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Underwriters Laboratories Inc.®

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August 7, 1995

Revision pages for

Standard for

Oil-Fired Wall Furnaces

UL 730, Fourth Edition

Attached to this transmittal notice is a reprinted title page for the Fourth edition of UL 730.

Attention is directed to the note on the title page of this standard outlining the procedure to be followed to retain the approved text of ANSI/UL 730-1995.

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

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1

UL 730

Standard for

Oil-Fired Wall Furnaces

First Edition – August, 1955
Second Edition – September, 1974
Third Edition – June 10, 1987

Fourth Edition

December 22, 1994

Approval as an American National Standard (ANSI) covers the numbered paragraphs on pages dated December 22, 1994. These pages should not be discarded when revised or additional pages are issued if it is desired to retain the ANSI approved text.

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

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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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UL 730

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Oil-Fired Wall Furnaces



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A not-for-profit organization
dedicated to public safety and
committed to quality service



December 22, 1994

Standard for

Oil-Fired Wall Furnaces

UL 730, Fourth Edition

Accompanying this transmittal notice is a copy of the Fourth edition of UL 730.

THIS EDITION OF THE STANDARD IS NOW IN EFFECT.

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

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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 oil-fired, vented, fan-type wall furnaces. Requirements for the installation and use of oil-burning equipment are included in the Standard for the Installation of Oil-Burning Equipment, NFPA 31.

1.2 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 may be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this Standard.

2 General

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.

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

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

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

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

3.7 **BASE** – The main supporting frame or structure of the wall furnace, exclusive of legs.

3.8 **BURNER, MECHANICAL ATOMIZING TYPE** – A power operated burner which prepares and delivers the oil 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 rotary, vertical rotary atomizing, and vertical rotary wall flame burners.

3.9 **BURNER, MECHANICAL DRAFT TYPE** – A burner which includes a power driven fan, blower, or other mechanism as the principal means for supplying air for combustion.

- 3.10 **BURNER, NATURAL DRAFT TYPE** – A burner which depends principally upon the natural draft created in the flue to induce into the burner the air required for combustion.
- 3.11 **BURNER, VAPORIZING TYPE** – 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 being used to vaporize the fuel, with provision for admitting air and mixing it with the oil vapor in combustible proportions.
- 3.12 **CASING** – An enclosure forming the outside of the appliance, no parts of which are likely to be subjected to intense heat.
- 3.13 **CENTRAL HEATING APPLIANCE** – A stationary indirect-fired vented appliance comprising the following classes: boilers, central furnaces, floor furnaces, and wall furnaces. A floor mounted unit heater to be connected to a duct system is categorized also as a central heating appliance.
- 3.14 **CHIMNEY CONNECTOR** – The pipe which connects a solid or liquid fuel burning appliance to a chimney.
- 3.15 **COMBUSTIBLE MATERIAL** – Combustible material as pertaining to materials adjacent to or in contact with heat producing appliances, chimney connectors and vent connectors, refers to 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 flame-proofed, fire-retardant treated, or plastered.
- 3.16 **COMBUSTION** – The rapid oxidation of fuel accompanied by the production of heat, or heat and light. Complete combustion of a fuel is possible only in the presence of an adequate supply of oxygen.
- 3.17 **COMBUSTION CHAMBER** – The portion of an appliance within which combustion occurs.
- 3.18 **COMBUSTION (FLAME) SAFEGUARD** – A safety combustion control.
- 3.19 **CONSTANT LEVEL VALVE** – A device for maintaining within a reservoir a constant level of fuel for delivery to the burner.
- 3.20 **CONTROL** – A device intended to regulate the fuel, air, water, or electrical supply to the controlled equipment. It may be automatic, semiautomatic, or manual.
- 3.21 **CONTROL, LIMIT** – An automatic safety control, responsive to changes in liquid level, pressure, or temperature, for limiting the operation of the controlled equipment.
- 3.22 **CONTROL, 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 unsafe operation of the controlled equipment.
- 3.23 **CONTROL, PRIMARY SAFETY** – The automatic safety control intended to prevent abnormal discharge of oil at the burner in case of ignition failure or flame failure.
- 3.24 **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.
- 3.25 **DAMPER** – A valve or plate for regulating draft or flow of flue gases. A damper is generally considered as being located on the downstream side of the combustion chamber, usually in a flue passage of the appliance or in the chimney connector.

