



UL 174

STANDARD FOR SAFETY

Household Electric Storage Tank Water Heaters

UL Standard for Safety for Household Electric Storage Tank Water Heaters, UL 174

Eleventh Edition, Dated April 29, 2004

Summary of Topics

This revision of ANSI/UL 174 dated April 28, 2025 includes the following changes:

- Smart-Enabled Water Heater Clarifications; [SB3.1](#)***
- Withdrawal and Replacement of ANSI/ISA MC96.1, Temperature Measurement Thermocouples; [28.2.8](#)***

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

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated March 21, 2025.

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APPENDIX A

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INTRODUCTION

1 Scope

1.1 These requirements cover household electric storage tank and small capacity storage tank water heaters rated no more than 600 volts and 12 kilowatts to be installed in accordance with the National Electrical Code, NFPA 70, and with model plumbing and mechanical codes.

1.2 These requirements do not cover immersed electrode, side arm, booster, instantaneous or immersion type water heaters or water heating portions of water dispensing appliances. These requirements do not cover water heaters with a tank capacity of less than 1 gallon (3.8 L) or more than 120 gallons (454 L).

1.3 Electric booster water heaters, electric commercial storage tank water heaters, and remote control assemblies for such heaters, rated 600 volts or less are not covered by this standard. They are covered in the Standard for Electric Booster and Commercial Storage Tank Water Heaters, UL 1453.

1.4 Permanently installed electric water heaters, rated 600 volts or less, for heating the water supplied through plumbing to separately heated public or private pools or tubs, in which swimming, wading, bathing, or partial or total immersion of persons, is to be involved are not covered by this standard. They are covered in the Standard for Electric Water Heaters for Pools and Tubs, UL 1261.

1.5 Water heaters rated 600 volts or less with a tank capacity of less than 1 gallon (3.8 liters) are not covered by this standard. They are covered under the Standard for Electric Heating Appliances, UL 499.

1.6 A water heater intended for use in a hazardous location is to be judged on the basis of its compliance with these requirements; however, further examination and testing shall be conducted to determine whether it is acceptable for the intended use.

2 Components

2.1 Except as indicated in this clause, a component of a product covered by this standard shall comply with the requirements for that component. See the individual sections of this standard for component requirements.

2.2 A component is not required to comply with a specific requirement that:

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

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

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

3 Units of Measurement

3.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

3.2 Unless otherwise stated, all electrical measurements are in root-mean-square units (rms).

4 Undated References

4.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

5 Glossary

5.1 For the purposes of these requirements, the following definitions shall apply.

5.2 DIP TUBE – A metallic or other tube attached to the inlet of a storage tank for the purpose of carrying cold inlet water to the bottom of the tank.

5.3 ENCLOSURE – The part of an electric water heater that surrounds insulated and uninsulated current-carrying live parts and that is intended to contain a fire resulting from an electrical fault.

5.3.1 FRAME – A structure of angle or channel or a folded rigid section of sheet metal that is rigidly attached to and has essentially the same outside dimensions as the enclosure surface and that has sufficient torsional rigidity to resist the bending moments which may be applied via the enclosure surface when it is deflected.

5.4 HEAT TRAP – A device that is capable of being integrally assembled or independently attached to the hot water connection of a water heater such that a portion of this device develops a cold water seal to reduce the natural convection and resultant heat loss from the hot water stored in the water heater.

5.5 INLET WATER DEFLECTOR (DIFFUSER) – A component, usually nonmetallic, attached to the inlet tube or pipe when the inlet is at or near the bottom of the water heater tank, that serves to spread the cold water uniformly on a horizontal plane to aid in mixing of the hot and cold water.

5.5.1 OPERATING CONTROL – A control intended to start or regulate the appliance during normal operation. An example would be a water temperature-regulating control. An operating control could provide Type 1 or Type 2 action. (See definitions [5.9](#) and [5.10](#).)

5.6 OUTER JACKET – The part of the water heater that surrounds the storage tank and that is intended to provide mechanical protection for the tank and for thermal insulation when the insulation is provided. The outer jacket also serves as an enclosure of current-carrying parts and insulated conductors between heating elements in separate control or wiring compartments.

