



UL 732

STANDARD FOR SAFETY

Oil-Fired Storage Tank Water Heaters

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UL Standard for Safety for Oil-Fired Storage Tank Water Heaters, UL 732

Sixth Edition, Dated January 31, 2018

Summary of Topics

This revision of ANSI/UL 732 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS).

The requirements are substantially in accordance with Proposal(s) on this subject dated May 18, 2018.

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

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CONTENTS

INTRODUCTION

1 Scope	5
2 Glossary	5
3 Units of Measurement	8
4 Components	8

CONSTRUCTION

5 Assembly	8
6 Accessibility for Servicing	9
7 Base	10
8 Casing	10
9 Radiation Shields	10
10 Insulation Materials	11
11 Combustion Chamber	11
12 Heating Surface Joints	11
13 Baffles	12
14 Flue Collars	12
15 Damper and Draft Regulator	12
16 Materials Contacting Water	12
17 Water-Storage Vessels	13
18 Dip Tubes	14
19 Controls	14
19.1 Application	14
19.2 Limit control	15
19.3 Water-temperature regulating control	16
20 Field Wiring	16
21 Internal Wiring	19
22 Separation of Circuits	23
23 Bonding for Grounding	24

ELECTRICAL COMPONENTS

24 General	27
25 Mounting of Electrical Components	27
26 Electrical Enclosures	28
27 Accessibility of Uninsulated Live Parts, Film-Coated Wire and Moving Parts	33
28 Motors and Motor Protection	38
29 Switches and Controllers	42
30 Capacitors	43
31 Electrical Insulating Material	43
32 Spacings – High-Voltage Circuits	44
33 Spacings – Low-Voltage Circuits	45
34 Protection of Users and Service Personnel	45

PERFORMANCE

35 General	49
36 Test Installation for Other Than Alcove-or Closet-Installed Heaters	50

36.1	Enclosure	50
36.2	Chimney connector	51
37	Test Installation for Alcove-or Closet-Installed Units	54
37.1	Enclosure	54
37.2	Chimney connector	57
38	Instrumentation	60
38.1	Draft measurement	60
38.2	Fuel-input measurement	60
38.3	Power measurement	60
38.4	Speed measurement	61
38.5	Temperature measurement	61
39	Initial Test Conditions	63
39.1	General	63
39.2	Heater equipped with mechanical atomizing burner	64
39.3	Heater equipped with vaporizing burner	64
40	Combustion Test – Burner and Water Heater	65
41	Water-Temperature Control Test	65
42	Limit-Control Cutout Test	66
43	Temperature Test	66
44	Seepage and Burnoff Test – Vaporizing Burner	70
45	Hydrostatic Test on Water-Storage Vessels	71
46	Short-Circuit Test	71
47	Dielectric Voltage-Withstand Test	73
48	Torque Test on Screws and Bolts	74
49	Securement Tests on Constant-Level Valve Assemblies	75
50	Bonding-Conductor Test	75
51	Strain-Relief Test	75
52	Nonmetallic Dip Tube Tests	76
52.1	Deformation and weight loss	76
52.2	Resistance to crushing	76
52.3	Collapse	79
 MANUFACTURING AND PRODUCTION TESTS		
53	General	80
 MARKING		
54	General	81
 INSTALLATION INSTRUCTIONS		
55	General	83
 APPENDIX A		
	Standards for Components	A1

INTRODUCTION

1 Scope

1.1 These requirements cover oil-fired storage-tank water-heating appliances having a fuel input of not more than 200,000 Btu per hour (60 kW). These requirements do not apply to heaters that include storage vessels having a water capacity of more than 120 gallons (454.2 liters), or that are intended for heating water to a temperature of more than 200°F (93.3°C).

1.2 The oil-burning equipment covered by these requirements are intended for installation in accordance with the National Fire Protection Association Standard for the Installation of Oil Burning Equipment, NFPA 31, the International Mechanical Code and the Uniform Mechanical Code.

2 Glossary

2.1 For the purpose of this standard the following definitions apply.

2.2 ANTIFLOODING DEVICE – A primary safety control that causes the fuel flow to be shut off upon a rise in fuel level or upon receiving excess fuel, and that operates before discharge of fuel can occur.

2.3 APPLIANCE FLUE – The flue passages within the appliance.

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

2.5 BAFFLE – An object placed in an appliance to direct the flow of air or flue gases.

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

2.7 BURNER, MECHANICAL-ATOMIZING – A power operated burner that prepares and delivers the fuel and all or part of the air by mechanical process in controllable quantities for combustion. Some examples are air atomizing, high- and low-pressure atomizing, horizontal and vertical rotary atomizing, and vertical rotary wall-flame burners.