- 3.26 **DAMPER, AUTOMATICALLY OPERATED** – A damper operated by an automatic control.
- 3.27 **DAMPER, MANUALLY OPERATED** – An adjustable damper manually set and locked in the desired position.
- 3.28 **DRAFT REGULATOR** – A device which functions to maintain a desired draft in the appliance by automatically reducing the chimney draft to the desired value.
- 3.29 **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 alternating current (42.4 peak or direct current) and supplied by a primary battery or by a standard Class 2 transformer or other suitable transforming device, or by a suitable combination of transformer and fixed impedance having output characteristics in compliance with what is required for a Class 2 transformer. A circuit derived from a source of supply classified as a high-voltage circuit, by connecting resistance in series with the supply circuit as a means of limiting the voltage and current, is not considered to be a low-voltage circuit.
 - c) **Safety Control Circuit** – A circuit involving one or more safety controls.
- 3.30 **EXCESS AIR** – Air which passes through the combustion area and the appliance flues in excess of that which is theoretically required for complete combustion.
- 3.31 **FLUE** – The general term for the conduit or passageway through which flue gases pass from the combustion chamber to the outer air.
- 3.32 **FLUE COLLAR** – That portion of an appliance intended for attachment of the chimney or vent connector.
- 3.33 **FLUE GASES** – Combustion products and excess air.
- 3.34 **FUEL OIL** – Any hydrocarbon oil as defined by the Standard for Specification for Fuel Oils, ANSI/ASTM D0396-1986.
- 3.35 **HEAT EXCHANGER, DIRECT** – A heat exchanger in which heat generated in the combustion chamber of the appliance is transferred direct through walls of the appliance to the heating medium, such as air, steam, or water, and 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.
- 3.36 **HEAT EXCHANGER, INDIRECT** – A heat exchanger which 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. It is an indirect heat transfer device.
- 3.37 **HEATING SURFACES** – All surfaces which transmit heat directly from flame or flue gases to the medium to be heated.
- 3.38 **INDIRECT FIRED APPLIANCE** – An appliance designed so that combustion products or flue gases are not mixed in the appliance with the medium to be heated; and provided with a flue collar.

- 3.39 LIMIT CONTROL – See Control, Limit – 3.21.
- 3.40 LINER – See Radiation Shield – 3.46.
- 3.41 MANUALLY LIGHTED APPLIANCE – An appliance in which fuel to the main burner is turned on only by hand and ignited under supervision.
- 3.42 NORMAL CARE – 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 normal care. Some examples of normal care are:
- a) Cleaning or replacing nozzles, atomizers, and pilots.
 - b) Setting ignition electrodes.
 - c) Cleaning strainers or replacing strainer or filter elements.
 - d) Resetting safety control.
 - e) Replacing igniter cable.
- 3.43 OIL-FIRED WALL FURNACE – A wall furnace equipped with one or more oil burners, and all the necessary safety controls, electrical equipment as needed, and related equipment, manufactured for assembly as a complete unit. This definition does not include oil stoves.
- 3.44 PILOT – A flame which is utilized to ignite the fuel at the main burner or burners.
- 3.45 PRIMARY AIR – The air introduced into a burner and which mixes with the fuel before it reaches the ignition zone.
- 3.46 RADIATION SHIELD – A separate panel or panels interposed between heating surfaces and adjacent objects to reduce heat transmission by radiation.
- 3.47 RADIATOR – Auxiliary heat transfer surfaces within the casing, connected between the combustion chamber and the flue collar.
- 3.48 READILY ACCESSIBLE – Capable of being reached easily and quickly for operation, adjustment, and inspection.
- 3.49 SAFETY CONTROL – See Control, Safety – 3.22.
- 3.50 SECONDARY AIR – The air externally supplied to the flame at or beyond the point of ignition.
- 3.51 SPECIAL PARTS AND TOOLS – Those parts and tools that are not available on the open retail market.
- 3.52 THERMOSTAT – An automatic control actuated by temperature change to maintain temperatures between predetermined limits.

3.53 VALVE MANUAL OIL SHUT-OFF – A manually operated valve in the oil line for the purpose of completely turning on or shutting off the oil supply to the burner.

3.54 VALVE, OIL CONTROL – An automatically or manually operated device consisting essentially of an oil valve for controlling the fuel supply to a burner:

- a) Metering (Regulating) Valve – An oil control valve for regulating burner input.
- b) Safety Valve – A normally closed valve of the ON and OFF type, without any bypass to the burner, that is actuated by a safety control or by an emergency device.

3.55 VENTED APPLIANCE – An indirect fired appliance provided with a flue collar to accommodate a flue pipe for conveying flue gases to the outer air.

