

**Underwriters Laboratories Inc.®**A not-for-profit organization dedicated to public safety
and committed to quality service**January 11, 1996****Revision pages for****Standard for****Gas-Burning Heating Appliances for Manufactured Homes and Recreational Vehicles****UL 307B, Fourth Edition**

Attached to this transmittal notice is a revision of the Fourth edition of UL 307B.

A CHANGE ON A PAGE DATED JANUARY 11, 1996 IS INDICATED BY A SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM, PRECEDED AND FOLLOWED BY AN ASTERISK.

THIS REVISION IS CONSIDERED NON-SUBSTANTIVE AND IS BEING ISSUED TO ELIMINATE THE OXYGEN BOMB TEST. THE OXYGEN BOMB TEST IS NO LONGER APPROPRIATE IN MOST CASES DUE TO THE ADDITION OF ANTIOXIDANTS TO RUBBER AND POLYMERIC COMPOUNDS. THEREFORE, UL IS ELIMINATING THE OXYGEN BOMB TEST AND REPLACING IT WITH AN AIR OVEN AGING TEST WHICH IS USED FOR THERMOPLASTIC COMPOUNDS. THE REQUIREMENTS ARE NOW IN EFFECT.

Revised and/or additional pages may be issued from time to time.

With the inclusion of the accompanying material, the standard consists of pages dated as shown in the following checklist:

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UL 307B

Standard for

**Gas-Burning Heating Appliances For Manufactured
Homes and Recreational Vehicles**

The First edition was titled "Gas- and Oil-Fired Heating Appliances for Trailer Coaches" and numbered UL 307. The Second edition was titled "Gas-Heating Appliances for Mobile Homes and Travel Trailers." The Third Edition was titled "Gas-Burning Heating Appliances for Mobile Homes and Recreational Vehicles."

First Edition – May, 1958

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Third Edition – February, 1982

Fourth Edition

January 26, 1995

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

Revisions of this standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest published set of revision pages.

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108.2 Vents

108.2.1 Vertical vent and vent/air intake terminals shall withstand a rain exposure for 30 minutes without water entering the appliance.

108.2.2 The vent or vent/air intake terminal is to be attached to a suitable watertight container and subjected to a rain exposure from the apparatus described in 108.1.7. The vent or vent/air intake terminal is to be tested under the conditions evaluated most likely to cause the entrance of water into the terminal. It may be necessary to orient the terminal in various other positions with respect to the rain exposure if more adverse conditions could result. In any case, each exposure is to be for 30 minutes and if more than one exposure is required, the terminal is to be completely dried before repeating the test.

108.2.3 After each exposure, no water shall have entered the vent or vent/air intake assembly.

109 Gaskets

109.1 Neoprene or rubber compounds, except foamed materials, used for gaskets to seal electrical enclosures, shall have physical properties as indicated in Table 109.1 before and after accelerated aging under the conditions indicated in Table 109.2.

Table 109.1
Physical properties for gaskets

	Neoprene or rubber compound		Polyvinyl-chloride materials	
	Before test	After test	Before test	after test
Recovery – maximum set when 1 inch (25.4 mm) gage marks are stretched to 2.5 inches (63.5 mm), held for 2 minutes and measured 2 minutes after release	1/4 inch (6.4 mm)	–	Not specified	
Elongation – minimum increase in distance between 1 inch (25.4 mm) gage marks at break	250 percent 1 to 3.5 inches (25.4 to 89.0 mm)	65 percent of original	250 percent 1 to 3.5 inches (25.4 to 89.0 mm)	75 percent of original
Tensile strength – minimum force at breaking point	850 psi (5.86 MPa)	75 percent of original	1200 psi (8.27 MPa)	90 percent of original

109.2 Foamed neoprene or rubber compounds forming gaskets to seal an electrical enclosure are to be subjected to accelerated aging under the conditions indicated in Table 109.2. The compounds shall not harden or otherwise deteriorate to a degree that will affect their sealing properties.

109.3 Thermoplastic materials forming gaskets to seal an electrical enclosure shall be subjected to accelerated aging under the conditions indicated in Table 109.2. Thermoplastic material shall not deform or melt, or otherwise deteriorate to a degree that will affect its sealing properties. Solid polyvinyl-chloride gasket material shall have physical properties as indicated in Table 109.1 before and after the accelerated aging.

Table 109.2
Accelerated aging conditions

Measured temperature rise degrees C (F)		Material	Test program
35	(63)	Rubber or neoprene	Air oven aging for 70 hours at 100°C
35	(63)	Thermoplastic	7 days in an air circulating oven at 87°C (189°F)
50	(90)	Rubber or neoprene	Air oven aging for 168 hours at 100°C
50	(90)	Thermoplastic	10 days in an air circulating oven at 100°C (212°F)
55	(99)	Rubber, neoprene or thermoplastic	7 days in an air circulating oven at 113°C (235.4°F)
65	(117)	Rubber or neoprene	10 days in an air circulating oven at 121°C (249.8°F)
65	(117)	Thermoplastic	7 days at 121°C (249.8°F) or 60 days at 97°C (206°F) in an air circulating oven
80	(144)	Rubber, neoprene or thermoplastic	7 days in an air circulating oven at 136°C (276.8°F)

Table 109.2 revised January 11, 1996

109.4 Where gaskets are secured by adhesives, samples of the gasket adhesive and mounting surface shall be exposed for a period of 72 hours to each of the following conditions:

- a) 100°C (212°F);
- b) Immersion in distilled water; and
- c) Minus 10°C (plus 14°F).

The force required to peel the gasket from its mounting surface after exposure shall not be less than 75 percent of the value determined on as-received samples.

109.5 The temperatures indicated in Table 109.2 correspond to the maximum temperature rise measured on the gasket during the Temperature Test, Section 66.

110 Metallic Coating Thickness Test

110.1 The solution to be used for this test is to be made from distilled water and is to contain 200 grams per liter of chemically pure chromic acid (CrO_3) and 50 grams per liter of chemically pure concentrated sulfuric acid (H_2SO_4). The latter is equivalent to 27 milliliters per liter of chemically pure concentrated sulfuric acid, specific gravity 1.84, containing 96 percent of H_2SO_4 .



Underwriters Laboratories Inc.®

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August 14, 1995

Revision pages for

Standard for

Gas-Burning Heating Appliances for Manufactured Homes and Recreational Vehicles

UL 307B, Fourth Edition

Attached to this transmittal notice is a revision of the Fourth edition of UL 307B.

A CHANGE ON A PAGE DATED AUGUST 14, 1995 IS INDICATED BY A SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM, PRECEDED AND FOLLOWED BY AN ASTERISK.

THESE NEW AND REVISED REQUIREMENTS ARE NOW IN EFFECT.

The new and revised requirements are substantially in accordance with UL's bulletin on this subject dated May 22, 1995. The bulletin is now obsolete and may be discarded.

Revised and/or additional pages may be issued from time to time.

With the inclusion of the accompanying material, the standard consists of pages dated as shown in the following checklist:

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APPENDIX B – REQUIREMENTS APPLICABLE TO SPECIFIC APPLIANCES

FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

36.1.19 A box or enclosure in which field-installed conductors are to be connected as indicated in 36.1.18 and 36.1.20 shall be located so that the temperature of conductors within the box or surfaces of the box likely to be in contact with the conductors will not exceed that specified for Type T wire when the appliance is tested in compliance with these requirements.

36.1.20 Wiring to be done in the field, where permitted, between the appliance and devices not attached to the appliance, or between separate devices that are field-installed and located, shall comply with these requirements when done with Type T wire enclosed in conduit or with metal-clad cable.

36.1.21 A knockout or opening for connection of a field-wiring system to a terminal box or compartment shall accommodate conduit of the trade size determined by applying Table 36.2.

Table 36.2
Trade size of conduit in inches^a

Wire size		Number of wires				
AWG	(mm ²)	2	3	4	5	6
14	(2.1)	1/2	1/2	1/2	1/2	1/2
12	(3.3)	1/2	1/2	1/2	3/4	3/4
10	(5.3)	1/2	1/2	1/2	3/4	3/4
8	(8.4)	3/4	3/4	1	1	1-1/4
6	(13.3)	3/4	1	1	1-1/4	1-1/4
4	(21.2)	1	1	1-1/4	1-1/4	1-1/2
3	(26.7)	1	1-1/4	1-1/4	1-1/4	1-1/2
2	(33.6)	1	1-1/4	1-1/4	1-1/2	2
1	(42.4)	1-1/4	1-1/4	1-1/2	2	2
1/0	(54.0)	1-1/4	1-1/2	2	2	2-1/2
2/0	(67.0)	1-1/2	1-1/2	2	2	2-1/2
3/0	(85.0)	1-1/2	2	2	2-1/2	2-1/2
4/0	(107.0)	2	2	2-1/2	2-1/2	3
MCM						
—						
250	(127)	2	2-1/2	2-1/2	3	3
300	(152)	2	2-1/2	3	3	3
350	(177)	2-1/2	2-1/2	3	3-1/2	3-1/2
400	(203)	2-1/2	3	3	3-1/2	4
500	(253)	3	3	3-1/2	4	4

^a This table is based on the assumption that all conductors will be of the same size and there will be no more than 6 conductors in the conduit. If more than 6 conductors will be involved or if all of them are not of the same size, the internal cross-sectional area of the smallest conduit that may be used is determined by multiplying by 2.5 the total cross-sectional area of the wires, based on the cross-sectional area of Type THW wire.

36.2 Grounding

36.2.1 The equipment grounding terminal or lead shall be located in the field wiring compartment and shall be suitable for connection of an equipment-grounding conductor of at least the size required by the National Electrical Code, ANSI/NFPA 70-1993, for the rating of the power supply circuit to be connected.

