the name of the manufacturer or vendor of that accessory. (See also 12.3.)

12.16 Provide instructions for installing a blower assembly on or with the blower assembly. Include a statement in the instructions warning the user that the blower assembly (1) must be disconnected from the source of electrical supply (as

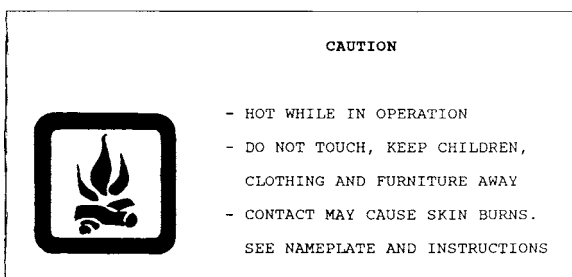


FIG. 11 Permanent Caution Label

appropriate) before attempting the installation and (2) is intended for use only with the room heater that is marked to indicate such use. (See 12.15.)

12.17 If an accessory is constructed to be installed by means of receptacles and plug-in connectors that have been investigated to make and break circuits under loads, and if such connection or disconnection does not result in the exposure of uninsulated live parts, the statement that the room heater must be disconnected from the source of electrical supply need not be used.

12.18 If a manufacturer produces room heaters at more than one factory, each assembly shall have a distinctive marking, which may be in code, to identify it as the product of a particular factory.

### 13. Installation and Operating Instructions

#### 13.1 *General:*

13.1.1 Installation and operating instructions shall be either in a single manual or separate manuals, and they shall be packed with the fire chamber of the product.

13.1.2 Instructions shall make reference to the manufacturer's or private labeler's catalog designation, or equivalent, for the room heater and related parts, and they shall include the manufacturer's or private labeler's name and address. All specified WARNING and CAUTION statements shall be in bold face upper-case letters.

13.1.3 Instructions shall include the following statements on the cover or first page:

13.1.3.1 "Please read this entire manual before installation and use of this pellet fuel-burning room heater. Failure to follow these instructions could result in property damage, bodily injury or even death."

13.1.3.2 "Contact local building or fire officials about restrictions and installation inspection requirements in your area."

13.1.3.3 "Save these instructions."

#### 13.2 *Installation Instructions:*

13.2.1 Installation instructions required to be provided with the product shall be furnished with the sample submitted for investigation and be used in the examination and tests of the room heater.

NOTE 11—The instructions need not be in final printed form for the investigation.

13.2.2 Installation instructions shall be illustrated and include directions and information necessary to complete the intended installation of the product.

13.2.3 Installation instructions shall include particular details concerning the following:

13.2.3.1 The parts and materials required and the step-by-step process for installing a room heater, accessories, and its exhaust venting system. For a manufactured home installation, part descriptions in illustrated and written form, including part identifications assigned to each specific part, both for replacement and for the initial installation parts.

13.2.3.2 The parts or materials to be used for the floor protector. The minimum areas to be covered and their relationship to the product, which shall include at least the area under

the product and 6 in. (152 mm) beyond the front and beyond each side of the fuel loading and ash removal openings.

13.2.3.3 The size and type of exhaust venting system to which the room heater is to be connected, including the following statements: (1) "DO NOT INSTALL A FLUE DAMPER IN THE EXHAUST VENTING SYSTEM OF THIS UNIT"; and (2) "DO NOT CONNECT THIS UNIT TO A CHIMNEY FLUE SERVING ANOTHER APPLIANCE."

13.2.3.4 Attachment and securement of the exhaust venting system to the product and to each adjoining section. All joints for connector pipe shall be required to be fastened with at least three screws. If vented horizontally, joints shall be made gastight in a manner that shall be specified.

13.2.3.5 Exhaust venting system termination requirements, including location restrictions; relationship to air inlets; distances from windows, doors, and air inlets; and distance to combustible materials.

13.2.3.6 Minimum installation clearances from the unit to combustible construction at the rear, sides, and top, and the following statement: "INSTALL VENT AT CLEARANCES SPECIFIED BY THE VENT MANUFACTURER."