2.8 BURNER, MECHANICAL-DRAFT – A burner that includes a power driven fan, blower, or other mechanism as the principal means for supplying air for combustion.

2.9 BURNER, NATURAL-DRAFT – A burner that principally depends upon the natural draft created in the flue to induce into the burner the air required for combustion.

2.10 BURNER, VAPORIZING – A burner consisting of an oil-vaporizing bowl or other receptacle to which liquid fuel may be fed in controllable quantities; the heat of combustion is used to vaporize the fuel, with provision for admitting air and mixing it with the fuel vapor in combustible proportions.

2.11 CASING – An enclosure forming the outside of the appliance, no parts of which are likely to be subjected to intense heat.

2.12 CHIMNEY CONNECTOR – The pipe that connects a solid or liquid fuel-burning appliance to a chimney.

2.13 COMBUSTIBLE MATERIAL – Combustible material as pertaining to materials adjacent to or in contact with heat-producing appliances, chimney connectors and vent connectors, steam and hot-water pipes, and warm-air ducts means material made of or surfaced with wood, compressed paper, plant fibers, or other material that will ignite and burn. Such material shall be considered as combustible even though flameproofed, fire-retardant treated, or plastered.

2.14 COMBUSTION – The rapid oxidation of fuel accompanied by the production of heat, or heat and light.

2.15 COMBUSTION CHAMBER – The portion of an appliance within which combustion occurs.

2.16 COMBUSTION (FLAME) SAFEGUARD – A safety combustion control.

2.17 CONSTANT-LEVEL VALVE – A device that maintains a constant level of fuel oil in a reservoir for delivery to the burner.

2.18 CONTROL – A device intended to regulate the fuel, air, water, or electrical supply to the controlled equipment. It may be automatic, semiautomatic, or manual.

2.19 CONTROL, LIMIT – An automatic safety control responsive to changes in liquid level, pressure, or temperature; for limiting the operation of the controlled equipment.

2.20 CONTROL, SAFETY – An automatic control including a relay, switch, or other auxiliary equipment used in conjunction therewith to form a safety control system that is intended to reduce the likelihood of operation of the controlled equipment that would result in a risk of fire or injury to persons.

2.21 CONTROL, PRIMARY-SAFETY – An automatic safety control intended to reduce the likelihood of abnormal discharge of fuel at the burner in case of ignition failure or flame failure.

2.22 CONTROL, SAFETY-COMBUSTION – A primary-safety control responsive directly to flame properties; sensing the presence of flame and causing fuel to be shut off in event of flame failure.

2.23 DRAFT REGULATOR – A device that functions to maintain a desired draft in the appliance by automatically reducing the chimney draft to the desired value.

2.24 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 circuit.

b) Low-Voltage Circuit – A circuit involving a potential of not more than 30 volts rms alternating-current (42.4 volts peak or direct current) and supplied by:

1) A primary battery;

2) A Class 2 transformer; or

3) 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 high-voltage circuit, by connecting 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.

c) Safety-Control Circuit – A circuit involving one or more safety controls.

2.25 FLUE COLLAR – That portion of an appliance constructed for attachment of the chimney or vent connector.

2.26 FLUE GASES – Combustion products and excess air.

2.27 FUEL OIL – Any hydrocarbon oil defined by Standard Specifications for Fuel Oils, ASTM D396-1992.

2.28 HEATING SURFACE – A surface that transmits heat directly from flame or flue gases to the medium to be heated.

2.29 INDIRECT-FIRED APPLIANCE – An appliance constructed so that combustion products or flue gases are not mixed in the appliance with the medium to be heated; hence is provided with a flue collar.

2.30 MAINTENANCE – The periodic tasks usually performed to operate and maintain an appliance, such as air, fuel, pressure, and temperature regulation, cleaning, lubrication, resetting of controls, and the like. Repair and replacement of parts other than those expected to be renewed periodically is not considered to be maintenance. Some examples of maintenance are:

- a) Cleaning or replacing nozzles, atomizers, and pilots.
- b) Setting ignition electrodes.
- c) Cleaning strainers or replacing strainer or filter element.
- d) Resetting safety control.
- e) Replacing igniter cable.

3 Units of Measurement

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

4 Components

4.1 Except as indicated in 4.2, 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.

4.2 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.