36.2.2 A soldering lug, a push-in (screwless) connector, or a quick-connect or similar friction fit connector shall not be used for the terminal for the field-installed grounding conductor.

36.2.3 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. At a wire-binding screw, upturned lugs, or the equivalent, shall be provided to retain the conductor. A pressure wire connector intended for connection of such a conductor shall be identified by being marked "G," "GR," "Ground," "Grounding," or by a marking on a wiring diagram provided on the equipment. The wire-binding screw or pressure wire connector shall be secured to the frame or enclosure and shall be located so that it is unlikely to be removed during servicing. If a pressure connector is used adjacent to the connectors intended for the supply conductors and if it could be mistaken for the neutral of a grounded supply, it shall be marked in accordance with 99.13.

36.2.4 The surface of an insulated lead intended for the connection of an equipment-grounding conductor shall be finished a continuous green color or a continuous green color with one or more yellow stripes, and no other lead visible to the installer shall be so identified.

36.3 Cord-connected appliances

36.3.1 An appliance intended for cord connection to the power supply shall be provided with a flexible cord and attachment plug of the grounding type, and of the type, voltage rating, ampacity, and current rating consistent with the rating and intended operation of the appliance.

36.3.1 added August 14, 1995

36.3.2 The marked current rating of a cord-connected appliance shall not exceed 80 percent of the current rating of the attachment plug.

36.3.2 added August 14, 1995

36.3.3 A cord-connected appliance shall employ a grounding-type attachment plug that complies with the ANSI/NEMA designations in Table 36.3.

36.3.3 added August 14, 1995

Table 36.3
Attachment plugs

Attachment plug rating, amperes, volts	ANSI/NEMA 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 WD6-1988.	

Table 36.3 added August 14, 1995

36.3.4 A cord-connected appliance shall employ a Type SJ, SJO, SJT, or SJTO power-supply cord rated for use at a voltage not less than the rated voltage of the appliance. The ampacity of the cord as specified in the National Electrical Code, ANSI/NFPA 70-1993 shall not be less than what is required by the appliance.

36.3.4 added August 14, 1995

36.3.5 The length of a power-supply cord shall not be less than 6 feet (1.82 m) and not more than 7 feet (2.13 m). The length is to be measured between the point at which the cord exits the appliance and the attachment plug.

36.3.5 added August 14, 1995

36.3.6 The power-supply cord shall be provided with a strain relief means so that a stress of the cord will not be transmitted to terminals, splices, or internal wiring. If a metallic cord rip is provided, it shall not contact uninsulated live parts or reduce spacings within the enclosure if the cord is moved inward. The cord shall not be subject to damage by moving parts if it can be moved inward. See Strain Relief Test, Section 97A.

36.3.6 added August 14, 1995

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

36.3.7 added August 14, 1995

36.3.8 The power-supply cord shall be attached to the appliance in a manner and location where it cannot be run through holes in walls, ceilings, and floors when it is connected to the manufactured home or recreational vehicle's power supply outlet.

36.3.8 added August 14, 1995

36.3.9 The power-supply cord shall be attached to the appliance in a manner and location where it cannot be concealed behind the walls, ceilings, and floors when it is connected to the manufactured home or recreational vehicle's power supply outlet.

36.3.9 added August 14, 1995

37 Factory Wiring

37.1 The wiring of high-voltage and safety-control circuits shall comply with this section.

37.2 Wiring shall be insulated conductors having current-carrying capacity, voltage and temperature ratings acceptable for the intended use. Conductors for line-voltage circuits shall be rated for use at potentials up to 600 volts. A conductor, other than an integral part of a component, shall be not smaller than No. 18 AWG (0.82 mm²).

37.3 The wiring of all circuits shall be furnished by the manufacturer as part of the appliance. If the appliance is not assembled and wired at the factory, such wiring shall:

- a) Be furnished as a wiring harness with each appliance and be arranged to facilitate attachment when the appliance is assembled; and
- b) A pictorial diagram showing the exact arrangement of the wiring shall be included with each appliance.

37.4 Electrical wiring to a part that must be moved for maintenance and servicing shall be arranged so that the part may be moved without breaking soldered connections or disconnecting conduit. Conductors to be disconnected from terminals of such a part shall terminate in eyelets or connectors. If the wiring to a part that functions also as an access plate or cover (for example, a transformer closing the access to the nozzle assembly) is not readily detachable, the assembly shall include provision for support of that part by means other than the wiring when the part is moved for servicing. Any allowable movement of such part shall not unduly twist, bend, or pull the wiring.

37.17 Cords or appliance wiring material as referenced in Group B of Table 37.1 may be employed if the wiring is enclosed by an appliance casing conforming to all of the following:

- a) There are no openings in the bottom, unless a U-shaped channel or trough is located under the wiring and the wires do not project through the plane of the top of the trough or channel.
- b) Openings in other than the bottom will not permit entrance of a rod having a diameter of 1/2 inch (12.7 mm), and openings for such items as pipe or conduit are not more than 1/2 inch (12.7 mm) in diameter larger than the object that will be installed through the opening.
- c) Openings are not closer than 6 inches (152.4 mm) to the wiring unless metallic barriers or baffles are placed between the wiring and the openings. Louvered openings of a kind which serve to protect the wiring from mechanical damage from outside the compartment and which are so formed as to assist in confining an electrical disturbance to within the compartment are exempt from this requirement. To conform with these requirements the louvers should be of a drawn metal of a form to completely obscure viewing of the wiring within the compartment when viewed from the horizontal outside the compartment, and the openings shall be located so an object falling vertically cannot enter the compartment through the louvered openings.
- d) Where flammable material other than electrical insulation is located within the compartment the wiring is separated from such material and the material will not sustain combustion upon removal of the ignition source. An air filter may be employed within the enclosure.

37.18 In applying the requirement of 37.17, an opening that is always intended to be connected to an air duct may be considered as closed.

37.19 Cords and other wiring material permitted in accordance with 37.17 and 37.24 shall be supported and arranged to avoid being physically damaged, such as by closely following surfaces. Strain relief, where required, shall be provided.

37.20 Holes in walls or partitions through which insulated wires or cords pass shall be provided with smoothly rounded bushings or shall have smooth, rounded surfaces, upon which the wires or cords may bear to prevent abrasion of the insulation. Bushings, if required, shall be ceramic, phenolic, cold-molded composition, fiber, or equivalent material.

37.21 A fiber bushing shall be not less than 3/64 inch (1.2 mm) thick, shall be so located that it will not be exposed to moisture, and shall not be employed where it will be subjected to a temperature higher than 90°C (194°F) under normal operating conditions.

37.22 A hole in porcelain, phenolic, phenolic composition, or other acceptable nonconducting material and having a smooth rounded surface is considered to be the equivalent of a bushing.

37.23 To provide an acceptable unbushed opening in sheet metal usually requires rolling, extrusion, or both, of the metal around the opening, or the insertion of an acceptable grommet.

37.24 Factory wiring of a low-voltage safety circuit may be Type SP-2 cord having all-neoprene insulation, Type SPT-2 cord or appliance wiring material having neoprene, thermoplastic, or equally durable insulation of equivalent thickness, or low-energy safety-control wire, if such wiring is located in a cavity or compartment of an appliance and is shielded from damage.

38 Electrical Systems Rated 12 Volt DC

38.1 Appliances for recreational vehicle use only may be equipped for operation on 120 volt ac and 12 volt dc, or 12 volt dc only power sources.

38.2 If the appliance includes a converter for 120 volt ac to 12 volt dc, the converter shall comply with the Standard for Power Units Other Than Class 2, UL 1012.

38.3 Wiring used in direct current circuits shall be of stranded copper not less than No. 18 AWG (0.82 mm²), be provided with insulation as required for line-voltage ac circuit, and have adequate current-carrying capacity.

38.4 The electrical circuitry on a direct current appliance shall be of the two-wire type. The body of the appliance shall not be used as the return leg of the circuitry.

38.5 An appliance for connection to a 12 volt dc power source shall comply with the field wiring requirements in 36.1.1 – 36.1.21 if it is permanently connected, or Section 36.3 if it is cord connected.

38.5 revised August 14, 1995

38.6 **Deleted August 14, 1995**

38.7 **Deleted August 14, 1995**

38.8 **Deleted August 14, 1995**

38.9 Appliances intended for operation on a 120 volt ac and a 12 volt dc power source shall be provided with a selector switch. Such appliances may be permanently connected to each power source.

38.10 An appliance intended to be connected only to a 12 volt dc power supply does not need provisions for equipment grounding.

39 Separation of Circuits

39.1 Unless supplied with insulation for the highest voltage involved, insulated conductors of different circuits (internal wiring, including wires in a junction box or compartment) except subdivided circuits or branch circuits of the same voltage from the same feeder, shall be separated by barriers or shall be segregated; and shall, in any case, be so separated or segregated from uninsulated current-carrying parts connected to circuits of another voltage.

39.2 Segregation of insulated conductors from uninsulated live metal parts or another circuit may be accomplished by clamping, routing, or equivalent means that provides for permanent separation.