5.6.1 PROTECTIVE CONTROL – A control intended to prevent the risk of electric shock, fire, or injury to persons during abnormal operation of the appliance. An example would be a water temperature limit control. A protective control always provides Type 2 action. (See definitions [5.9](#) and [5.10](#).)

5.7 SMALL CAPACITY STORAGE TANK WATER HEATER – A water heater marked with a rated capacity within the range of 1 gallon (3.8 L) to 5 gallons (18.9 L).

5.8 STORAGE TANK – The part of the heater (either with or without the heating elements) that is intended to contain or store water and that has a rated capacity of 1 gallon (3.8 L) or more.

5.8.1 THERMOSTATIC MIXING VALVE – A device installed on the water heater that automatically moderates the water outlet temperature independent of the water heater temperature-regulating control setting.

5.9 TYPE 1 ACTION – Automatic action for which the manufacturing deviation and the drift of its operating value, operating time, or operating sequence have not been declared and tested to the Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1.

5.10 TYPE 2 ACTION – Automatic action for which the manufacturing deviation and the drift of its operating value, operating time, or operating sequence have been declared and tested to the Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1.

CONSTRUCTION

6 Frame, Enclosures, and Outer Jacket

6.1 General

6.1.1 The frame, if provided, enclosure, and outer jacket of a water heater shall have the strength and rigidity required to resist the abuses encountered during intended use. The degree of resistance inherent in the appliance shall preclude total or partial collapse, with the attendant reduction of spacings, loosening or displacement of parts, and other serious defects that alone or in combination constitute an increase in the risk of fire, electric shock, or injury to persons.

6.2 Enclosures

6.2.1 A sheet-metal enclosure made of steel or aluminum that encloses or protects a live electrical part shall have a minimum thickness as indicated in [Table 6.1](#). A cast-metal enclosure shall have a minimum thickness as indicated in [Table 6.2](#).

Exception: An enclosure thinner than specified in [Table 6.1](#) and [Table 6.2](#) is able to be used when it complies with Section [41](#), Enclosure Strength Test.

Table 6.1
Minimum thickness of sheet-metal enclosures

	Sheet steel				Sheet aluminum	
	Uncoated		Galvanized			
	inch	(mm)	inch	(mm)	inch	(mm)
Sheet metal enclosing live parts in a heater of any size, either (1) not serving as the jacket or (2) serving as the jacket of a heater of no more than 52 gallons (197 L) capacity.	0.020	(0.51)	0.023	(0.58)	0.032	(0.81)
Sheet metal enclosing live parts and serving as the outer jacket of a heater of more than 52 gallons capacity.	0.026	(0.66)	0.029	(0.74)	0.036	(0.91)

Table 6.2
Minimum thickness of cast metal enclosures

	Cast metal		Malleable iron		Die cast metal	
	inch	(mm)	inch	(mm)	inch	(mm)
Unreinforced blast surfaces of enclosures housing electrical parts	0.125	(3.18)	0.094	(2.39)	0.078	(1.98)
Curved, ribbed, or otherwise reinforced enclosures for electrical parts	0.094	(2.39)	0.062	(1.57)	0.047	(1.19)

6.2.2 A magnesium enclosure shall not be used unless the following are taken into consideration:

- a) Mechanical strength;
- b) Resistance to impact; and
- c) Combustibility under conditions of intended or abnormal use.

6.2.3 An enclosure made of polymeric material shall comply with the fixed equipment requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, and be rated for the maximum temperature it is subjected to during normal operation as determined during the Temperature Test specified in Section [28](#).

Exception: A water heater is required to comply only with the stationary equipment requirements in UL 746C when the water heater has:

- a) A tank capacity of five gallons (18.9 L) or less; and*
- b) A power-supply cord provided in accordance with Electrical Supply Connections – Cord Connection, Section [12](#).*

6.3 Outer jacket

6.3.1 A sheet metal outer jacket of steel or aluminum that also encloses insulated or uninsulated current-carrying parts shall have a minimum thickness as indicated in [Table 6.1](#).

Exception: An outer jacket thinner than specified in [Table 6.1](#) is able to be used when it meets the requirements in Section [41](#), Enclosure Strength Test.