3.56 WALL FURNACE – A self-contained indirect-fired appliance intended for incorporation in, insertion into, or permanent attachment to a wall or partition, and furnishing heated air circulated by gravity or by a fan directly into the space to be heated through openings in the casing.

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 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.

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

4.4 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.

CONSTRUCTION – MECHANICAL

5 Assembly

5.1 A wall furnace shall be factory built as a group assembly and shall include all the essential components necessary for its normal function when installed as intended. A wall furnace may be shipped as two or more major subassemblies.

5.2 A wall furnace, if not assembled by the manufacturer as a unit, shall be arranged in major subassemblies. Each subassembly shall be capable of being incorporated readily into the final assembly without requiring alteration, cutting, drilling (except to the extent indicated in 5.3), threading, welding, or similar tasks by the installer. Two or more subassemblies, which must bear a definite relationship to each other for the proper and safe installation or operation of the furnace, shall be arranged and constructed to permit them to be incorporated into the complete assembly only in the correct relationship with each other, without need for alteration or alignment, or such subassemblies shall be assembled, tested, and shipped from the factory as one element.

5.3 To be in accordance with 5.2, major subassemblies of a wall furnace are deemed to be the:

- a) Burner;
- b) Heat exchanger, including its base, combustion chamber, casing, and safety controls;
- c) Blower assembly, including the base, filters, and casing; and
- d) Blower motor if not included as part of the blower assembly.

A wiring harness may be packaged with one of the major subassemblies.

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

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

5.5 The design of a wall furnace shall be such that, for any normal installation, the alteration or removal of a baffle, insulation, or a radiation shield needed to prevent unsafe temperatures is not required.

5.6 A wall furnace shall afford convenient operation by the user of those parts requiring attention or manipulation by him in normal usage.

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

5.8 Screws or bolts used to attach parts which are detached for normal care or servicing of the appliance shall be capable of holding upon the application of the torques indicated in Table 5.1 after removal and replacement.

Table 5.1
Maximum torque requirements for screws

Screw size (mm)		Torque, pound-inches (N • m)	
No. 8	(4.2)	20	(2.3)
No. 10	(4.8)	25	(2.8)
1/4 inch	(6.4)	100	(11.3)
5/16 inch	(7.9)	200	(22.6)
3/8 inch	(9.5)	350	(39.5)
7/16 inch	(11.1)	550	(62.1)
1/2 inch	(12.7)	800	(90.3)
9/16 inch	(14.3)	1200	(135.5)

5.9 A wall furnace shall be such that no portion of the products of combustion nor any portion of the heated circulating air or air from the space being heated will be discharged into spaces within walls, floor, or ceiling. Openings in the jacket, top, or sides, through which the chimney connector extends, shall be sufficiently close fitting to comply with this requirement.

5.10 A wall furnace shall be constructed to provide a constant circulation of heated air at all times during normal operations.

5.11 A wall furnace with a single warm air register shall not be equipped with a shutter to restrict the flow of warm air from the heater.

5.12 A wall furnace having more than one warm air register, when equipped with a shutter, shall be such that at least one warm air register will be open at any position of the shutter.

5.13 The bottom of the heater shall provide an oil-tight pan with an upturned flange not less than 1/2 inch (12.7 mm) high around the periphery and around any openings through the pan. All oil handling parts, including the fuel supply line connection, shall be directly above the pan.

5.14 The construction of a wall furnace shall provide for maintaining the minimum clearance required between the bottom, sides, and top of the furnace and concealed surfaces of the wall or partition in which or to which the furnace is to be installed. Spacers shall be of such strength and bearing surface as to maintain required clearance from building material.

5.15 The requirement of 5.14 does not apply to unconcealed portions of a furnace extending beyond the wall or partition into a readily accessible space such as an alcove, closet, or room. The clearance from such portions of the furnace to combustible construction may be as specified in integral inches by the manufacturer in the instructions for installation and as marked on the unit. See 51.1.

5.16 If the chimney connector is located within the wall or partition structure when the furnace is installed as intended, the furnace shall be designed for direct connection to a chimney or venting system when the furnace is placed directly adjacent to or beneath the chimney or venting system. Any special connection or extension required shall be provided as part of the furnace.

5.17 Any external door providing access into the combustion chamber of a wall furnace shall be self-closing.

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

5.19 A wall furnace equipped with an anti-flooding device shall be such that, when the furnace is level, the minimum distance between the intended maximum normal oil level maintained by the oil control device and the level of the lowest point at which overflow may occur is not less than 3/4 inch (19.1 mm).