Table 66.1 (Cont'd)
Maximum temperature rises

Materials and components	Column 1		Column 2	
	Degrees		Degrees	
	C	F	C	F
B. Components				
1. Capacitors:				
a. Electrolytic type ^d	40	72	(Not specified)	
b. Other types ^d	65	117	(Not specified)	
2. Field wiring	35	63	60	108
3. Relay, solenoid, and other coils with: ^b				
a. Class 105 insulated winding;				
Thermocouple method	65	117	115	208
b. Class 130 insulated winding;				
Thermocouple method	85	153	140	252
4. Sealing compounds	40°C (72°F) less than its melting point			
5. Transformer enclosures ^b				
a. Class 2 transformers	60	108	85	153
b. Power and ignition transformers	65	117	90	162
C. Insulated Conductors^{e,f}				
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 including surfaces of the appliance which the cord may contact ^e	35	63	60	108
3. GTO cable	35	63	60	108
4. Wire, Code				
Types R, RU, RUW	35	63	60	108
Types RH, RFH, FFH, RHW, THW, THWN	50	90	75	135
Types T, TF, TFF, TW	35	63	60	108
Type TA	65	117	90	162
5. Other types of insulated wires	e	e	e	e
D. Electrical Insulation^f				
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

(Continued)

Table 66.1 (Cont'd)
Maximum temperature rises

Materials and components	Column 1		Column 2	
	Degrees		Degrees	
	C	F	C	F
4. Phenolic composition used as electrical insulation or as parts where failure will result in a risk of fire or electric shock	125	225	150	270
5. Thermoplastic material	25°C (45°F) less than its temperature rating			
6. Varnished cloth insulation	60	108	85	153
E. Metals				
1. Aluminum alloys —				
a. 1100	183	330	239	430
b. 3003	239	430	294	530
c. 2014, 2017, 2024, 5052	294	530	350	630
2. Aluminum-coated steel ^g	656	1180	767	1380
3. Carbon steel sheet, cast iron	517	930	683	1230
4. Carbon steel — Coated with Type A19 ceramic	572	1030	628	1130
5. Galvanized steel ^h	267	480	350	630
6. Stainless steel —				
Types 302, 303, 304, 316, 321, 347	767	1380	878	1580
Type 309	961	1730	1072	1930
Type 310	1017	1830	1128	2030
Type 405	683	1230	795	1430
Types 403, 409, 410, 416	572	1030	683	1230
Type 430	711	1280	822	1480
Type 442	877	1580	933	1680
Type 446	961	1730	1072	1930
7. Zinc castings	89	160	145	260
F. General				
1. Air filter	50	90	97	175
2. Flue gases	i	i	i	i
3. Surfaces of the appliance at points of zero clearance to test structure	50	90	97	175
4. Surface of floor beneath and within 3 feet (0.91 m) of the appliance to be classified for installation on combustible floors	50	90	97	175
5. Surfaces of test enclosure (ceiling, walls, and the like)	50	90	97	175

(Continued)

Table 66.1 (Cont'd)

- a** The motor diameter is to be measured in the plane of the laminations of the circle circumscribing the stator frame, excluding lugs, boxes, or the like, 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 (such as 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, other than a universal motor, having a diameter 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 the coil (not including universal motors) where the temperature is affected by an external source of heat, the temperature rise measured by a thermocouple may exceed the indicated maximum by the following amounts, provided that 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 Column 1 limits for Class A insulation on coil windings of alternating-current motors having a diameter of 7 inches (178 mm) or less, open type.
 2. 10°C (18°F) for Column 1 limits 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 Column 1 limits 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 Column 1 limits 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 may be not more than 65°C (117°F).
- d** A capacitor which operates at a temperature higher than a 65°C (117°F) rise may be judged on the basis of its marked temperature rating.
- e** For standard insulated conductors other than those specified, reference should be made to the National Electrical Code, ANSI/NFPA 70-1993; the maximum allowable temperature rise in any case is 25°C (45°F) less than the temperature limit of the wire 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.
- f** The limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to compounds which have been investigated and found to have special heat-resistant properties.
- g** When the reflectivity of aluminum-coated steel is utilized to reduce the risk of fire, the maximum allowable temperature rise is 830°F (461°C).
- h** The specified maximum temperature rises apply if the galvanizing is required as a protective coating, or the reflectivity of the surface is utilized to reduce the risk of fire.
- i** The temperature of flue gases shall be consistent with the recognized temperature units for the flue-gas outlet assembly and the chimney or vent connector to be furnished with the appliance. The flue-gas temperature is to be measured during each test described in 74.1 – 74.4.

Table 66.1 revised August 14, 1995

67 Wind Test

67.1 General

67.1.1 The requirements in 67.1.2 – 67.4.2 are applicable to direct vent system appliances. Gas to the main burner and the pilot is to be at normal test pressure.

67.1.2 The pilot or pilots of an automatically lighted burner, and the main gas supply of a manual or automatically lighted burner equipped with an electric ignition system shall ignite when the vent-air intake terminal is exposed to wind of sufficient velocity to produce a static pressure at the appliance wall surface of 0.04 inch (1.0 mm) water column [nominal 10 mile per hour (16 km/h) wind velocity].

67.1.3 The appliance is to be installed in an appropriate test enclosure in accordance with Sections 52 – 57. A deflector wall is to be installed against the test enclosure and be of a size and configuration that wind from the wind apparatus will not effect that portion of the heating appliance normally intended for indoor installation.

67.1.4 A wind produced by a blower having sufficient capacity to develop a 0.04-inch (1.0-mm) water column static pressure [nominal 10 mile per hour (16 km/h) wind velocity] is to be directed against the outside surface of the test structure on which the vent-air intake terminal is attached. The blower is to be located so that the wind is directed perpendicular to the surface of the wall structure. Static pressure is to be measured by means of static pressure taps encompassing the area of the vent terminal. The static pressures at these points are to indicate uniform pressure distribution. Additional tests may be conducted with the same fan setting as determined above, with the wind directed from other directions.

67.1.5 With the appliance subjected to the above wind conditions, the pilot or pilots shall be capable of being ignited in accordance with instructions furnished with the appliance and within the pilot flame or ignition establishing period.

67.2 Main burners

67.2.1 The main burner or burners shall not become extinguished and shall ignite from the automatic ignition device or devices without excessive delay when the vent-air intake terminal is exposed to a wind of sufficient velocity to produce a static pressure at the wall surface of 0.66 inch (16.8 mm) water column [nominal 40 mile per hour (64 km/h) wind velocity].

67.2.2 The test is to be as specified in 67.1.4 and 67.1.5 except the blower is to be capable of producing a static pressure on the surface of the test wall of 0.66 inch (16.8 mm) water column. Each pilot, if provided, is to be ignited before the appliance is subjected to the wind. A manual or automatic operated appliance is to be operated at rated input. If the appliance is investigated for a firing rate range, it is to be adjusted to operate at any allowable input between the minimum and maximum firing rate. While operating under the aforementioned wind conditions, each pilot, when operating alone, and each pilot or igniter and main burner or burners when operating simultaneously shall not become extinguished during a 10-minute period. See 67.2.3 and 67.2.4.

67.2.3 The main burner valve is then to be shut off. After a period of at least 30 seconds the main burner valve is to be turned on and the main burner gas shall ignite from the pilot or pilots or ignition source without excessive delay. Automatically controlled appliances shall also comply with this test when the burner or burners are turned on and off by the automatic controls.

67.2.4 Additional tests may be conducted with the same fan setting and distance as determined above, with wind from other directions.

96.3 Collapse

96.3.1 A nonmetallic dip tube shall be immersed in water at a temperature of 225 plus 5 minus 0°F (107 plus 3 minus 0°C) under the conditions of test described in 94.4.1 – 94.5.2. The dip tube shall not collapse, as evidenced by a reduction in internal diameter of more than 1/8 inch (3.2 mm).

96.3.2 The internal diameter of a 49-inch (1.24-m) long dip tube sample is to be determined before the conditioning described in 96.3.4 – 96.3.6.

96.3.3 The sample is to be installed in the hot-water outlet of a representative water heater. A quick-acting valve is to be installed at the outlet connection of the storage vessel. The minimum cross-sectional area through this valve is to be equal to or greater than that of a Schedule 40, 1/4 inch pipe having an internal diameter of 0.364 inch (9.25 mm) as specified in Welded and Seamless Wrought Steel Pipe, ANSI/ASME B36.10M-1985. A flow-restricting device adjusted or constructed so as to maintain a flow rate of 5 gallons (18.9 L) per minute during the test is to be connected to the inlet of the heater.

96.3.4 A mercury thermometer graduated to 1°F (0.5°C), or a thermocouple for connection to a potentiometer, is to be installed in the storage vessel within the top 6 inches (152.4 mm) of the tank. A water-pressure regulator is to be located between the inlet connection to the storage vessel and the water supply line and adjusted so that, at a steady flow rate of 5 gallons (18.9 L) per minute, the pressure at the inlet connection will be 40 psig (276 kPa).

96.3.5 The storage vessel is to be filled and the test water heater placed in operation, with the thermostat, if any, bypassed. When the temperature indicated by the thermometer or thermocouple in the top of the storage vessel is 225 plus 5 minus 0°F (107 plus 3 minus 0°C), the quick acting valve is to be opened and water allowed to flow until the outlet-water temperature is the same as the inlet-water temperature.

96.3.6 The dip tube is then to be removed from the test heater and examined for compliance with the requirement in 96.3.1.

97 Hydrostatic Pressure Test

97.1 The storage vessel of a water heater shall be constructed to withstand a hydrostatic test pressure of 300 pounds per square inch (2.07 MPa), or its rated hydrostatic test pressure if greater than 300 pounds per square inch (2.07 MPa), or a hydrostatic test pressure determined in accordance with 97.2, without developing leakage or visible permanent distortion.

97.2 If a tank carries the symbol of the ASME Boiler and Pressure Vessel Code, Section VIII – Division I, the hydrostatic-test pressure is to be calculated from either the working pressure (maximum allowable working pressure) or 150 psi (1.03 MPa), whichever is more.

97.3 The storage vessel is to be connected to a hydraulic system capable of creating the required test pressure. A calibrated pressure gauge graduated in increments of not more than 5 psi (34.5 kPa) is to be provided. The storage vessel and system are to be filled with water at atmospheric pressure, care being exercised to avoid pockets of air. All tapped openings in the storage vessel are to be closed by threaded fittings. If the storage vessel is equipped with a pressure-relief device, it is to be removed and the opening plugged.