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

4.4 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.

CONSTRUCTION

5 Assembly

5.1 An oil-fired water heater shall be factory built as a single complete assembly or a group of subassemblies and shall include all of the essential components necessary for its function when installed as intended. An oil-fired water heater may be shipped as two or more major subassemblies.

5.2 An oil-fired storage-type water heater may be furnished as two major subassemblies, each factory built to accommodate the other. The assembly formed when the two subassemblies are joined shall comply with the requirements in this standard. One subassembly is to consist of the oil burner, which may include safety controls. The other subassembly is to consist of the tank assembly and its appurtenances, including the safety controls if not furnished with the burner. The two subassemblies need not originate at, nor be shipped together from, the same factory but are to be marked to identify the subassemblies to be joined.

5.3 An oil-fired water heater that is not assembled by the manufacturer as a single complete assembly shall be arranged in major subassemblies, see 5.4. Each subassembly shall be capable of being incorporated into the final assembly without requiring alteration, 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 operation of the heater, shall be:

- a) Arranged and constructed so that they can be incorporated into the complete assembly, without the need for alteration or alignment, and only in the correct relationship with each other; or
- b) Assembled, tested, and shipped from the factory as one single complete assembly.

5.4 The burner assembly and the water-storage vessel, including its base, combustion chamber, and casing are considered to be major subassemblies. The controls and a wiring harness, if employed, may be packaged with either of the subassemblies.

5.5 A radiation shield or baffle employed to reduce the likelihood of excessive temperature shall be:

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

5.6 The construction of a water heater shall be such that, for any typical installation, the alteration or removal of a baffle, insulation, or a radiation shield needed to reduce the likelihood of excessive temperatures is not required.

5.7 A water heater shall be constructed so that parts requiring attention or manipulation during typical use can be easily operated.

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

5.9 Any external door providing access into the combustion chamber of a water heater intended for installation with a clearance of less than 24 inches (610 mm) from the face of or 48 inches (1220 mm) above the door shall be self-closing.

5.10 A burner shall be secured so it will not twist, slide, or drop out of position.

5.11 A water heater equipped with an anti-flooding device shall be constructed so that a level heater has a minimum distance of 3/4 inch (19.1 mm) between the intended maximum oil level maintained by the oil control device and the lowest level of the point at which overflow is able to occur.

6 Accessibility for Servicing

6.1 A water heater shall be constructed so that parts, such as interior surfaces of vaporizing burners, heating surfaces in contact with combustion products, oil inlet pipes, and oil strainers, can be cleaned without major dismantling of the water heater or removal of parts required by 5.2 to be factory assembled.

6.2 The removal of an access panel, burner, blower, cap, plug, or the like, specifically constructed to permit removal and replacement for servicing and the detachment of the chimney connector is not considered major dismantling with regard to the requirement in 6.1.

6.3 Burners, controls, and safety devices shall be accessible for cleaning, inspection, repair, and replacement when the water heater is installed as recommended by the manufacturer. The arrangement of parts in the assembly that may be removed for maintenance shall be such that their replacement, following removal, will not necessitate their realignment to maintain their intended relationship with other parts of the assembly. Specific tools required for maintenance to be done by the operator shall be provided with the heater.

7 Base

7.1 A water heater shall be provided with a base or frame that will support the heater. The base or frame shall be constructed of steel or equivalent material.

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. Sheet-metal casings shall be made of:

- a) Steel not less than 0.020 inch (0.51 mm) thick if uncoated, or 0.023 inch (0.58 mm) thick if galvanized; or
- b) Nonferrous sheet metal having an average thickness of not less than 0.029 inch (0.74 mm).

8.2 Access panels that need to be removed for service and accessibility shall be constructed to permit repeated removal and replacement without causing damage or reducing any required insulating value.

8.3 A removable panel through which air is drawn for combustion shall be constructed to prevent being attached in a manner that may result in a risk of fire or injury to persons and so that it is not attachable in a manner that would impede air flow.

8.4 A removable panel shall be constructed so that it cannot be interchanged with other panels on the same heater if interchange may result in a risk of fire or injury to persons.

8.5 The casing of a heater intended for installation on combustible flooring shall completely close the bottom or be constructed to provide an effective radiation barrier between the floor and the bottom of a combustion chamber, fire box, or vaporizing burner.