6.3.2 An outer jacket of polymeric material that also encloses insulated or uninsulated current-carrying parts shall comply with the enclosure requirements in [Table 6.3](#) and [Table 6.4](#).

Exception: An outer jacket is required to comply only with the requirements in [Table 6.5](#), when the outer jacket:

- a) Does not enclose any current-carrying parts; or*
- b) Encloses parts that are completely covered with minimum 1/32 inch (0.8 mm) thick electrical insulation.*

Table 6.3
Polymeric material enclosure application code

Supply connection	Encloses current-carrying parts		Direct support of current-carrying parts	Indirect support of current-carrying parts	Enclosure application code
	Parts with insulation less than 0.028 inch (0.71 mm) thick	No parts with insulation less than 0.028 inch (0.71 mm) thick			
Conduit	X	–	–	–	1
Conduit	–	X	–	–	2
Conduit	X	–	X	–	3
Conduit	X	–	–	X	4
Conduit	–	X	–	X	5
Cord	X	–	–	–	6
Cord	–	X	–	–	7
Cord	X	–	X	–	8
Cord	X	–	–	X	9
Cord	–	X	–	X	10

Table 6.4
Polymeric material enclosure property and test requirements

Application code (see Table 6.3 for code)	Minimum flammability classification ^a	Resistance to ignition		Electrical				End product tests ^d			
		Maximum hot wire (HWI) ^b PLC ^c	Maximum high current (HAI) ^b PLC ^c	Minimum dielectric strength, volts ^b	Maximum high voltage track rate (HVTR) ^b PLC ^c	Maximum comparative tracking index (CTI) ^b PLC ^c	Volume resistivity ^b 50 megohms /cm wet	Input resistance	Crush resistance	Mold stress relief	Strain relief
1	5V	3	2	5000	–	–	X	X	X	–	–
2	5V	–	2	5000	–	–	–	X	–	X	–
3	5V	3	2	5000	1	4	X	X	X	X	–
4	5V	3	2	5000	–	–	X	X	X	–	–
5	5V	–	2	5000	–	–	–	X	–	–	–
6	5V	3	2	5000	–	–	X	X	X	–	X
7	5V	–	2	5000	–	–	–	X	–	X	X
8	5V	3	2	5000	1	4	X	X	X	X	X
9	5V	3	2	5000	–	–	X	X	X	–	X
10	5V	–	2	5000	–	–	–	X	–	–	X

^a The flammability classification is to be determined by tests described in the Standard for Tests for Flammability of Plastic Material for Parts in Devices and Appliances, UL 94, unless it has already been determined to be 5V.

^b Tests are to be conducted in accordance with the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.

^c The Performance Level Category (PLC) value is as specified in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

^d Tests are to be conducted in accordance with UL 746C.

Table 6.5
Polymeric outer jacket

Part	Impact test ^a	Burning characteristics		Moisture resistance ^d
		Maximum flame spread index ^b	Minimum flammability classification ^c	
Outer jacket, indoor only				
A. Less than 10 square feet (0.93 m ²) and all dimension less than 6 feet (1.83 m)	X	–	HB	–
B. 10 square feet or more, or a single dimension greater than 6 feet	X	200	HB	–
Outer Jacket, damp locations				
A. Less than 10 square feet (0.93 m ²) and all dimension greater than 6 feet (1.83 m)	X	–	HB	X
B. 10 square feet or more, or a single dimension greater than 6 feet	X	200	HB	X

^a Test is to be conducted in accordance with the Resistance to Impact Test described in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

^b The maximum flame spread index is to be determined by the method described in the Standard for Test for Surface Burning Characteristics of Building Materials, UL 723, or in accordance with the Test for Surface Flammability of Materials Using a Radiant heat Energy Source, ASTM E162.

^c The flammability classification is to 00 19 be determined by tests described in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

^d Moisture resistance is to be determined in accordance with the Standard Test Method for Water Absorption of Plastics, ASTM D570, and the method for measuring water absorption of polymeric materials in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.

7 Mechanical Assembly

7.1 An electrical component shall be securely mounted in place.

7.2 A surface-mounted temperature control shall be:

- a) Secured indirectly to the storage tank by a bracket so as not to be readily displaced, as determined by the Mounting Test of Surface-Mounted Temperature Controls described in Section [31](#); or
- b) Secured directly to the storage tank by positive fastening means such as screws or stud and nut.