97.4 Before starting the test, such measurements of the storage vessel as are necessary to reveal permanent deformation resulting from the hydrostatic pressure test are to be taken. These observations are to include circumferential measurements at intervals along the vessel of not more than 12 inches (305 mm). Extensometers are to be placed with the movable spindle against top and bottom heads.

97.5 Hydrostatic pressure in the system is to be increased gradually until the test pressure in accordance with 97.1 or 97.2 is reached. The required test pressure is to be maintained for 30 minutes. At the end of that time, the pressure in the system is to be reduced to atmospheric, and the measurements originally taken repeated. Circumference measurements shall not vary more than 0.2 percent of the corresponding measurement taken prior to the application of the test pressure. Top or bottom head deflections as shown by extensometers shall not exceed 0.5 percent of tank diameter. At no time during the application of the hydrostatic test pressure is leakage of water from the storage vessel to be evident.

97A Strain-Relief Test

97A.1 A strain-relief means on the power-supply cord of a cord-connected appliance is to be subjected for 1 minute to the test described in 97A.2. There shall be no movement transmitted to the cord that would indicate that stress would have resulted on the cord connections.

97A.1 added August 14, 1995

97A.2 A 35-pound (15.9 Kg) mass is to be suspended on the cord and supported by the appliance so that the strain-relief means will be stressed from any angle that the design of the heating appliance permits.

97A.2 added August 14, 1995

97B Leakage-Current Test

97B.1 The leakage current of a cord-connected appliance shall not be more than:

- a) 0.5 milliamperes for a cord-connected appliance having a nominal 120 volt rating; and
- b) 0.75 milliamperes for a cord-connected appliance having a nominal 208 or 240 volt rating.

97B.1 added August 14, 1995

97B.2 Leakage current refers to all currents, including capacitively coupled currents, that may be conveyed between exposed conductive surfaces of an appliance and ground or other exposed conductive surfaces of an appliance.

97B.2 added August 14, 1995

97B.3 All exposed conductive surfaces are to be tested for leakage currents. The leakage currents from the surfaces are to be measured to the ground supply conductor individually as well as collectively where simultaneously accessible and from one surface to another where simultaneously accessible. Parts are considered to be exposed surfaces unless guarded by an enclosure considered acceptable for protection against risk of electric shock as defined in 42.1.1 and 42.1.12. Surfaces are considered to be simultaneously accessible where they can be contacted by one or both hands of a person at the same time.

97B.3 added August 14, 1995

97B.4 If a conductive surface other than metal is used for the enclosure or part of the enclosure, the leakage current is to be measured using a metal foil with an area of 10 by 20 centimeters in contact with the surface. Where the surface is less than 10 by 20 centimeters, the metal foil is to be the same size as the surface. The metal foil is not to remain in place long enough to effect the temperature of the appliance.

97B.4 added August 14, 1995

97B.5 The measurement circuit for leakage current is to be as illustrated in Figure 97B.1. The measurement instrument is defined in items (a) – (d). The meter which is actually used for a measurement need only indicate the same numerical value for a particular measurement as would the defined instrument. The meter used need not have all the attributes of the defined instrument.

- a) The meter is to have an input impedance of 1500 ohms resistive shunted by a capacitance of 0.15 microfarad.
- b) The meter is to indicate 1.11 times the average of the full-wave rectified composite wave form of voltage across the resistor or current through the resistor.
- c) Over a frequency range of 0 - 100 kilohertz, the measurement circuitry is to have a frequency response (ratio of indicated to actual value of current) equal to the ratio of the impedance of a 1500-ohm resistor shunted by a 0.15 microfarad capacitor to 1500 ohms. At an indication of 0.5 or 0.75 milliamperes, the measurement is to have error of not more than 5 percent at 60 hertz.
- d) Unless the meter is being used to measure leakage from one part of a heating appliance to another, the meter is to be connected between the accessible parts and the grounding supply conductor.

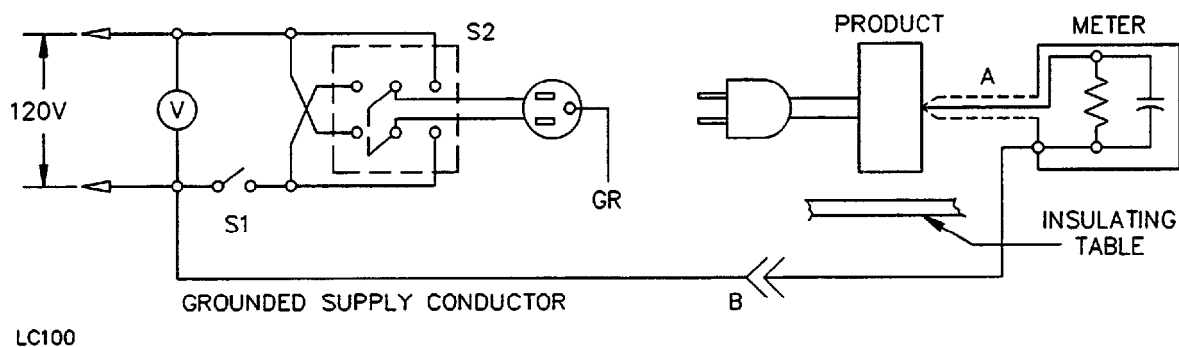
97B.5 added August 14, 1995

97B.6 A sample of the appliance is to be tested for leakage current starting with the as-received condition with all switches and thermostats closed, but with its grounding conductor, opened at the attachment plug cap. The as-received condition is without prior energization, except as may occur as part of the production line testing. The supply voltage is to be 120 or 240 volts, depending upon the voltage rating of the appliance. The test sequence, with reference to the measuring circuit, Figure 97B.1, is to be as follows:

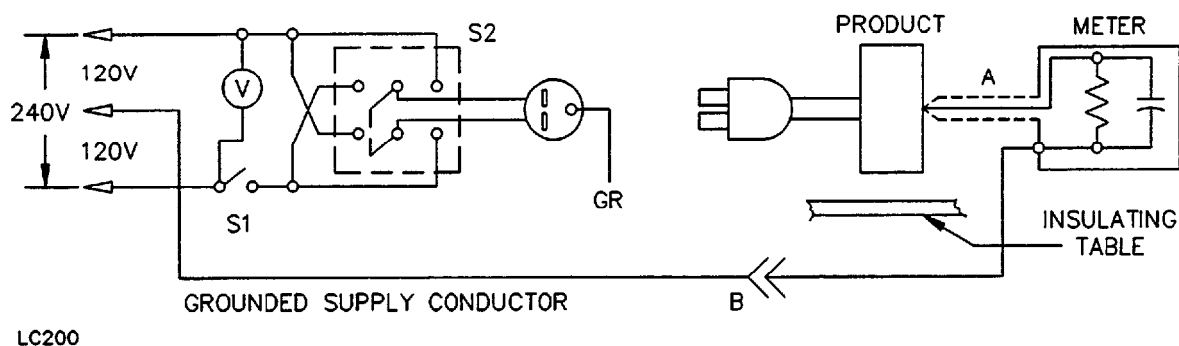
- a) With switch S1 opened, the appliance is to be connected to the measuring circuit. Leakage current is to be measured using both positions of switch S2.
- b) Switch S1 is then to be closed, energizing the appliance, and within 5 seconds, the leakage current is to be measured using both positions of switch S2 and with the heating appliance operated at the maximum heat setting of the controls.
- c) Leakage current is to be monitored until thermal stabilization under the maximum heat condition. Both positions of switch S2 are to be used. If any adjustable thermostat does not cycle at the maximum heat setting, it is to be adjusted until it does cycle before the final measurements at thermal stabilization are taken. Measurements are to be made with the thermostat, if any, open and closed, normally following the 5 second measurements, item B, the first monitoring reading will be taken 10 minutes after energizing. Upon evidence of stabilizing readings, monitoring periods may be increased.
- d) If the appliance employs a single-pole switch or a control thermostat for adjusting temperatures, then monitoring of leakage current is to continue until the leakage current stabilizes or decreases after the appliance is turned off.

97B.6 added August 14, 1995

Figure 97B.1
Leakage current measurement circuit(s)



Product intended for connection to a 120 V power supply.



Product intended for connection to 208 V or 240 V power supply.

NOTES:

A – Probe with shielded lead.

B – Separated and used as a clip when measuring current from one part of a product to another.

Figure 97B.1 added August 14, 1995

MANUFACTURING AND PRODUCTION TESTS

98 General

98.1 The manufacturer shall check, inspect, and test the components and the assemblies of each appliance as indicated in 98.2 – 98.4.

98.2 Factory inspections and tests shall include the following:

- a) Inspection of raw materials;
- b) Inspection of combustion chambers of the devices and heat exchangers to determine conformance with manufacturing specifications; and
- c) Inspection of each gas pressure regulator for correct pressure setting.

98.3 Dielectric voltage-withstand tests shall be conducted on each appliance incorporating a high-voltage electrical circuit. The test is to consist of the application of a 60 hertz potential between high-voltage, current-carrying parts and the casing frame and similar noncurrent-carrying parts of the appliance with any switch contacts open or closed. The potential is to be applied for 1 second, except that if the time of application is 1 minute the test potential may be reduced to five-sixths (83-1/3 percent) of the values specified below. The test potential is to be:

- a) Twelve hundred volts for an appliance rated 250 volts or less, with or without a motor rated 1/2 horsepower output (373 W output) or less;
- b) One hundred twenty percent of the sum of 1000 volts plus twice the rated voltage for an appliance:
 - 1) Rated for more than 250 volts; or
 - 2) Employing a motor rated at more than 1/2 horsepower output (373 W output).