6 Servicing

6.1 General

6.1.1 A wall furnace shall be built to allow cleaning of parts such as interior surfaces of vaporizing burners, heating surfaces in contact with combustion products, oil inlet pipes, and oil strainers, without major dismantling of the wall furnace or removal of parts required by 5.2 to be factory assembled.

6.1.2 The removal of access panels, burners, blowers, caps, plugs, and the like intended to permit ready removal and replacement for servicing, are not considered major dismantling as defined by 6.1.1.

6.1.3 Sufficient and reasonable accessibility shall be afforded for cleaning, inspection, repair, and replacement of all burners, controls, and safety devices when the wall furnace is installed as recommended by the manufacturer. The disposition of parts in the assembly removed for normal care shall be such that their restoration, following removal, will not necessitate their realignment to secure their proper relationship with other parts of the assembly. Special facilities required for normal care to be done by the operator shall accompany the wall furnace to the user.

6.1.4 The requirements of 33.1 are not applicable to mechanical service functions that are not intended to be performed while the equipment is energized.

6.2 Moving parts

6.2.1 Moving parts such as fan blades, blower wheels, pulleys, belts, and the like, which may cause injury shall be enclosed or guarded.

6.2.2 If the removal of doors, panels, or shields will expose such moving parts:

- a) The opening or removal of the door, panel or shield shall require the use of tools; or
- b) An interlocking device shall shut off the mechanism; or
- c) A warning marking shall be displayed which reads essentially as follows:

DANGER — To Avoid Injury From Moving Parts, Shut Off The (Equipment) Before (Removing-Opening) This (Cover-Door).

6.2.3 The distance from an opening in a required guard or enclosure to the moving part mentioned in 6.2.2 shall be in accordance with Table 6.1, but the minor dimension of the opening shall not in any case exceed 3 inches (76.2 mm). For an opening having a minor dimension intermediate between two of the values included in the table, the distance from the opening to the moving part shall be not less than that found by appropriate interpolation between the corresponding values in the right-hand column of the table. The minor dimension of the opening is determined by the largest hemispherically tipped cylindrical probe that can be inserted through the opening with a force of 5 pounds (22.5 N).

Table 6.1
Dimensions of openings

Minor Dimensions of Opening, Inches ^a (mm)		Minimum Distance from Opening to Moving Part, Inches (mm)	
1/4	(6.4)	1/2	(12.7)
3/8	(9.5)	1-1/2	(38.1)
1/2	(12.7)	2-1/2	(63.5)
3/4	(19.1)	4-1/2	(114)
1	(25.4)	6-1/2	(165)
1-1/2	(38.1)	10-1/2	(267)
2	(50.8)	14-1/2	(369)
Over 2 Inches(over 50.8)		30	(762)
^a Openings less than 1/4 inch (6.4 mm) are not to be considered.			

6.2.4 A moving part is not to be considered when judging compliance with 33.1 and 6.2.2 if the part is unlikely to be contacted through the opening because of fixed components, including baffles.

7 Disposal of Combustion Products

7.1 The construction of a wall furnace shall not allow the products of combustion to become mixed with the circulating air.

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 steel having a minimum thickness of 0.020 inch (0.51 mm) (No. 24 MSG), if uncoated, or 0.023 inch (0.58 mm) (No. 24 GSG), if galvanized, or of nonferrous sheet metal having an average thickness of not less than 0.029 inch (0.74 mm), and all surfaces shall be protected against corrosion. The finish on the outer casing or jacket of the wall furnace shall not be damaged by heat during any of the tests.

8.2 The casing of a wall furnace shall allow the access of sufficient air for combustion and for a draft regulator enclosed within the casing.

8.3 A wall furnace shall have all cold air inlet and warm air outlet openings blanked out at the factory where fabricated. These openings shall be fitted with grilles or registers attached to the casing or installed at the ends of stub ducts which shall be not more than 10 inches (254 mm) in length; except as provided in 8.4. Where such ducts are provided, they are to be supplied by the manufacturer as an integral part of the appliance and tested as such in accordance with these requirements.

8.4 When a wall furnace with multiple warm air outlet openings is intended for installation and use with fewer as well as with all such openings, all except the minimum number of warm air outlets found acceptable by test shall have suitable covers supplied at the factory to close openings in liners and casings which may not be used at the installation.

8.5 Access panels which may be removed for normal service and accessibility shall permit ready removal and replacement without causing damage or impairing any required insulating value.

8.6 A removable panel through which air is drawn for combustion shall be such as to prevent it from being attached in a manner that may cause unsafe performance of the heater.