8 Accessibility of Live Parts

8.1 A live electrical part of a water heater shall be so located or enclosed to reduce the risk of unintentional contact with an uninsulated live part.

8.2 An uninsulated live part shall not be exposed to contact by the user or service personnel adjusting the setting of a temperature-regulating thermostat, operating the resetting mechanism of a temperature-limiting control, operating a water drain valve, or performing a similar operation. This requirement applies even when the unit is marked as indicated in [48.1](#).

8.3 When a marking draws the attention of the user to an opening of any size for the insertion of a tool to adjust a thermostat, operate a reset mechanism, or any similar activity, the construction shall reduce the risk of contact with any uninsulated live part. The construction complies with this requirement when a 1/16 inch (1.6 mm) diameter rod does not contact any uninsulated live part when inserted through such an opening.

8.4 A barrier provided to reduce the risk of contact with a live part as required in [8.2](#) shall comply with all the following items. Thermal insulation shall not be employed for purposes of compliance with this requirement. The barrier shall:

- a) Be an electrical insulating material having a temperature rating of at least 90°C (194°F);
- b) Be at least 1/16 inch (1.6 mm) thick;

Exception: A barrier is not required to be at least 1/16 inch (1.6 mm) thick, when it is not less than 1/32 inch (0.8 mm) thick, and ribs or other means of providing mechanical strength, equivalent to a 1/16 inch (1.6 mm) thick barrier, are provided as determined by [32.1](#).

- c) Extend at least 1/16 inch (1.6 mm) beyond any uninsulated live part (including any uninsulated portion of the conductor); and
- d) Be secured in place by at least two independent means that have been subjected to the barrier pull test described in [32.2](#). Two parallel or symmetrical tabs are to be identified as two independent means of securement when they project from two different points on the barrier.

8.5 When a cover or barrier is provided to comply with [8.2](#), no more than 1/8 inch (3.2 mm) of an uninsulated conductor shall extend from a terminal covered by this cover or barrier after connection is made.

9 Wetting of Live Parts

9.1 An electrical part (including internal wiring) shall be located so that a leak at any point in the tank does not result in such a part being submerged in an accumulation of water. When a drain hole is provided for this purpose, it shall have an area no less than 0.049 square inch (31.61 mm²).

9.2 A drain valve, if provided, shall be positioned or provided with tubing so that water does not contact any electrical parts.

10 Corrosion Resistance

10.1 General

10.1.1 An iron or steel part shall be made resistant to corrosion by enameling, galvanizing, plating, or other equivalent means when such corrosion results in a risk of fire, electric shock, or injury to persons.

Exception: When the oxidation of steel is not accelerated by exposure of the metal to air and moisture – thickness of metal and temperature also being factors – surfaces of sheet steel within an enclosure is not required to be corrosion resistant.

10.2 Storage tanks

10.2.1 A steel storage tank having a wall thinner than 1/4 inch (6.4 mm) shall have the inside surface resistant to corrosion.

Exception: This requirement does not apply to a storage tank that carries the American Society of Mechanical Engineers (ASME) Code symbols described in Storage Tank, Section [25](#).

11 Electrical Supply Connections – Permanent Connection

11.1 General

11.1.1 An electrical supply connection (branch-circuit wiring) is one that is made to the source of electrical supply when a heater is installed in the field.

11.1.2 A water heater shall have provision for the connection to a permanent wiring system in accordance with [11.3.1](#). The sheet metal surrounding the opening for permanent wiring connection shall be of such thickness or shall be formed or reinforced such that it has rigidity no less than that of a flat sheet of the same material having an average thickness no less than 0.053 inch (1.35 mm) if uncoated and 0.056 inch (1.42 mm) if galvanized.

Exception No 1: A small capacity storage tank water heater is not required to be permanently connected when it complies with Electrical Supply Connections – Cord Connection, Section [12](#).

Exception No. 2: A water heater rated 120 volts or less is not required to be permanently connected when it complies with Electrical Supply Connections – Cord Connection, Section [12](#).