98.4 The test equipment used for the test in 98.3 is to include a visible indication of application of the test potential and an audible and/or visible indication of breakdown. In the event of breakdown, manual reset of an external switch is to be required, or an automatic reject of the unit under test is to result. Other arrangements may be considered and accepted if found to achieve the results contemplated.

98A Production-Line Grounding Continuity Test

98A.1 The manufacturer shall test each product provided with a power-supply cord to verify the electrical continuity between the device and the grounding blade of the attachment plug. See Bonding for Grounding, Section 40.

98A.1 added August 14, 1995

98A.2 This test is also required for permanently-connected units or sections and accessories of such units that device power by means of a cord and plug connection.

98A.2 added August 14, 1995

98A.3 An indicating device, such as an ohmmeter, low-voltage battery-and-buzzer-combination, or the like, may be employed in establishing compliance with these requirements.

98A.3 added August 14, 1995

98A.4 If internal parts, as referred to in the requirements for Bonding for Grounding, Section 40, are determined in the investigation of the device to be bonded to the frame and enclosure of the unit, a test that determines the electrical continuity between the grounding blade and the frame or enclosure is sufficient for establishing compliance with the requirement in 98A.1.

98A.4 added August 14, 1995

UL 307B

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Gas-Burning Heating Appliances for Manufactured Homes and Recreational Vehicles



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January 26, 1995

Standard for

Gas-Burning Heating Appliances for Manufactured Homes and Recreational Vehicles

UL 307B, Fourth Edition

Accompanying this transmittal notice is a copy of the Fourth edition of UL 307B.

A CHANGE IS INDICATED BY A SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM, PRECEDED AND FOLLOWED BY AN ASTERISK.

THIS EDITION OF THE STANDARD IS NOW IN EFFECT EXCEPT FOR PARAGRAPHS 20.1 and 102.17 AND SECTION 68, WHICH BECOME EFFECTIVE JANUARY 26, 1997 AS INDICATED IN THE SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEMS.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this standard unless the applicant specifically requests that the product be judged under the current requirements. However, should the applicant elect this option, it should be noted that compliance with all the requirements in this standard will be required as a condition of continued Listing and Follow-Up Services after the effective date and understanding of this should be signified in writing.

The requirements in this standard are substantially in accordance with UL's bulletins on this subject dated August 17, 1992 and June 22, 1994. These bulletins are now obsolete and may be discarded.

Revised and/or additional pages may be issued from time to time.

JANUARY 26, 1995

1

UL 307B

Standard for

**Gas-Burning Heating Appliances For Manufactured
Homes and Recreational Vehicles**

The First edition was titled "Gas- and Oil-Fired Heating Appliances for Trailer Coaches" and numbered UL 307. The Second edition was titled "Gas-Heating Appliances for Mobile Homes and Travel Trailers." The Third Edition was titled "Gas-Burning Heating Appliances for Mobile Homes and Recreational Vehicles."

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Third Edition – February, 1982

Fourth Edition

January 26, 1995

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

Revisions of this standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest published set of revision pages.

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APPENDIX B – REQUIREMENTS APPLICABLE TO SPECIFIC APPLIANCES

FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 These requirements apply to the following gas fuel-burning heating appliances:

- a) Direct-vent system appliances for manufactured homes and recreational vehicles; and
- b) Vented appliances for manufactured homes other than the direct-vent system type that provide for separation of the combustion system from the atmosphere of the manufactured home by an installation method.

1.2 Requirements for the installation and use of heating appliances in manufactured homes and recreational vehicles are included in:

- a) The Department of Housing and Urban Development Manufactured Home Construction and Safety Standards, Chapter II of 24 CFR, Part 3280-1994; and
- b) The Standard for Recreational Vehicles, NFPA 501C-1993.

1.3 An appliance designed to burn either oil or gas, and a gas appliance designed to be converted to burn oil by the installation of an optional factory-furnished burner, shall also comply with the requirements in the Standard for Liquid Fuel-Burning Heating Appliances for Manufactured Homes and Recreational Vehicles, UL 307A.

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

2 General

2.1 Components

2.1.1 Except as indicated in 2.1.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

2.1.2 A component need not comply with a specific requirement that:

- a) Involves a feature or characteristic not needed in the application of the component in the product covered by this standard; or
- b) Is superseded by a requirement in this standard.

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

2.1.4 Specific components are recognized as being 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 for which they have been recognized.

2.2 Units of measurement

2.2.1 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.

2.2.2 Unless indicated otherwise, all voltage and current values mentioned in this standard are rms.

2.3 Terminology

2.3.1 The term "appliance" as used in this standard refers to any heating appliance covered by this standard, such as a warm air central furnace, a wall furnace, a heating boiler, and a water heater.

3 Glossary

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

3.2 **AIR SHUTTER** – An adjustable device for varying the size of the air inlet or inlets regulating primary or secondary air.

3.3 **APPLIANCE FLUE** – The flue passages within the appliance.

3.4 **AUTOMATICALLY LIGHTED APPLIANCE** – An appliance in which fuel to the main burner is intended to be turned on and ignited automatically.

3.5 **BOILER** – A closed vessel in which water or some other liquid is heated or steam is generated or superheated, under pressure or vacuum, by direct application of heat.

3.6 **BOILER, LOW PRESSURE HOT WATER** – A boiler that furnishes hot water at a pressure not exceeding 160 psig (1103 kPa) and at a temperature not exceeding 250°F (121°C).

3.7 **BOILER, LOW PRESSURE STEAM** – A boiler in which steam is generated at a pressure not exceeding 15 psig (103 kPa).

3.8 **BURNER** – A device for the final conveyance of fuel or a mixture of fuel and air to the combustion zone.

a) **Forced-Draft** – (See Power Burner, (e)).

b) **Induced-Draft** – A burner that depends on the draft induced by a fan beyond the appliance for its proper operation.

c) **Injection (Bunsen) Type** – A burner employing the energy of a jet of gas to inject air for combustion into the burner and mix it with the gas.

1) **Atmospheric Injection Type** – A burner in which the air at atmospheric pressure is injected into the burner by a jet of gas.

d) **Luminous or Yellow-Flame** – A burner in which secondary air only is depended on for combustion of the gas.

e) **Power** – A burner in which either gas or air or both are supplied at pressure exceeding, for gas, the gas line pressure, and for air, atmospheric pressure; this added pressure being applied at the burner. A burner for which air for combustion is supplied by a fan ahead of the appliance is commonly designated as a forced-draft burner.

f) **Premixing** – A power burner in which all or nearly all of the air for combustion is mixed with the gas as primary air.

g) **Pressure Burner** – A burner that is supplied with an air-gas mixture under pressure [usually from 0.5 to 14.0 inches water column (124 – 4032 Pa) and occasionally higher].

3.9 **BURNER HEAD** – That portion of a burner beyond the outlet end of the mixer tube which contains the ports.

3.10 **CENTRAL FURNACE** – A self-contained appliance for heating air by transfer of heat of combustion through metal to the air, and designed to supply heated air through ducts to spaces remote from or adjacent to the appliance location.

3.11 **COMBUSTIBLE MATERIAL** – As pertaining to materials adjacent to or in contact with heat-producing appliances, chimney and vent connectors, steam pipes, and warm-air ducts, combustible material is that material made of or surfaced with wood, compressed paper, plant fibers, or other material that will ignite and burn. Such material is considered to be combustible even though flame-proofed, fire-retardant treated, or plastered.

3.12 **CONDENSATE** – The liquid which separates from the combustion by-products of a fuel (flue gases) due to a reduction in temperature below dew point.

3.13 **CONTROL** –

a) **Fan** – An automatic control intended to control the operation of the fan on forced air appliances.

b) **Limit** – An automatic safety control responsive to changes in liquid level, pressure, or temperature and intended to be set beyond the operating range for limiting the operation of the controlled equipment.

c) **Low Water** – A control that automatically cuts off the fuel supply when the surface of the water falls to the lowest safe water level. This point should not be lower than the bottom of the water glass.

d) **Operating** – A control, other than a safety control or interlock, to start or regulate burner firing according to demand and to stop or regulate firing on satisfaction of demand or upon reaching intended temperature or pressure in the appliance being fired.

e) **Primary Safety** – An automatic control that monitors the operation of a gas-fired or an oil-fired burner that is responsive directly to flame properties, sensing the presence or absence of flame and, in event of ignition failure or unintentional flame extinguishment, causes safety shutdown (lockout).

f) **Safety** – Automatic controls (including relays, switches, and other auxiliary equipment used in conjunction therewith to form a safety control system) which are intended to prevent operation of the controlled equipment that could cause a risk of fire, explosion, or injury to persons.

3.14 DIRECT VENT SYSTEM APPLIANCE – An appliance which by its inherent design is constructed so that:

- a) All air supplied for combustion;
- b) The combustion system of the appliance; and
- c) All products of combustion are isolated from the atmosphere of the space in which the appliance is installed.

3.15 DRAFT HOOD – A device built into a gas appliance, or made a part of the vent connector from a gas appliance, which is intended to:

- a) Provide for the ready escape of the products of combustion in the event of no draft, backdraft, or stoppage beyond the draft hood;
- b) Prevent a backdraft from entering the appliance; and
- c) Neutralize the effect of stack action of the flue or vent upon the operation of the appliance.