8.7 A removable panel shall be so constructed that it will not be interchangeable with other panels on the same wall furnace when interchange may allow unsafe operation of the heater.

9 Radiation Shields

9.1 A radiation shield or liner shall be so constructed, formed, and supported as to ensure proper positioning and to prevent distortion or sagging in service. See 10.4 and 10.5. A shield or liner shall be protected against corrosion if its deterioration may cause excessive temperatures when the wall furnace is tested in accordance with these requirements. Any finish to obtain the required resistance to corrosion shall not be damaged by heat when the furnace is tested under these requirements.

10 Materials in Air Handling Compartment

10.1 Materials in a compartment handling air for circulation shall not have a flame spread rating over 25 nor a smoke developed rating over 50 when tested in accordance with the Standard for Test for Surface Burning Characteristics of Building Materials, UL 723. This requirement does not apply to the following:

- a) Air filters, drive belts, wire insulation, and paint as applied for corrosion protection.
- b) Gaskets forming air or water seals between metal parts.
- c) Miscellaneous small parts such as resilient or vibration mounts, wire ties, clamps, labels, and the like.
- d) An adhesive that, when tested in combination with the specific insulating material, complies with the requirement.
- e) Molded or formed components made of polymeric materials, not liners, in such quantity that the total surface area of such materials in the compartment does not exceed 10 square feet (0.92 m²). See 10.7.

10.2 The supporting surface to be used in the test for adhesives as described in the Standard for Test for Surface Burning Characteristics of Building Materials, UL 723, is to be of asbestos-cement board or metal. Other materials requiring support may be supported using metal rods or bars or 2 inch (50.8 mm) hexagonal mesh wire with metal bars or rods.

10.3 Exposed unimpregnated asbestos material shall not be used in the air handling compartment. The unprotected edge of a gasket sandwiched between two parts is considered to be exposed.

10.4 Thermal or acoustic insulating material shall be securely positioned if loosening may reduce or block air flow to cause temperatures in excess of those acceptable during testing as specified in Sections 43 – 47 and 49, or if loosening will result in reduction of electrical spacings below the required values, short-circuiting, or grounding. Leading edges of insulation shall be protected against damage from the effects of the velocity of the moving air, such as by butting edges of insulation against bulkheads.

10.5 A mechanical fastener for each square foot (0.09 m²) of exposed surface is considered to securely position insulating liners. Mechanical fasteners may be bolts, metal clamps, wire rods, or the equivalent. Rigid or semirigid sheets of insulating material may not require fastening to the extent needed for less rigid material or protection of leading edges if the material possesses inherent resistance to damage.

10.6 An adhesive required for securing insulation shall retain its adhesive qualities at any temperature attained by the adhesive when the unit is tested under the performance requirements of this standard and at minus 17.8°C (0°F) or minus 29°C (minus 20°F) for outdoor use equipment.

10.7 Polymeric materials exempted by 10.1(e) shall not have a flame spread rating exceeding 25, or shall comply with the requirements specified in Section 52, Flammability Test.

11 Air Filter

11.1 A filter, if supplied as a part of the wall furnace, shall be accessible for inspection or replacement without the use of special tools and without dismantling the wall furnace.

12 Combustion Chamber

12.1 A combustion chamber and flueway within the air handling compartment shall be constructed of cast iron, sheet steel, or other equivalent material. Sheet steel, if used, shall have the strength, rigidity, durability, resistance to corrosion, and other physical properties equivalent to sheet steel having a minimum thickness of 0.032 inch (0.81 mm).

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

13 Radiator

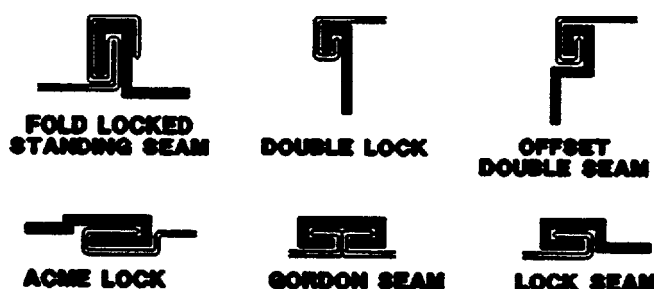
13.1 A radiator shall be made of material not lighter than that specified in 12.1 for a combustion chamber and shall be capable of being cleaned as intended.

14 Heating Surface Joints

14.1 Joints in heating surfaces shall be tight, to the degree afforded by being welded, lock-seamed, machined and bolted, riveted, and the like. A joint shall be equivalent to that afforded by lock-seaming and shall not depend primarily on cement for tightness. A slip or lap joint shall not depend solely upon friction of the joint itself for strength.