9 Radiation Shields

9.1 A radiation shield or liner shall be constructed, formed, and supported to provide for its intended positioning and to reduce the likelihood of distortion or sagging in service. A shield or liner shall be protected against corrosion if its deterioration may cause excessive temperature when the heater is tested for compliance with these requirements. Any finish used to provide the required resistance to corrosion shall not be damaged by heat when the heater is tested under these requirements.

10 Insulation Materials

10.1 Thermal insulation that is not acceptably self-supporting shall be securely applied to solid surfaces in a manner to reduce the likelihood of sagging. The insulating value of the material shall be unimpaired when the heater is tested under these requirements. An adhesive required for securing insulating material shall retain its adhesive qualities at any temperature attained by the adhesive when the heater is tested under these requirements and at 0°F (minus 17.8°C).

11 Combustion Chamber

11.1 A combustion chamber and flueway shall be constructed of cast iron, sheet steel, or other material having the strength, rigidity, durability, resistance to corrosion, and other physical properties equivalent to sheet steel not less than 0.042 inch (1.07 mm) thick.

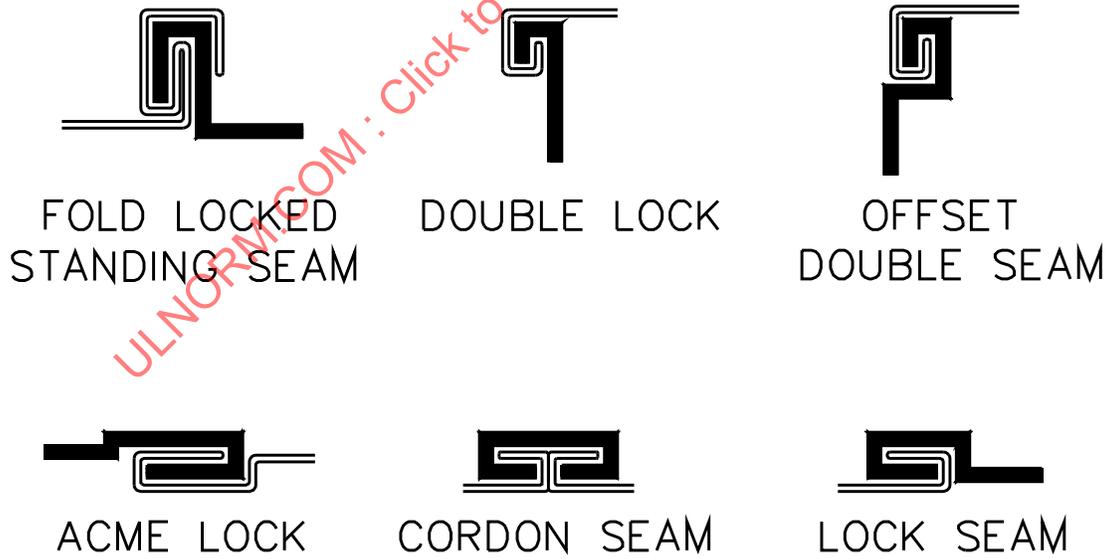
11.2 A combustion chamber (fire box) lining material shall be durable, secured in place, and accessible for replacement with equivalent material.

12 Heating Surface Joints

12.1 Joints in heating surfaces shall be mechanically secure and tight, for example, welded, lock-seamed, machined and bolted, riveted, or the like. A joint shall not depend on cement for tightness. A slip or lap joint shall not depend solely upon friction of the joint itself 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 A baffle in a flue-gas passage or otherwise exposed to combustion products shall be constructed and arranged to remain in its intended position. A flue baffle shall be made of material having rigidity, heat, and corrosion resistance equivalent to AISI C1010 sheet steel not less than 0.042 inch (1.07 mm) thick.

13.2 A flue baffle shall be accessible for cleaning. A flue baffle that is removable for cleaning shall be constructed so that it can be removed and replaced in a manner that does not result in a risk of fire or injury to persons.

13.3 If it is necessary to remove a flue baffle to clean the flueway, the flue baffle of a water heater having an internal flue shall be constructed to allow removal within a clearance above the floor of 78 inches (2.00 m), or 24 inches (0.61 m) above the flue collar on a heater taller than 54 inches (1.37 m).

14 Flue Collars

14.1 A flue collar shall have rigidity and heat and corrosion resistance at least equivalent to that of AISI C1010 steel not less than 0.032 inch (0.81 mm) thick. The collar shall be constructed and arranged to permit secure attachment of the chimney connector.

15 Damper and Draft Regulator

15.1 An adjustable damper shall be equipped with minimum and maximum operating stops. The minimum operating stop for such damper shall be located to obtain sufficient air for complete combustion at minimum burner input.