3.16 ELECTRICAL CIRCUITS –

- a) **High-Voltage Circuit** – A circuit involving a potential of not more than 600 volts and having circuit characteristics in excess of those of a low-voltage or an isolated-limited-secondary circuit.
- b) **Low-Voltage Circuit** – A circuit involving a potential of not more than 30 volts alternating current (42.4 volts peak or direct current) and supplied by a primary battery or by a standard Class 2 transformer, or by a combination of transformer and fixed impedance that, as a unit, complies with all the performance requirements for a Class 2 transformer. A circuit derived from a source of supply classified as a high-voltage circuit using resistance in series with the supply circuit as a means of limiting the voltage and current, is not considered to be a low-voltage circuit nor an isolated limited secondary circuit.
- c) **Safety Control Circuit** – A circuit involving one or more safety controls, in which failure due to grounding, opening, or shorting of any part of the circuit can cause operation of the controlled equipment that can cause a risk of fire, explosion, or injury to persons.

3.17 EXCESS AIR – Air that passes through the combustion chamber and the appliance flues in excess of that theoretically required for complete combustion.

3.18 HEAT EXCHANGER –

- a) **Direct** – A heat exchanger in which heat generated in the combustion chamber of the appliance is transferred directly through walls of the appliance to the heating medium (such as air, steam, or water) held in close contact with the combustion chamber walls. It is a self-contained combustion and heat-transfer device, hence a direct heat-transfer device.
- b) **Indirect** – A heat exchanger that encloses or contains a heating medium (such as air, steam, or water), the heat from which is transferred to another heating medium separately contained in close contact with or directed through the heat exchanger.

3.19 HEATING SURFACES – All surfaces that transmit heat directly from flame or flue gases to the medium to be heated.

3.20 HEATING VALUE, GAS – The (Total) number of British Thermal Units produced by the combustion at constant pressure of 1 cubic foot of gas when the products of combustion are cooled to the initial temperature of the gas and air, when the water vapor formed during combustion is condensed, and when all the necessary corrections have been applied.

3.21 IGNITION SOURCE –

a) **Continuous** – An ignition source that, once placed in operation, is intended to remain ignited or energized continuously until manually interrupted.

b) **Intermittent** – An ignition source that is automatically ignited or energized when an appliance is called on to operate and that remains continuously ignited or energized during each period of main burner operation. The ignition source is automatically extinguished or de-energized when each main burner operating cycle is completed.

c) **Interrupted** – An ignition source that is automatically ignited or energized when an appliance is called on to operate and that remains ignited or energized during the main burner flame-establishing period. The ignition source is automatically extinguished or de-energized when each main burner flame-establishing period is completed.

3.22 LINING – Those interior surfaces of a combustion chamber exposed to combustion during use of the appliance.

3.23 LIQUEFIED-PETROLEUM (LP) GAS – Fuel gases, including commercial propane, predominantly propane or propylene, or commercial butane, predominantly butane, isobutane, and/or butylene.

3.24 LP-GAS-AIR MIXTURE – Liquefied-petroleum gases distributed at relatively low pressures and normal atmospheric temperatures that have been diluted with air to produce desired heating value and utilization characteristic.

3.25 MANIFOLD – The conduit of an appliance that supplies gas to the individual burner.

3.26 MANUFACTURED HOME – A manufactured or mobile home, or other housing factory-built in accordance with The Department of Housing and Urban Development Manufactured Home Construction and Safety Standards.

3.27 MIXER, GAS – The combination of mixer head, mixer throat, and mixer tube.

a) **Mixer Head** – That portion of an injection (Bunsen) type burner, usually enlarged, into which primary air flows to mix with the gas stream.

b) **Mixer Throat** – That portion of the mixer that has the smallest cross-sectional area and that lies between the mixer head and the mixer tube.

c) **Mixer Tube** – That portion of the mixer that lies between the throat and the burner head.

3.28 ORIFICE – The opening in a cap, spud, or other device whereby the flow of gas is limited and through which the gas is discharged to the burner.

- 3.29 **ORIFICE CAP (HOOD)** – A movable fitting having an orifice that permits adjustment of the flow of gas by the changing of its position with respect to a fixed needle or other device.
- 3.30 **ORIFICE SPUD** – A removable plug or cap that contains an orifice and that permits adjustment of the flow of gas either by substitution of a spud with a different sized orifice or by the motion of a needle with respect to it.
- 3.31 **PILOT** – A small flame utilized to ignite the fuel at the main burner or burners.
- a) **Continuous** – A pilot that burns without turndown throughout the entire time the burner is in service, whether the main burner is firing or not.
 - b) **Proved** – A pilot flame supervised by a primary safety control that senses the presence of the pilot flame prior to permitting the main burner fuel to be delivered for combustion.
- 3.32 **PIPING** – Either pipe or tubing or both.
- a) **Pipe** – Refers to rigid metal pipe.
 - b) **Tubing** – Refers to semirigid metal tubing.
- 3.33 **PLENUM** – An air compartment, part of a distributing system, to which one or more ducts are connected.
- a) **Furnace Supply** – A furnace plenum attached directly to, or an integral part of, the supply outlet of the furnace.
 - b) **Furnace Return** – A furnace plenum attached directly to, or an integral part of, the return inlet of the furnace.
- 3.34 **PORT** – Any opening in a burner head through which fuel or an air-fuel mixture is discharged for ignition.
- 3.35 **PRIMARY AIR** – The air introduced into a burner that mixes with the fuel before it reaches the ignition zone.
- 3.36 **RADIATION SHIELD** – A separate panel or panels interposed between heating surfaces and adjacent objects to reduce heat transmission by radiation.
- 3.37 **RECREATIONAL VEHICLE** – A vehicular type unit primarily designed as temporary living quarters for recreational, camping, or travel use, which either has its own motive power or is mounted on or drawn by another vehicle. The basic entities are:
- a) **Camping Trailer** – A vehicular portable unit mounted on wheels and constructed with collapsible partial side walls which fold for towing by another vehicle and unfold at the camp site to provide temporary living quarters for recreational, camping, or travel use.
 - b) **Motor Home** – A vehicular unit designed to provide temporary living quarters for recreational, camping or travel use built on or permanently attached to a self-propelled motor vehicle chassis or on a chassis cab or van which is an integral part of the completed vehicle.

- c) **Travel Trailer** – A vehicular unit, mounted on wheels, designed to provide temporary living quarters for recreational, camping, or travel use and of such size or weight as not to require special highway movement permits when towed by a motorized vehicle, and of gross trailer area less than 320 square feet (29.7 m²).
- d) **Truck Camper** – A portable unit consisting of a roof, floor, and sides, designed to be loaded onto and unloaded from the bed of a pickup truck.
- 3.38 **SECONDARY AIR** – The air externally supplied to the flame at or beyond the point of ignition.
- 3.39 **THERMOELECTRIC CIRCUIT** – A circuit which receives its electrical energy by a conversion of heat to electricity by means of a thermocouple or thermopile.
- 3.40 **VALVES** –
- a) **Automatic** – A device consisting essentially of a valve and operator that controls the fuel supply to the burner or burners during intended operation of the appliance. The operator may be actuated by application of fuel pressure on a flexible diaphragm, by electrical, mechanical, or other means.
- b) **Burner-Input Control** – An automatic-control valve for regulating burner input.
- c) **Lubricated-Plug Type** – A valve of the plug and barrel type designed to maintain a lubricant between the bearing surfaces.
- d) **Manual Gas Shutoff** – A manually operated valve in the fuel line for completely turning on or shutting off the fuel supply to the appliance.
- e) **Safety Shutoff** – A valve that is automatically closed by the safety control system or by an emergency device. This type of valve may be of the automatic or manually opened type.
- 3.41 **VENT/AIR INTAKE TERMINAL** – The device used with a direct vent system appliance which is located on the outside of the building through which the air for combustion is taken from the outside atmosphere and from which products of combustion are discharged.
- a) **Air Intake Terminal** – The fitting at the inlet of the air intake pipe that allows entrance of the outside atmosphere to the air intake pipe.
- b) **Vent Terminal** – The fitting at the end of the vent pipe that directs the flue products into the outside atmosphere.
- 3.42 **VENTED APPLIANCE** – An indirect-fired appliance provided with means to accommodate a chimney or a roof-jack connector.
- 3.43 **VENT LIMITER** – A means that limits the flow of air from the atmospheric diaphragm chamber of a gas pressure regulator to the atmosphere. This may be either a limiting orifice or a limiting device.

3.44 WALL FURNACE – A self-contained appliance, complete with grills or equivalent, intended for incorporation or permanent attachment to the structure of a manufactured home or recreational vehicle in furnishing heated air circulated by gravity or by a fan directly into the space to be heated through openings in the casing. Such appliances are not provided with duct extensions beyond the vertical and horizontal limits of the casing, except that boots not to exceed 10 inches (254 mm) beyond the horizontal limits of the casing for extensions through walls of nominal thicknesses may be permitted. When such boots are provided, they are supplied by the manufacturer as an integral part of the appliance and tested as such in accordance with these requirements.

3.45 WATER HEATER – An appliance for supplying hot water for domestic or commercial purposes other than for space heating. Categories of water heaters are:

- a) **Domestic Storage Water Heater** – A water heater that heats and stores water at a thermostatically controlled temperature for delivery on demand. Input rating may not exceed 75,000 Btu per hour (22 kW).
- b) **Counter Type** –
 - 1) **Concealed Type** – A vented automatic storage heater which is for flush installation beneath a counter top 36 inches high, wherein the entire heater is concealed.
 - 2) **Flush Type** – A vented automatic storage water heater with flat sides, top, front and back, and which is primarily for flush installation in conjunction with or adjacent to a counter 36 inches (0.9 m) high; wherein the front and top of the heater casing are exposed.
 - 3) **Recessed Type** – A vented automatic storage water heater with flat sides, top, front, and back, which is for flush installation beneath a counter 36 inches high; wherein the front of the heater casing is exposed.