14.2 Examples of some acceptable lock-seams are illustrated by Figure 14.1.

Figure 14.1
Types of acceptable lock-seams



ED100

15 Baffles

15.1 A baffle in a flue gas passage or otherwise exposed to combustion products shall be fixed in position. A flue baffle shall be made of material having resistance to corrosion equivalent to AISI 1010 hot-rolled sheet steel having a minimum thickness of 0.032 inch (0.81 mm) unless its deterioration will not cause temperatures in excess of those specified when the wall furnace is tested as specified in the Temperature Tests, Section 43; and Continuous Operation Temperatures, Section 44.

15.2 A flue baffle shall be accessible for cleaning. A flue baffle that is removable for cleaning shall be such as to facilitate its removal and permit replacement only in its intended position.

16 Flue Collar

16.1 A flue collar shall be designed and arranged to permit the secure attachment of the chimney connector.

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

17 Damper and Draft Regulator

17.1 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.

17.2 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.

17.3 A furnace to be equipped with a barometric draft regulator shall not require that the regulator 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.

17.4 A draft regulator for a wall furnace to be installed within a concealed space shall be within the confines of the wall furnace casing and shall be accessible.

CONSTRUCTION — ELECTRICAL

18 Controls

18.1 Application

18.1.1 A safety control or protective device shall interrupt the ungrounded conductors.

18.1.2 The requirement in 18.1.1 does not apply to a circuit within a safety control or to the extension of a circuit to a separate element of the control such as a flame sensing device.

18.1.3 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.

18.1.4 All safety controls shall be accessible.

18.1.5 A safety control shall be supported so that it and its sensing element will remain in their intended position. It shall be possible to determine by observation or test whether or not each control is in its intended location.

18.1.6 Nothing shall be provided for the purpose of permitting any safety control to be rendered ineffective or to allow firing of the wall furnace without the protection of each of the required safety controls.

18.1.7 A burner not equipped to provide for automatic restarting shall be arranged 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.

18.2 Limit control

18.2.1 A furnace shall be provided with a limit control to prevent temperatures in excess of those specified in Sections 45 – 47, and 49.

18.2.2 The maximum setting of a limit control allowed by a fixed stop shall permit an outlet air temperature of not more than 250°F (121°C).

18.2.3 A limit control that functions to interrupt the delivery of fuel for combustion by opening an electrical circuit shall be so arranged as to effect the direct opening of that circuit, whether the switching mechanism is integral with or remote from the sensing element.

18.2.4 The purpose of the requirement specified in 18.2.3 is to avoid interposing in the limit control circuit other controls, the malfunction of which may result in a condition that the limit control is intended to prevent. However, a limit control may interrupt the pilot circuit of a magnetic-type motor controller that, in turn, directly opens the safety circuit when it is necessary to interrupt a single-phase circuit carrying a load greater than the capacity of available limit controls, or to interrupt a multiphase circuit.

18.2.5 A furnace equipped with a vaporizing burner shall be constructed to avoid pooling of the burner upon functioning of the limit control.

18.3 Primary safety control

18.3.1 A wall furnace shall be equipped with a primary safety control.

18.3.2 A constant level device shall maintain the oil level to within $\pm 1/32$ inch (0.8 mm) of the intended oil level during operation of the furnace.

19 Field Wiring

19.1 General

19.1.1 Provision shall be made for connection of a power supply wiring system conforming with the National Electrical Code, ANSI/NFPA 70-1993.

19.1.2 The location of an outlet box or compartment in which field wiring connections are to be made shall be such that these connections may be inspected after the equipment is installed as intended.

19.1.3 The connections are to be accessible without removing parts other than a service cover or panel and the cover of the outlet box or compartment in which the connections are made. A component intended for such use may serve as a cover.

19.1.4 The size of a junction box in which field installed conductors are to be connected by splicing shall be not less than that specified in Table 19.1. A conductor passing through the box is counted as one conductor, and each conductor terminating in the box is also counted as one conductor. A field-furnished conductor for high-voltage circuits is considered to be not smaller than No. 14 AWG (2.1 mm²).

Table 19.1
Size of junction boxes

Size of conductors AWG (mm ²)	Free space within box for each conductor, cubic inches (cm ³)
16 or smaller (1.3 or less)	1.5 (24.6)
14 (2.1)	2.0 (32.8)
12 (3.3)	2.25 (36.9)
10 (5.3)	2.5 (41.0)
8 (8.3)	3.0 (49.2)

19.1.5 A knockout for connection of a field wiring system to a terminal box or compartment shall accommodate conduit of the trade size determined by applying Table 19.2.