15.2 An automatically operated damper shall maintain the intended damper opening at all times and be arranged to prevent starting of the burner unless the damper is in the intended position for starting.

15.3 A water heater to be equipped with a barometric draft regulator shall be assembled so as not to require the regulator to be installed in a false ceiling, in a different room, or in any manner that will permit a difference in pressure between the air in the vicinity external to the regulator and the combustion air supply.

16 Materials Contacting Water

16.1 A nonmetallic material in contact with water shall comply with the requirements in the National Sanitation Foundation Standard for Plastic Piping Components and Related Materials, NSF No. 14-1990, with regard to toxicity, taste, color, solubility, and odor.

17 Water-Storage Vessels

17.1 A water-storage vessel shall be constructed to withstand the applicable hydrostatic test specified in the Hydrostatic Test on Water-Storage Vessels, Section 45, without rupture, leakage, or visible permanent distortion, or the water-storage vessel shall carry one of the following symbols of the ASME Boiler and Pressure Vessel Code:

"H" – Designating a Steam Heating Boiler, Hot Water Heating Boiler, or Hot Water Supply Boiler, constructed in accordance with the ASME Boiler and Pressure Vessel Code, Section IV, Rules for Construction of Heating Boilers.

"HLW" – Designating a Complete Potable Water Heater, constructed in accordance with the ASME Boiler and Pressure Vessel Code, Section IV, Rules for Construction of Heating Boilers.

"U" – Designating a pressure vessel, constructed in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 Rules for Construction of Pressure Vessels.

17.2 The working pressure of a water-storage vessel that does not carry one of the symbols of the ASME Boiler and Pressure Vessel Code, specified in 17.1 shall not be higher than 50 percent of the hydrostatic-test pressure specified in Section 45.

17.3 The inside surfaces of a steel water-storage vessel shall be protected against corrosion by galvanizing, porcelain enameling, or the equivalent.

17.4 A storage vessel shall be equipped with a valve to facilitate draining of the tank.

17.5 A storage tank shall have an opening for installation of a temperature-and-pressure relief valve. The opening:

- a) Shall be located:
 - 1) In the top of the tank; or
 - 2) With its centerline in the upper 6 inches (152 mm) of the side.
- b) Shall be separate from the openings for water connections.
- c) Shall be threaded in conformity with the Standard for Welding Procedure and Performance Qualification, AWS B2.1-1984.
- d) Shall accommodate a 3/4-inch or larger trade-size pipe.

18 Dip Tubes

18.1 A dip tube shall be provided with an antisiphoning hole located so that after the dip tube is installed, the hole is within 6 inches (152 mm) of the top of the tank.

18.2 A dip tube having a specific gravity less than 1.0 shall be held in place by a positive means that limits any vertical displacement to not more than 1/4 inch (6.4 mm).

18.3 Nonmetallic material for a dip tube shall have a specific gravity greater than 0.94.

18.4 A nonmetallic dip tube shall be investigated for acceptability, particularly with respect to solubility, brittleness, and resistance to deformation, collapse, and sagging at temperatures likely to be encountered in service. Specific tests are described in Nonmetallic Dip Tube Tests, Section 50.

19 Controls

19.1 Application

19.1.1 A safety-control circuit shall be 2-wire, one side grounded, having a nominal rating of 120 volts. A safety control or protective device shall interrupt the ungrounded conductor.

19.1.2 A short circuit or combination of short circuits to ground shall not render a safety control or protective device inoperative. Safety-control circuit arrangements other than described in 19.1.1 may be considered if they accomplish the intent of this requirement.

19.1.3 The requirement in 19.1.1 does not apply to a supervised circuit within a safety control or to the extension of such circuit to a separate element of the control, such as a flame-sensing device.

19.1.4 A control circuit shall be arranged so that it may be connected to a power-supply branch circuit that can be fused at not more than the value appropriate for the rating of any control included in the circuit.

19.1.5 A safety control shall be accessible.

19.1.6 A safety control shall be supported in such a manner that the control and its sensing element will remain in its intended position. It shall be possible to determine by observation or test whether or not each control is in its intended location.

19.1.7 Nothing shall be provided for the purpose of rendering any safety control ineffective or to allow firing of the water heater without the protection of each of the required safety controls.

19.1.8 A burner not equipped to provide automatic restarting shall be constructed to require manual restart after any control functions to cause the fuel supply to be shut off and following restoration of an interrupted power supply.