CONSTRUCTION

GENERAL

4 Assembly

4.1 An appliance shall be factory-built as a group assembly and shall include all the essential parts necessary for its intended function when installed as intended. An appliance may be shipped as two or more subassemblies.

4.2 An appliance that provides for separation of the combustion system from the indoor atmosphere of the manufactured home by an installation method shall be provided with an air-intake assembly conforming to these requirements. See 102.1.6.

4.3 A direct vent system appliance shall be constructed so that:

- a) All air supplied for combustion;
- b) The combustion system of the appliance; and
- c) All products of combustion are isolated from the atmosphere of the manufactured home or recreational vehicle.

Doors, panels, and any other access openings serving an enclosure required for such isolation of a fuel-burning appliance are to communicate only to the outdoors.

4.4 Compliance with 4.3 is not intended to preclude constructions including parts which, when opened or removed, may permit the combustion system to communicate with the atmosphere of the manufactured home or recreational vehicle, provided:

- a) The appliance is not operable when such part is opened or removed;
- b) Compartment doors or access panels are hinged to the compartment in a manner not likely to permit or invite their removal, and an interlock switch is provided that will automatically open the circuit when the door or panel is opened and that will automatically close the circuit when the door or panel is closed – the construction of the interlock switch is such that a serviceman can manually close the circuit for servicing but the switch will automatically return to its normal position when the door or panel is closed, that is, be in a position to automatically open the circuit when the door or panel is reopened – and the interlock switch is wired in the power circuit to the appliance or in the combustion-detector circuit of the primary safety control; or
- c) A combination of two or more compartment doors or access panels and interlock switches that provide equivalent protection to the preceding are furnished, in which case only one of the doors or panels need be hinged to the compartment.

4.5 A boiler shall be constructed, equipped, inspected, tested, and marked in accordance with the ASME Boiler Pressure Vessel Code, Section IV, Heating Boilers.

4.6 An appliance may include an opening, communicating with the combustion system, needed for the user to light or start the appliance, provided that the opening does not exceed a 28 square inch (181 cm²) cross-sectional area and has an attached cover plate. The cover plate shall be self-closing and equipped with a means, such as a latch or spring, to hold it firmly in the closed position. The cover plate shall be marked as described 99.15.

4.7 Air-intake assemblies and flue-gas outlet assemblies for appliances of direct vent system construction shall be an integral part of the appliance, or each assembly shall be constructed for direct attachment to the appliance.

4.8 If an appliance is not assembled by the manufacturer as a unit, it shall be arranged in as few subassemblies as practicable. Each subassembly shall be capable of being incorporated readily into the final assembly without requiring alteration, such as cutting, drilling, threading, welding, or similar tasks, by the installer. Two or more subassemblies, that must bear a definite relationship to each other for the intended installation or operation of the appliance, shall be arranged and constructed to permit them to be incorporated into the complete assembly, without need for alteration or alignment, only in the intended relationship with each other; or such subassemblies shall be assembled, tested, and shipped from the factory as one element.

4.9 A radiation shield or baffle employed to prevent excessive temperature shall be:

- a) Assembled as part of the appliance;
- b) Part of a subassembly that must be attached to the appliance for its intended operation; or
- c) Constructed so that the appliance cannot be assembled for operation without first attaching a required shield or baffle in its intended position.

4.10 The construction of an appliance shall not, for any intended installation, require the alteration or removal of a baffle, insulation, or a radiation shield needed to prevent temperatures that can cause risk of fire or injury to persons.

4.11 The inherent construction of an appliance for recessed, alcove, or closet installation shall provide for maintaining the minimum clearance required between the bottom, sides, and back of the appliance and between concealed surfaces of the wall or partition in which or to which the appliance is to be installed. Spacers shall have the strength and bearing surface necessary to maintain required clearance from such constructions.

4.12 Appliances for alcove or closet installation, such as upflow and downflow furnaces, boilers, and the like, are considered to comply with the requirements of 4.11, if spacers are located at no less than one level to provide essentially continuous interference with adjoining construction as provided, for example, by an extended base or support. Appliances for recessed installation in an interior wall under a cabinet, or through an outside wall may require spacers at more than one level, or more than one spacer on each surface of the appliance, to maintain the required clearance.

4.13 Integral spacers, where required on the appliance, shall be of such strength and bearing surface as to maintain the required clearance. A sheet steel spacer shall have a minimum thickness of 0.032 inch (0.81 mm) unless equivalent strength and rigidity are obtained with lesser thickness. A spacer shall be attached to the appliance by welding, riveting, or equally permanent means.

4.14 An appliance for recessed, alcove, or closet installation shall permit no portion of the products of combustion nor any portion of the heated circulating air or air from the space being heated to be discharged into spaces within walls, floor, or ceiling. Openings in the jacket, top, or sides through which the chimney or vent connector extend shall be sufficiently close-fitting to comply with this requirement.

4.15 Adjustable or movable parts shall be provided with locking devices to prevent unintentional shifting.

4.16 Screws or bolts used to attach parts that are detached during normal care or servicing of the appliance shall function as intended upon the application of the torques indicated in Table 4.1 after removal and replacement.

Table 4.1
Maximum torque requirements for screws

Screw size	Torque, pound-inches
No. 8	20
No. 10	25
1/4 inch	100
5/16 inch	200
3/8 inch	350
7/16 inch	550
1/2 inch	800
9/16 inch	1200

4.17 An appliance shall afford convenient operation by the user of those parts requiring attention or manipulation by him in intended usage.

4.18 Bolts, nuts, screws, except sheet-metal screws, and other threaded parts used in the general assembly of the appliance shall have threads in accordance with the requirements for Unified Inch Screw Threads, ANSI/ASME B1.1-1989.

4.19 The construction of an appliance shall be such to prevent products of combustion from coming in contact with thermal insulation.

4.20 Sheet steel parts of the appliance, except where otherwise specified in these requirements, shall be at least thick of 0.021 inch (0.53 mm) if uncoated or 0.016 inch (0.41 mm) if galvanized. This applies to parts such as radiation shields and liners not exposed to combustion products, and intake tubes, and the like, unless greater strength and rigidity are required for the application.

4.21 A removable cover for an access opening that maintains, with the cover closed, required separation between the combustion system and the atmosphere of the manufactured home or recreational vehicle, and a removable flue collector box, shall fit tightly and shall, together with any gasket material:

- a) Be made of a material rated for the temperature to which it is exposed;
- b) Show no evidence of deterioration or damage as a result of tests of the appliance; and
- c) Be formed and cut to prevent parts from blocking air openings of a burner or pilot.

4.22 The construction of an appliance for furnishing heated air, circulated by gravity or by a fan, directly into the space to be heated through openings in the casing shall provide continuous circulation of heated air at all times during intended operation. Such an appliance having a single warm-air register shall not be equipped with a shutter to restrict the flow of warm air from the appliance. Such an appliance having more than one warm-air register may be equipped with a shutter, if the construction of the appliance permits at least one warm-air register to be open at any position of the shutter.

4.23 A horizontal furnace intended for suspended installation shall be provided with brackets or hangers to support the furnace from its basic frame or structure.

4.24 Neither gas piping nor gas controls shall be located within circulating air passageways, except on an appliance for recreational vehicle installation without provision for connecting return air ducts. No filters shall be permitted and service accessibility of gas piping and gas controls shall be accomplished without disrupting the integrity of the direct vent system.

5 Accessibility for Servicing

5.1 An appliance shall be constructed so that parts and controls requiring attention, manipulation, or adjustment in usage are accessible.

5.2 An appliance shall be constructed to allow cleaning of parts such as interior surfaces of burners, heating surfaces in contact with combustion products, without major dismantling of the appliance or removal of parts required by 4.8 to be factory assembled.

5.3 The removal of access panels, burners, caps, manifold assemblies, and the like, specifically constructed to permit ready removal and replacement for servicing, are not considered major dismantling as defined by 5.2.

5.4 Accessibility achieved with the use of simple tools shall be afforded for cleaning, inspection, repair, and replacement of all burners, controls, and safety devices when the appliance is installed as recommended by the manufacturer. The arrangement of parts in the assembly removed for servicing shall be such that their restoration, following removal, will not necessitate realignment to secure their intended relationship with other parts of the assembly. Special equipment that may be required for servicing to be done by the operator shall accompany the appliance to the user.

5.5 The heads and nuts of bolts, and the threads of screws, which must be removed to permit the removal of clean-out plates shall not be placed where they are in contact with flue-gases.

Exception: Bolts made of Type 430 stainless steel or material equally resistant to heat and corrosion and brass nuts need not comply with this requirement.

5.6 The flue-gas passageways of an air-heating appliance shall be accessible for cleaning if:

- a) The products of combustion are drawn below the level of the burner;
- b) The temperature of the combustion products is less than 250°F (121°C) when the appliance is operated within ± 2 percent of the manufacturer's Btu per hour (W) input rating; or
- c) The width of any flue-gas passage is less than 1-1/2 inches (38.1 mm).

5.7 A forced air heating appliance intended to be connected to a supply duct or ducts shall include means for measuring static pressure developed within the appliance casing. Such connection shall consist of a pipe or tubing connector fitting with a removable cap or plug and shall be located in the warm air outlet end of the appliance and be accessible after the appliance is installed in accordance with the manufacturer's instructions.

Exception: The cap or plug need not be provided if the orifice in the appliance casing is 0.040 inch (1.02 mm) in diameter or less. See Figure 52.1.

5.8 A forced air heating appliance shall be constructed to permit:

- a) Replacement of each filter and blower belt, when provided;
- b) Removal of the blower assembly; and
- c) Oiling the motor, blower or fan bearings, which require that lubricant be added, without dismantling or removing any portion of the vent/air intake system, unless the construction is such that removal and replacement can be accomplished without the necessity of resealing the vent/air intake system.