11.2 Field-wiring compartment

11.2.1 A heater shall be provided with a compartment for connection to the supply (branch circuit) wiring. The volume of the compartment shall be no less than as indicated in [Table 11.1](#). Each conductor extending outside the compartment and terminating inside the compartment is counted as one conductor. The thickness of any metal used for such a compartment shall be as indicated in [Table 6.1](#) or [Table 6.2](#).

Table 11.1
Minimum volume of field-wiring compartment

Size of conductor ^a		Free space within compartment for each conductor	
AWG	(mm ²)	inch ³	(cm ³)
14	(2.1)	2	(32.8)
12	(3.3)	2.25	(36.9)
10	(5.3)	2.5	(41.0)
8	(8.4)	3	(49.2)
6	(13.3)	5	(81.9)

^a For 4 AWG (21.2 mm²) or larger conductors, the minimum wire-bending space in [Table 11.2](#) shall be provided.

Table 11.2
Minimum wire-bending space

Size of wire		Minimum bending space from connector, lug, knockout, or hole to wall ^a	
AWG	(mm ²)	inch	(mm)
14 – 10	(2.1 – 5.3)	Not specified	(–)
8 – 6	(8.4 – 13.3)	1-1/2	(38.1)
4 – 3	(21.2 – 26.7)	2	(50.8)

Table 11.2 Continued on Next Page



Documents
Document Sharing Hub

Table 11.2 Continued

Size of wire		Minimum bending space from connector, lug, knockout, or hole to wall ^a	
AWG	(mm ²)	inch	(mm)
2	(33.6)	2-1/2	(63.5)
1	(42.4)	3	(76.2)

^a When a conductor is restricted from bending by a barrier or otherwise where it leaves the lug, the distance is to be measured from the end of the barrier.

11.2.2 The depth of the compartment in the vicinity of any opening at which supply conductors enter shall be such that the required space for wire bending and manipulation remains between any wire connector, wiring lug, conduit knockout, or conduit hole and any wall of the wiring compartment that results in the wire bending, as specified in [Table 11.2](#).

11.2.3 The size of the opening provided in the wiring compartment for the connection of conduit in the field, whether in the form of a knockout or an open hole, shall be sized to accommodate no less than the minimum trade size of conduit that is used, considering no less than 125 percent of the current the equipment draws, and the minimum conductor size that is required when aluminum supply conductors are used.

11.2.4 A terminal box or compartment for field connection to the power source shall be accessible for inspection of the connections without moving the installed heater.

11.2.5 The accessibility for inspection required in [11.2.4](#) is identified as intended when, after the heater has been installed in its intended operating position, the connections are examined without using a tool of other than the ordinary type, such as an offset screw driver, and similar tools, or disturbing the wiring in the terminal compartment. It is to be assumed that the rear of a water heater of the table-top type is in contact with a vertical wall, and that cabinets as high and as deep as the heater are in contact with the sides of the heater. The possibility of installation close to vertical walls is to be disregarded in evaluating a heater that is cylindrical in shape.

11.2.6 Wiring space or other compartments intended to enclose wires that are field installed shall be free of any sharp edge, burr, or fin that damages the conductor insulation.

11.2.7 Electrical (Junction) boxes shall comply with the Standard for Metallic Outlet Boxes, UL 514A or the Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C, as applicable.

11.2.8 Fittings for conduit and/or metal clad cable shall comply with the Standard for Conduit, Tubing, and Cable Fittings, UL 514B.

11.3 Field-wiring terminals and leads

11.3.1 A water heater shall be provided with wiring terminals or with pigtail leads for connection to the supply conductors.

11.3.2 Each wiring terminal shall accommodate connection of supply conductors having an ampacity of no less than 125 percent of the current the equipment draws. When the current is 24 amperes or less, the terminal shall be able to accommodate the connection of a 10 AWG (5.3 mm²) copper wire, or a 8 AWG (8.4 mm²) aluminum wire when the equipment is to be connected with aluminum supply conductors.

11.3.3 A pigtail lead shall be no more than two wire sizes smaller than the supply conductor (copper) to which it is connected.

Exception: Multiple leads, when provided, are not required to comply with this requirement when the sum of the conductor cross-sectional areas of such leads for any given pole are equivalent to the size specified in this paragraph; however, in no case shall any pigtail lead be smaller than 14 AWG (2.1 mm²).