13.2.3.7 Methods and parts to be used for maintaining ventilation and air circulation, if required.

13.2.3.8 Any limitations with respect to installation and minimum installation clearances; joining of two or more parts to constitute an assembly, such as installation of support legs, enclosures, and the like.

13.2.3.9 For a room heater intended for use in a manufactured home, the label "WARNING" and the following or equivalent statement: "DO NOT INSTALL IN SLEEPING ROOM"; and the label "CAUTION" and the following or equivalent statement: "THE STRUCTURAL INTEGRITY OF THE MANUFACTURED HOME FLOOR, WALL, AND CEILING/ROOF MUST BE MAINTAINED."

13.2.3.10 For a room heater intended for use in a manufactured home, a description of all outside combustion air supply and exhaust venting system parts, including exhaust venting system sections, supports, spark arrester, and the like, determined by testing to be acceptable for use with the room heater.

#### 13.3 *Operating Instructions:*

13.3.1 Operating instructions required to be provided with each product are to be used during examination and testing of the product.

NOTE 12—The instructions need not be in final printed form for the investigation.

13.3.2 Operating instructions shall include particular details concerning the following:

13.3.2.1 Complete startup and shutdown instructions.

13.3.2.2 Inspection, maintenance, and cleaning of the exhaust and convection air filter.

13.3.2.3 Selection of fuel(s), including size requirements and information on the effects of fuel quality (that is, moisture and ash content) on operation, maintenance, and cleaning requirements.

13.3.2.4 Disposal of ashes, including the following statement: "Disposal of Ashes—Ashes should be placed in a metal container with a tight fitting lid. The closed container of ashes

should be placed on a noncombustible floor or on the ground, well away from all combustible materials, pending final disposal. If the ashes are disposed of by burial in soil or otherwise locally dispersed, they should be retained in the closed container until all cinders have been thoroughly cooled.”

13.3.2.5 Caution against the storage or use of flammable liquids, as follows: “Never use gasoline, gasoline-type lantern fuel, kerosene, charcoal lighter fluid, or similar liquids to start or ‘freshen up’ a fire in this heater. Keep all such liquids well away from the heater while it is in use.”

13.3.2.6 For wood pellet fuel-burning heaters, reference to the formation and removal of soot and flyash buildup in the exhaust venting system as follows (the inspection frequency “once every year” stated herein may be a shorter time period at the manufacturer’s or private labeler’s option): “*Soot and Flyash: Formation and Need for Removal*—The products of combustion will contain small particles of flyash. The flyash will collect in the exhaust venting system and restrict the flow of the flue gases. Incomplete combustion, such as occurs during startup, shutdown, or incorrect operation of the room heater will lead to some soot formation which will collect in the exhaust venting system. The exhaust venting system should be inspected at least once every year to determine if cleaning is necessary.”

13.3.2.7 Reference to the use or non-use of grates or other methods of supporting the fuel.

13.3.2.8 Operation and use of manual or thermostatic controls.

13.3.2.9 Instructions and procedures for building and maintaining the fire, and warnings against overfiring.

## 14. Supplementary Requirements

14.1 The following supplementary requirements shall apply only when additional solid fuels, other than wood pellet fuel meeting the requirements of 10.1.2, are specified by the manufacturer for use in the room heater.

14.1.1 *Fire Tests*—The maximum burning conditions test (see 10.1.3) and the negative pressure tests (see 10.1.5) shall be conducted for each additional fuel.

14.2 The following supplementary requirements shall apply only when the room heater is specified for installation as a fireplace insert in a masonry fireplace.

14.2.1 *Test Structure*—The test installation shall comply with UL 907.

14.2.2 *Temperature Measurement*—Temperature measurement shall comply with UL 907 and with the minimum number of locations specified in 9.16.

14.2.3 *Fire Tests*—The maximum burning conditions test (see 10.1.3) and the circulating air blower failure portion of the component failure tests (see 10.1.5) shall be conducted.

## 15. Keywords

15.1 exhaust venting system; fuel hopper; manufactured home; pellet fuel; performance criteria; room heater; safety testing

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