6 Air-Intake Assemblies

6.1 An appliance shall be provided with a combustion air intake. The intake for an appliance equipped with a draft hood shall also provide air for draft hood dilution. An intake shall communicate with the outdoors.

6.2 If two intakes are employed to provide air as required by 6.1, both shall be designed for location in the same floor, roof, or wall of the manufactured home or recreational vehicle, or both shall terminate in the same pressure zone in an appliance enclosure inside the manufactured (mobile) home or recreational vehicle.

6.3 An air-intake assembly to the underside of a manufactured home or recreational vehicle shall extend at least 7 inches (177.8 mm) below the upper surface of the floor. An air-intake assembly through the roof of a manufactured home or recreational vehicle shall be constructed so that, when the assembly is installed as intended, the air entrance will be at least 6 inches (152.4 mm) above the top surface of the roof and the exit at least 6 inches below the top surface of the roof.

6.4 An air intake assembly for installation through an outside wall of a manufactured home shall be capable of being extended from at least 2 to 4-3/4 inches (50.8 to 121 mm) beyond the inside face of the wall and shall not project more than 3 inches (76.2 mm) beyond the outside wall.

6.5 An air-intake assembly for an appliance intended only for installation through an outside wall of a recreational vehicle shall be capable of being extended at least 2 inches (50.8 mm) beyond the inside face of the wall and shall not project more than 3 inches (76.2 mm) beyond the outside wall. The appliance shall be marked as specified in 99.29.

6.6 If a telescoping slip-fit connection is used in the air-intake tube to provide for installation in walls of varying thickness, the overlap shall be at least 1-1/4 inches (31.8 mm).

6.7 If a slip-fit is used at the connection of an air-intake tube with the appliance, the minimum overlap shall be 1/2 inch (12.7 mm), and means shall be provided to position the tube with respect to the wall structure.

6.8 The air entrance of an air-intake assembly shall be guarded, shielded, or located to exclude rain, snow, debris, and birds. A screen, if used, shall have a mesh of not less than 1/4 inch (6.4 mm).

6.9 An air entrance located beneath the floor and having a free area of at least 10 square inches (65 cm²) with no cross-sectional dimension less than 1-1/2 inches (38.1 mm) is considered as complying with 6.8 without additional guarding or shielding.

6.10 The construction of an air intake and the path of intake air shall provide adequate combustion air to burners and adequate dilution air to any draft hood.

6.11 The free area of openings to the outdoors in combustion air and dilution air-intake assemblies to be installed in the wall of an enclosure in which an appliance, other than a direct vent system appliance, is to be installed shall not be less than 1 square inch (645 mm²) for each 5000 Btu per hour (14.64 W) of the total input rating of all appliances to be in the enclosure.

6.12 The minimum cross-sectional dimension of an internal air passage in an air-intake assembly shall be at least 1/2 inch (12.7 mm).

6.13 The top or plane of any concealed combustion air or ventilation opening shall be at least 2 inches (50.8 mm) above the floor level. The bottom of such openings shall be at least 1 inch (25.4 mm) above the floor level unless all performance provisions can be met with the bottom of the opening blocked to a distance 1 inch (25.4 mm) above the floor.

6.14 Openings in perforated or expanded metal panels, provided over combustion air, circulating air, or draft relief openings shall not be less than 1/4 inch (6.4 mm) diameter. If the openings in such panels are other than circular in shape, they shall be of such size that will permit entrance of a No. 3 DMS (drill mean size) (5.4102 mm) drill.

7 Base

7.1 General

7.1.1 The base or frame of an appliance shall be constructed to provide for the support of the appliance. A base or frame shall be constructed of noncombustible material in a manner to provide strength and durability.

7.1.2 An appliance shall be provided with facilities to permit secure and ready attachment to the floor or structure of the manufactured home or recreational vehicle. If special bolts, screws, or other parts are needed for that purpose, they shall be furnished with each appliance.

7.1.3 Means for leveling and alignment, if required, shall be included.

7.1.4 A subbase, if furnished as a separate assembly, shall be marked to indicate the correct position of the appliance with respect to the subbase. A separate subbase that cannot be assembled incorrectly with respect to the appliance need not be marked.

7.2 Warm air appliances

7.2.1 The base, subbase, or duct connector of a downflow appliance shall be acceptable for installation on a combustible floor and shall establish and maintain not less than the required clearance between vertical surfaces of the plenum or duct to be attached thereto and the floor construction. A spacer shall extend at least 3/4 inch (19.1 mm) below the upper surface of the floor on which the appliance is to be installed.

7.2.2 The use of spacers in the form of separate blocks, shims, and the like, is not considered to be in accordance with 7.2.1.

8 Casing

8.1 The outer casing or jacket shall be made of steel or equivalent material, reinforced or formed if necessary, so that it is not likely to be damaged through handling in shipment, installation, and use.

8.2 A sheet-metal casing made of steel having a minimum thickness of 0.021 inch (0.53 mm) if uncoated, or 0.023 inch (0.58 mm) if galvanized, or of nonferrous sheet metal having an average thickness of 0.029 inch (0.74 mm) is considered to comply with 8.1 thinner materials may be used if adequate reinforcement is provided.

8.3 Access panels which need to be removed for intended service and accessibility shall be constructed to permit ready removal and replacement repeatedly without causing damage or impairing any required insulating value.

8.4 A removable panel through which air is drawn for combustion shall be constructed so as to prevent it from being attached in a manner that may result in performance of the appliance that could cause a risk of fire or injury to persons.

8.5 A removable panel shall be constructed so that it is not interchangeable with another panel on the same appliance if operation of the appliance with the panel interchanged could cause a risk of fire or injury to persons.

8.6 The casing shall completely close the bottom or be constructed to provide an effective radiation barrier between the heat exchanger and the floor except for an opening intended to be permanently connected to a circulating air distribution duct.

8.7 The casing shall be provided with an opening for the installation of a gas supply line. The edges of the opening against which the connected supply line is likely to bear, including any internal parts of the appliance, shall be free of sharp edges.

8.8 With reference to 8.7, protection of sharp edges may be provided by hemming or forming the edges of the opening, or by providing a grommet of metal or other material having the necessary aging properties, temperature and strength characteristics, and durability for the purpose.

9 Radiation Shields

9.1 A radiation shield or liner shall be constructed, formed, and supported for intended positioning and to prevent distortion or sagging in service. A shield or liner shall be protected against corrosion if its deterioration may cause excessive temperature when the appliance is tested in accordance with these requirements. Any finish provided to obtain the required resistance to corrosion shall not be damaged by heat when the appliance is tested as specified in this standard.

10 Combustion Chamber

10.1 A combustion chamber and flueway shall be constructed of sheet steel, or other equivalent material that has the strength, rigidity, durability, resistance to corrosion, and other physical properties equivalent to AISI C1010 sheet steel having a minimum thickness of 0.026 inch (0.66 mm) for an appliance having a maximum rated input not in excess of 50,000 Btu per hour (14.6 kW) and of 0.032 inch (0.81 mm) for all other sizes.

10.2 Combustion chamber (fire box) lining material, if used, shall be durable, supported in place, and accessible for replacement with equivalent material.

11 Radiator

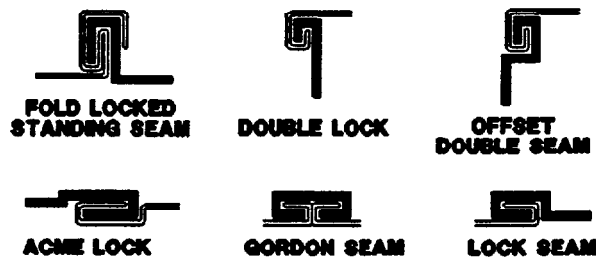
11.1 A radiator of an air heating appliance shall be made of material not lighter than that designated in 10.1 for a combustion chamber.

12 Heating-Surface Joints

12.1 Joints in heating surfaces shall be substantial and reasonably tight, as attained by being welded, lock-seamed, machined and bolted, or riveted. A joint shall not depend primarily on cement for tightness. A slip or lap joint shall not depend solely upon friction of the joint for strength.

12.2 Examples of some acceptable lock seams are illustrated in Figure 12.1.

Figure 12.1
Types of acceptable lock seams



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13 Baffles

13.1 General

13.1.1 A flue baffle shall be fixed in position and shall be accessible for cleaning. A flue baffle that is removable for cleaning shall be of such construction as will facilitate its removal and permit replacement only in its intended position. It shall be made of material not lighter than that designated in 10.1 for a combustion chamber.

13.1.2 A baffle in a flue-gas passage or otherwise exposed to combustion products, whose malfunction would not cause a risk of fire or injury to persons and if considered replaceable, shall be observable and replaceable without dismantling the appliance.

13.2 Water heaters

13.2.1 If it is necessary to remove a flue baffle to clean the flueway, the flue baffle of an internal-flue-type water heater shall be constructed for removal within a clearance of 6-1/2 feet (2.0 m) above the floor, or 2 feet (610 mm) above the flue collar on a heater taller than 4-1/2 feet (1.3 m).

14 Flue Collar

14.1 A flue collar shall be arranged to permit secure attachment of a vent connector or draft hood, as required for the type of appliance.

14.2 A flue collar, or flue connector parts within the air handling compartment of a warm air appliance, shall have the rigidity, heat, and corrosion resistance at least equivalent to that of sheet steel having a thickness of not less than 0.032 inches (0.81 mm).

15 Flue-Gas Outlet Assembly

15.1 A flue-gas outlet assembly intended to convey flue gases to the outdoors shall be furnished with each appliance. A connector shall be furnished, if required, to connect the flue collar of the appliance to the flue-gas inlet of the outlet assembly.