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

11.3.5 A field-wiring terminal, that is in accordance with the marking described in [49.5](#), shall be capable of being used for the connection of either:

- a) A copper supply conductor only; or
- b) An aluminum or a copper supply conductor.

11.3.6 A wiring terminal shall be provided with a soldering lug bolted or held by a screw, or with a pressure wire connector.

Exception: A wire-binding screw is capable of being used at a wiring terminal for the connection of a 10 AWG (5.3 mm²) or smaller conductor when upturned lugs or the equivalent are provided to hold the wire in position.

11.3.7 A wiring terminal shall be prevented from turning.

11.3.8 When a screw and washer construction is employed at a wiring terminal, the binding screw shall be no smaller than No. 10 (4.8 mm major diameter).

Exception: A No. 8 (4.2 mm) machine screw is capable of being used at a terminal intended only for the connection of a 14 AWG (2.1 mm²) conductor.

11.3.9 A terminal plate tapped for a wire-binding screw shall be of metal no thinner than 0.050 inch (1.27 mm). There shall be no fewer than two full threads in the metal.

Exception: A plate no thinner than 0.030 inch (0.76 mm) is capable of being used when the tapped threads have equivalent mechanical strength.

11.3.10 If required to provide two full threads for the binding screw, a terminal plate shall have the metal extruded at the tapped hole.

11.3.11 Upturned lugs or a cupped washer, when employed, shall be capable of retaining a 14 AWG (2.1 mm²) or larger conductor under the head of the screw or washer provided to hold the wire in position.

11.3.12 A wire-binding screw shall thread into metal.

11.3.13 A water heater intended for permanent connection to a grounded conductor of a power supply circuit shall have one terminal or lead identified for the connection of such a conductor. No switch or overcurrent protective device of the single pole type shall be connected in the grounded conductor.

11.3.14 Terminal blocks shall comply with the Standard for Terminal Blocks, UL 1059.

11.3.15 Electrical Quick Connect Terminals shall comply with the Standard for Electrical Quick Connect Terminals, UL 310.

12 Electrical Supply Connections – Cord Connection

12.1 Power supply cords

12.1.1 With respect to the Exceptions of [11.1.2](#), a storage tank water heater intended for cord and plug connection to the supply circuit shall be provided with damp location, hard or extra hard usage flexible cord, such as Type S, SO, ST, STO, SJ, SJT, SJTO, HS, or HSO cord as described in the National Electrical Code, ANSI/NFPA 70. The length of the cord external to the water heater, measured to the face of the attachment plug, shall be no less than 2 feet (0.61 m) nor more than 6 feet (1.83 m).

12.1.2 An attachment plug provided on a small capacity storage tank water heater shall be of the grounding type and shall be rated in accordance with [Table 12.1](#) and shall comply with the Standard for Attachment Plugs and Receptables, UL 498.

Table 12.1
Attachment plug rating and supply cord size

Maximum load (amperes)		Supply cord (AWG)	Attachment plug rating (amperes)
More than	No more than		
0	10	18	15 or 20
10	12	16	15 or 20
12	13	16	20
13	16	14	20
16	18	12	30
18	24	10	30
24	25	10	40
25	30	8	40
30	32	6	40
32	40	6	50

12.1.3 A power supply cord provided on a small capacity storage tank water heater shall have conductors of the size specified in [Table 12.1](#).

12.1.4 Flexible cords and cables shall comply with the Standard for Flexible Cords and Cables, UL 62.

12.2 Bushings

12.2.1 At a point where a power supply cord passes through an opening in a wall, barrier, or enclosing case:

- a) There shall be a bushing or equivalent that is secured in place; or
- b) The opening shall have a smooth, rounded surface against which the cord bears.

12.2.2 A soft bushing of rubber, neoprene, or polyvinyl chloride shall not be used at any point in a water heater unless the bushing is not relied upon to protect the cord insulation and the edges of the hole in which the bushing is mounted are smooth and free from burrs, fins, or any sharp edge.

12.3 Strain relief

12.3.1 Strain relief, other than a knot in a power supply cord, shall be provided such that mechanical stress on a power supply cord is not transmitted to terminals, splices, or internal wiring, as determined by the Strain Relief Test described in Section [37](#).