Table 19.2
Trade size of conduit in inches^{a,b}

Wire size AWG (mm ²)	Number of wires				
	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

^a This Table is based on the assumption that all conductors will be of the same size and there will be no more than six conductors in the conduit. If more than six 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.

^b Conversion factors: 1/4 inch = 6.4 mm, 1 inch = 25.4 mm.

19.2 Leads and terminals

19.2.1 Wiring terminals, or leads that are not less than 6 inches (152 mm) long, shall be provided for connection of field wiring conductors of at least the size required by the National Electrical Code, ANSI/NFPA 70-1993, and corresponding to the marked rating of the assembly.

19.2.2 Leads may be less than 6 inches (152 mm) in length if it is evident that the use of a longer lead can cause a risk of fire or electric shock.

19.2.3 Leads intended for connection to an external circuit shall be provided with strain relief if stress on the lead may be transmitted to terminals, splices, or internal wiring which may cause the lead to separate from its termination or result in damage to the lead from sharp edges. Each lead shall withstand a pull of 10 pounds (44.5 N) for 1 minute without damage to the assembly.

19.2.4 An identified (grounded) terminal or lead shall not be electrically connected to a single-pole manual switching device which has an OFF position or to a single-pole overcurrent (not thermal) protective device.

19.2.5 At terminals, stranded conductors shall be prevented from contacting other uninsulated live parts and from contacting dead metal parts. This may be accomplished by use of pressure-terminal connectors, soldering lugs, crimped eyelets, soldering all strands of the wire together, or equivalent means. Open slot-type connector shall not be used unless they are intended to prevent disconnection resulting from loosening of the clamping means. The shanks of terminal connectors shall be protected by insulating tubing or the equivalent; if the required spacings may be reduced as a result of loosening of the clamping means, the thickness of the insulation on the shanks shall be not less than 0.028 inch (0.71 mm).

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

19.2.7 Terminal parts by which field wiring connections are made shall consist of soldering lugs or pressure terminal connectors, secured in place in accordance with 19.2.12, except that for No. 10 AWG (5.3 mm²) and smaller wires, the parts to which wiring connections are made may consist of clamps or wire binding screws with cupped washers, terminal plates having upturned lugs, or the equivalent, to hold the wire in position.

19.2.8 A wire binding screw at a high-voltage wiring terminal for field connection shall be not smaller than No. 10 (4.8 mm diameter) except that a No. 8 (4.2 mm diameter) screw may be used for the connection of a conductor not larger than No. 14 AWG (2.1 mm²) and a No. 6 (3.5 mm diameter) screw may be used for the connection of No. 16 or No. 18 AWG (1.3 or 0.82 mm²) control circuit conductors.

19.2.9 A terminal plate for a wire binding screw shall be of metal not less than 0.030 inch (0.76 mm) in thickness for a No. 14 AWG (2.1 mm²) or smaller wire, and not less than 0.050 inch (1.27 mm) in thickness for a wire larger than No. 14 AWG; and in either case there shall be not less than two full threads in the metal.

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

19.2.11 A wire binding screw shall thread into metal.

19.2.12 Field wiring terminals shall be secured to their supporting surfaces by methods other than friction between surfaces so that they will be prevented from turning or shifting in position if such motion may result in reduction of spacings to less than those required. This may be accomplished by two screws or rivets; by square shoulders or mortices; by a dowel pin, lug, or offset; by a connecting strap or clip fitted into an adjacent part; or by some other equivalent method.

19.2.13 Conductors intended for connection to a grounded neutral line shall be identified, that is, finished a white or natural gray color. All other current carrying conductors shall be finished in colors other than white, natural gray, or green. A terminal for connection of a grounded conductor shall be identified by a metallic-plated coating, substantially white in color and shall be readily distinguishable from other terminals, or it shall be identified in some other manner, such as on an attached wiring diagram.

19.2.14 A box or enclosure included as part of the assembly and in which a branch circuit supplying power to the furnace is to be connected shall not require that it be moved for normal care of the unit. This requirement does not apply to separate limit controls and stack switches, where permitted, to which metal-clad cable or flexible metallic conduit is to be directly attached.

19.2.15 A box or enclosure in which field installed conductors are to be connected as indicated in 19.2.14 and 19.2.16 shall be so located 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 a wire rated 60°C (140°F) when the furnace is tested in accordance with these requirements.

19.2.16 Except as otherwise permitted by 20.1.4, wiring to be done in the field between the furnace and devices not attached to the furnace, or between separate devices which are field installed and located, shall comply with these requirements if done with a 60°C (140°F) rated wire enclosed in conduit or with metal-clad cable.

20 Internal Wiring

20.1 General

20.1.1 The wiring of high-voltage and safety-control circuits shall conform to the requirements specified in 20.1.2 – 20.3.2.

20.1.2 Wiring shall be done with insulated conductors having current carrying capacity, voltage, and temperature ratings consistent with their use. A conductor, other than an integral part of a component, shall be not smaller than No. 18 AWG (0.82 mm²).

20.1.3 The wiring for all furnace circuits shall be furnished by the manufacturer as part of the furnace. If the furnace is not assembled and wired at the factory, such wiring shall be furnished as harness with each furnace and be arranged to facilitate attachment when the furnace is assembled; in which case a pictorial diagram showing the exact arrangement of the wiring shall be included with each furnace.

20.1.4 If insulated conductors rated for use at temperatures in excess of 60°C (140°F) are required, such wiring shall be furnished by the manufacturer as part of the assembly. The devices to be connected by such wiring shall be factory located on the equipment.

20.2 Methods

20.2.1 Electrical wiring to a part which 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 part shall terminate in eyelets or connectors. If the wiring to a part which functions also as an access plate or cover, that is, 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 twist, bend, or pull the wiring to the extent that could cause damage to wire insulation or reduce spacings below those specified.

20.2.2 Conductors shall be enclosed within conduit, electrical metallic tubing, metal raceway, electrical enclosure, or metal-clad cable, except as permitted by 20.2.15 and 20.2.16.

20.2.3 Group A of Table 20.1 includes some wiring materials recognized for use if enclosed as indicated in 20.6.

20.2.4 Flexible metal conduit, if used, shall be not smaller than 3/8 inch (9.5 mm) electrical trade size. This does not apply to parts of components, such as conduit protecting flame sensor leads, considered under other standards.

20.2.5 If flexible metal conduit is used it shall be mechanically secured at intervals not exceeding 4-1/2 feet (1.37 m) and within 12 inches (0.03 m) on each side of every junction box except for lengths not over 36 inches (914 mm) where flexibility is necessary.

20.2.6 All splices and connections shall be mechanically secure and bonded electrically. A soldered connection shall be made mechanically secure before being soldered if breaking or loosening of the connection may result in any hazardous condition.

Table 20.1
Typical wiring materials

Group	Type of wire, cord, cable, or appliance wiring material with insulation thicknesses shown at the right corresponding to wire sizes indicated	Wire size		Insulation thickness	
		No. AWG	mm ²	Inch	mm
A	FF-2, FFH-2, TF, TFF, TFN, TFFN, SF-2, SFF-2, RH, RHH, RHW, RUH, RUW, THW, XHHW, MTW, THWN, TW or thermoplastic appliance wiring material.	10 and smaller	5.3	2/64	0.8
			8.3	3/64	1.2
		8	13.3	4/64	1.6
		6	21.2	4/64	1.6
		4	25.7	4/64	1.6
		3	33.6	4/64	1.6
		2	42.4	5/64	2.0
		1	53.5	5/64	2.0
		1/0	67.4	5/64	2.0
		2/0	85.0	5/64	2.0
		3/0	107.0	5/64	2.0
		4/0			
B	SO, ST, SJO, SJT, or appliance wiring material with thermoplastic or neoprene insulation	18	0.82	4/64	1.6
		16	1.3	4/64	1.6
		14	2.1	5/64	2.0
		12	3.3	5/64	2.0
		10	5.3	5/64	2.0
		8	8.3	6/64	2.4
		6	13.3	8/64	3.2
Thermoplastic wiring materials, as referenced in Group A, with insulation thickness of 2/64 inch (0.8 mm) for No. 16 or 18 AWG (1.3 or 0.82 mm ²) and 3/64 inch (1.2 mm) for No. 14, 12, 10, or 8 AWG (2.1, 3.3, 5.3, or 8.3 mm ²), are considered equivalent to the wiring material referenced in Group B, when the conductors are covered with 1/32 inch (0.8 mm) wall thickness thermoplastic insulating tubing of a type recognized for the purpose from the standpoint of dielectric properties, heat resistance, moisture resistance, and flammability.					

20.2.7 A splice shall be provided with insulation equivalent to that required for the wires involved if permanence of spacing between the splice and other metal parts is not ensured.