12.3.2 Means shall be provided to prevent the power supply cord from being pushed into the enclosure of a water heater through the cord entry hole when such displacement:

- a) Subjects the cord to mechanical damage;
- b) Exposes the cord to a temperature higher than that for which it is rated; or
- c) Reduces spacings to values below the minimum values specified in [Table 13.1](#).

To determine compliance, the supply cord shall be tested in accordance with Section [38](#), Push Back Relief Test.

13 Electrical Spacings

13.1 General

13.1.1 The electrical spacings in a water heater shall be in accordance with [Table 13.1](#).

Exception No. 1: The spacing requirements in [Table 13.1](#) do not apply to the inherent spacings of a component, as such spacings are judged under the individual requirements for the component. However, the electrical clearance resulting from the assembly of the component into the heater unit, including spacings from parts of such a component to a dead metal part or enclosure, shall be as indicated in [Table 13.1](#).

Exception No. 2: At closed-in points only, such as the screw-and-washer construction of an insulated terminal mounted in metal, a spacing of 3/64 inch (1.2 mm) is capable of being used between uninsulated live parts of opposite polarity and between uninsulated live parts and dead metal parts when:

- a) The heater is rated 250 volts or less; and
- b) The points in question are at other than wiring terminals.

Table 13.1
Minimum electrical spacings

Location in water heater	Rated voltage	Minimum spacing			
		Through air		Over surface	
		inch	(mm)	inch	(mm)
Between uninsulated live parts of opposite polarity and between uninsulated live parts and dead metal parts	250 or less	1/16	(1.6)	1/16	(1.6)
	More than 250	1/4	(6.4)	1/4	(6.4)
At wiring terminals, and not connecting straps or busses extending from such terminals, between:					
A. Uninsulated metal of terminal and enclosure metal	250 or less	1/2	(12.7)	1/2	(12.7)

Table 13.1 Continued on Next Page

Table 13.1 Continued

Location in water heater	Rated voltage	Minimum spacing			
		Through air		Over surface	
		inch	(mm)	inch	(mm)
B. Uninsulated terminal parts of opposite polarity or between uninsulated terminal parts and metal other than the enclosure that are grounded in service	More than 250	1/2	(12.7)	1/2	(12.7)
	250 or less	1/4	(6.4)	3/8	(9.5)
	More than 250	3/8	(9.5)	1/2	(12.7)

13.1.2 An insulating lining, barrier of fiber, or similar material employed where spacings otherwise are less than the required values shall be no less than 1/32 inch (0.8 mm) thick, and shall be so located or of such material that it is not adversely affected by arcing. As an alternative to air alone, fiber no less than 1/64 inch (0.4 mm) thick shall be used in conjunction with an air spacing of no less than half the required spacing.

Exception: Insulating material is capable of being used at a thickness less than specified when, upon investigation, it is determined that it is not adversely affected by arcing.

13.1.3 Unless it is protected from mechanical damage during assembly and intended use, a barrier of mica shall be at least 0.01 inch (0.25 mm) thick.

13.2 Reduction of spacings due to turning or shifting

13.2.1 Wire mesh used to secure thermal insulation in a heater not provided with an outer enclosure shall be secured in place so that it does not shift or distort during shipment, installation, or operation of the heater to the extent that spacings to uninsulated live parts are reduced below the minimum values specified in [Table 13.1](#).

13.2.2 An uninsulated live part shall be secured in place so that it is prevented from turning or shifting to such extent that spacings are reduced below the minimum values specified in [Table 13.1](#).

13.2.3 Unless the construction has been investigated and found to prevent shifting or turning, friction between surfaces shall not be used to prevent shifting or turning of live parts. A lock washer is capable of being used for this purpose. Thermal insulation alone shall not be used as a means for securing an uninsulated live part in place.

14 Grounding

14.1 General

14.1.1 An exposed dead metal part that becomes energized and a dead metal part within the enclosure that is exposed to contact during service and that becomes energized shall be conductively connected:

- a) To the enclosure at the point of connection of the wiring system; and
- b) To the equipment-grounding terminal or lead.

Exception: The requirement for grounding does not apply to:

- a) A small metal part (such as an adhesive attached foil marking label, a screw, or a handle) that is: