

UL 1889

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Commercial Filters for Cooking Oil



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

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AUGUST 30, 1996

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UL 1889

Standard for

Commercial Filters for Cooking Oil

Prior to the first edition, the requirements for the products covered by this standard were included in the Standard for Commercial Electric Cooking Appliances, UL 197, the Standard for Motor-Operated Appliances, UL 73, and the Standard for Motor Operated Water Pumps, UL 778.

First Edition

August 30, 1996

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

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

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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 cover commercial filters for cooking oil rated 600 volts or less and intended for use in accordance with the National Electrical Code, NFPA 70. These requirements cover both portable filters and fixed filters intended to be used with a specific fryer or fryers or with any fryer or fryers.

1.2 These requirements cover oil filters used to filter cooking oil used in deep fat fryers usually found in commercial kitchens, restaurants, or other business establishments where food is dispensed. The filters consist of a pump motor to pump oil to and/or from a deep fat fryer and are capable of including an integral oil heater. The requirements are also applicable to filters built into a fryer.

1.3 When a filter is provided as part of a larger appliance, these requirements cover the filter and related components. The other portions of the appliance are to be evaluated in accordance with the requirements that normally apply to that type of equipment. However, consideration shall be given to the interaction between the two portions of the appliance; for example, to the possibility that the entire appliance is capable of being exposed to hot cooking oil.

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

2 General

2.1 Components

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

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

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

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

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

2.2 Units of measurement

2.2.1 When a value for measurement is followed by a value in other units in parentheses, the first stated value is the requirement.

2.3 Undated references

2.3.1 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.

3 Glossary

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

3.2 SAFETY CIRCUIT – A primary or secondary circuit that is relied upon to prevent a risk of fire, electric shock, or injury to persons; for example, an interlock circuit.

3.3 USER SERVICING – Any servicing that is capable of being performed by personnel other than those who are trained to maintain the particular appliance. Some examples of user servicing are:

- a) Attaching an accessory by means of an attachment plug and receptacle or by means of other separable connectors.
- b) Resetting or replacing any protective device in an appliance, or its receptacle circuit, that are capable of being overloaded by the user.
- c) Resetting a circuit breaker or replacing a fuse.
- d) Making a routine operating adjustment required to adapt the appliance for a different intended function.
- e) Routine cleaning.

CONSTRUCTION

4 Accessories

4.1 An appliance having provisions for the use of an electrical accessory intended to be attached in the field shall comply with the requirements in this standard, with or without an accessory installed.

4.2 Electrical connection of an accessory by the user shall be by means of a receptacle and plug-in connector. See 14.2.

4.3 The installation of an accessory by service personnel shall be by means of receptacles, plug-in connectors, insulated wire connectors, or by connection to existing wiring terminals. Receptacles, when used, shall be located and protected in accordance with 14.2.

4.4 With regard to 4.3, an installation shall not require the cutting of wiring or the soldering of connections by the installer. Installations shall not require cutting, drilling, or welding in electrical enclosures and in other areas where such operations are capable of damaging electrical components and wiring within the enclosure.

4.5 A means for strain relief shall be provided for the wiring in the accessory when there is a possibility of transmitting stress to the terminal connections during installation.

4.6 All terminals and wiring intended to be field connected shall be identified on the accessory, on the appliance when connections are made between the accessory and the appliance, and on a wiring diagram provided with the accessory unless they are obvious.

4.7 The mounting location of the accessory shall be indicated on the appliance.

Exception: When the mounting location is obvious due to the function of the accessory and arrangement of the appliance, and instructions are provided covering the installation and location for the accessory, the mounting location of the accessory is not required to be indicated on the appliance.

4.8 As part of the investigation, an accessory is to be trial-installed to determine whether:

- a) The installation is feasible;
- b) The instructions are detailed and correct; and
- c) The use of the accessory does not introduce a risk of fire, electric shock, or injury to persons.

5 Frames and Enclosures

5.1 General

5.1.1 An appliance shall be formed and assembled so that it has the strength and rigidity required to resist the abuses to which it is subjected, without increasing the risk of fire, electric shock, or injury to persons due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts, or other serious defects.

5.1.2 The enclosure of an appliance shall be of a material capable of being used for the application and shall house all electrical parts, except a supply cord, that are capable of presenting a risk of fire, electric shock, or injury to persons under any condition of use. An adjacent wall or adjacent equipment shall not be depended upon to complete an enclosure.

5.1.3 Among the factors included in the evaluation of an enclosure are:

- a) Mechanical strength,
- b) Resistance to impact,
- c) Moisture-absorptive properties,
- d) Resistance to combustion,
- e) Resistance to corrosion, and
- f) Resistance to distortion at temperatures to which the enclosure is capable of being subjected under conditions of normal or abnormal use.

For a nonmetallic enclosure, all of these factors are to be evaluated with regard to thermal aging.

5.1.4 An enclosure of polymeric material shall comply with the applicable requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. A polymeric enclosure part that is capable of coming in contact with hot oil – that is, a part that is not shielded to prevent contact with hot oil – shall be evaluated to determine the long-term affects of such contact.

5.1.4 effective March 1, 1998

5.1.5 The minimum thickness of cast metal shall be in accordance with Table 5.1.

Exception: Thinner metal complies with the intent of this requirement when the metal is evaluated in accordance with the Enclosure Strength Test, Section 52, and the Impact Test, Section 53, with acceptable results.

Table 5.1
Minimum thicknesses of cast metal

Metal	Minimum thickness, inch (mm)			
	At reinforced surfaces ^a		At unreinforced flat surfaces	
Die-cast metal	3/64	1.2	5/64	2.0
Cast malleable iron	1/16	1.6	3/32	2.4
Other cast metal	3/32	2.4	1/8	3.2

^a Includes surfaces that are curved, ribbed, and similar designs, or that are otherwise of a shape or size to provide intended mechanical strength.

5.1.6 In addition to being evaluated with regard to the factors specified in 5.1.3, an enclosure of sheet metal is to be evaluated with regard to its size and shape, the thickness of metal, and its acceptability for the particular application. Sheet steel having a thickness less than 0.026 inch (0.66 mm) when uncoated or 0.029 inch (0.74 mm) when galvanized, or of nonferrous sheet metal having a thickness of less than 0.036 inch (0.91 mm) shall not be used except for a small area or for a surface that is curved or otherwise reinforced.

5.1.7 Sheet metal to which a wiring system is to be connected in the field shall have a thickness of no less than 0.032 inch (0.81 mm) when of uncoated steel, no less than 0.034 inch (0.86 mm) when of galvanized steel, and no less than 0.045 inch (1.14 mm) when of nonferrous metal.

Exception: Sheet steel no less than 0.026 inch (0.66 mm) thick when uncoated steel or no less than 0.029 inch (0.74 mm) thick when galvanized steel meets the intent of the requirement when the area surrounding a knockout has a thickness of no less than 0.053 inch (1.35 mm).

5.2 Openings

5.2.1 An opening in the bottom of an appliance shall not be located below an electrical part unless a solid, noncombustible pan complying with Figure 5.1 is interposed between the electrical part and supporting surface. The pan is to have a rim, lip, or other raised edge that is in a horizontal plane and extends all the way around the pan. The bottom of the pan is not required to be flat or any regular

shape and the transition from the bottom to the rim, lip, and similar raised edges are allowed to have any convenient shape, but at every point directly below the electrical part, the floor of the pan is to be 1/8 inch (3.2 mm) or more below the plane of the rim, lip, and similar raised edges.

Exception: The use of a pan constructed from noncombustible material under a motor is not required when:

- a) The motor has no openings below a horizontal plane through the center of the motor;*
- b) The structural parts of the motor or of the appliance provide the equivalent of the described barrier;*
- c) The protection provided with the motor is such that no burning insulation or molten material falls to the surface that supports the appliance when the motor is energized under each of the following fault conditions:*
 - 1) Open main winding,*
 - 2) Open starting winding,*
 - 3) Starting switch short-circuited, and*
 - 4) For a permanent-split capacitor motor, capacitor short-circuited. The short circuit is to be applied before the motor is energized and the rotor is to be locked;*
- d) The motor is provided with a thermal motor protector – a protective device that is sensitive to temperature and current – so that the temperature of the motor windings does not exceed 125°C (257°F) at the maximum load under which the motor is capable of running without causing the protector to cycle and does not exceed 150°C (302°F) with the rotor of the motor locked; or*
- e) The motor is impedance-protected and the locked-rotor temperature of the motor winding is no more than 150°C (302°F) with the appliance otherwise operating as intended.*

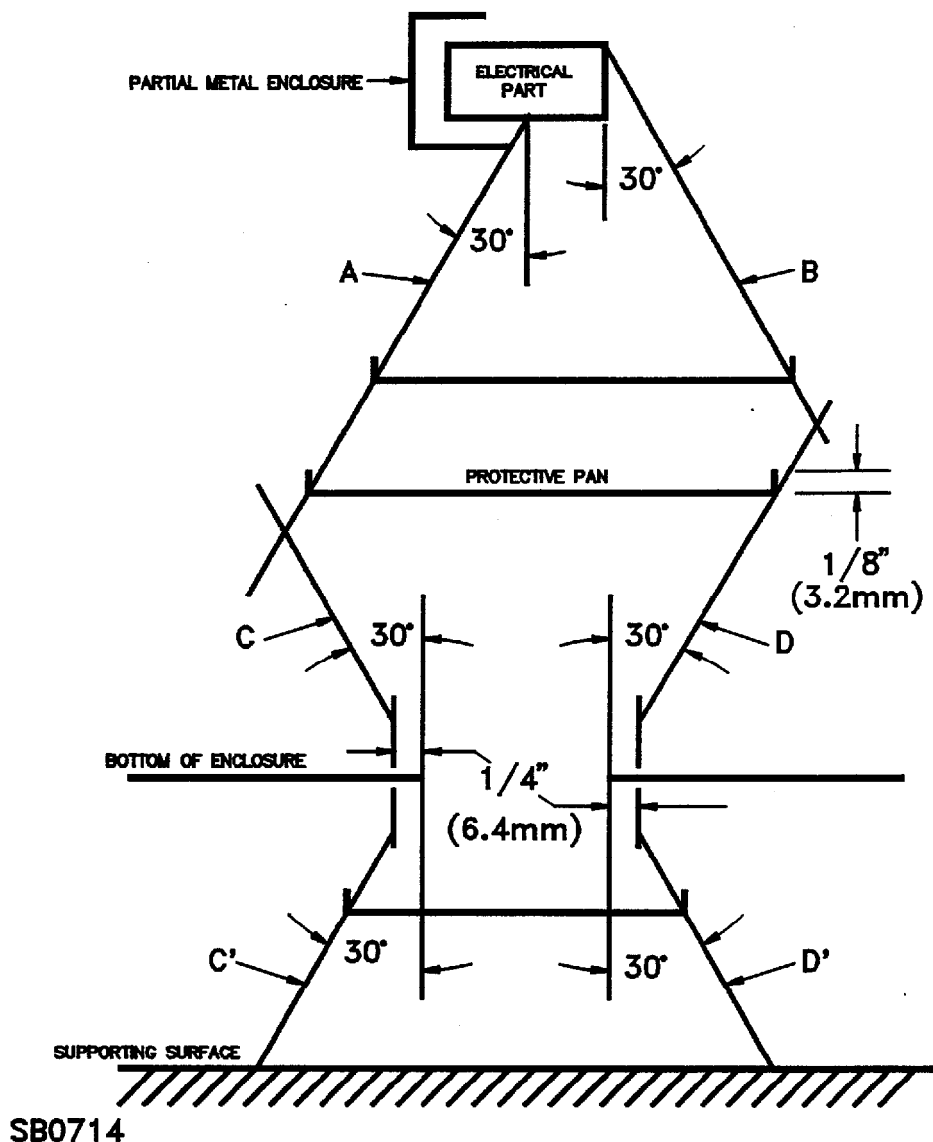
5.2.2 The structure of the part or appliance is not prohibited from providing the equivalent of the pan described in 5.2.1 when it complies with Figure 5.1. The raised edge is capable of being incorporated in the opening.

5.2.3 An appliance shall be constructed so that, with the appliance in any normal position of operation, cooking oil and cleaning solution do not contact electrical parts, including internal wiring, during operation, user servicing, or cleaning under any of the following conditions:

- a) In the as-received condition;*
- b) With any fitting that is intended to be loosened during user servicing or cleaning loosened or damaged; and*
- c) After deterioration or breakdown of a timer switch, a float- or pressure-operated switch, a hose, flexible tubing, a gasket, a boot, a seal, a diaphragm, or similar parts.*

5.2.3 effective March 1, 1998

Figure 5.1
Minimum extent of baffle for opening in bottom of enclosure



A, B, C, and D are projections that define a volume between an electrical part and an opening; C' and D' are projections that define a volume between an opening and the supporting surface. A protective pan in any horizontal plane between the part and the opening in the supporting surface shall be larger than the area defined by projections A, B, C, and D, or projections C' and D', respectively. Three samples of protective pans are illustrated in the figure; two are above the opening and one is below it.

5.2.4 An appliance is determined to comply with 5.2.3(c) when no oil leaks when the appliance is operated with the part in question removed, as described in Deterioration of Parts, Section 47. When oil leaks during the test, the appliance shall be examined to determine whether oil has contacted, or is capable of contacting, electrical parts. Consideration shall be given to any possible spraying or dripping that occurs upon partial deterioration of the part. In addition, when any of the components or connections described in 5.2.3 (b) and (c) are located within the enclosure, a guard shall be provided to prevent oil from contacting electrical components in case of failure or poor operation of such components.

Exception: Parts as described in 5.2.3(c) that are not subject to flexing and that have been evaluated for exposure to hot oil in accordance with Parts Subject to Contact With Oil or Other Liquids, Section 57, are not required to be further evaluated.

5.2.4 effective March 1, 1998

5.2.5 A pump motor with supports of polymeric material shall be tested in accordance with Polymeric Motor Supports, Section 58.

5.2.5 effective March 1, 1998

5.2.6 An opening in a surface other than the bottom of an enclosure that contains electrical parts shall be provided with a baffle, such as the one illustrated in Figure 5.2, that prevents the emission of flame, molten metal, burning insulation, or similar occurrences.

Exception: A baffle is allowed to be omitted from an enclosure that contains electrical parts other than an overcurrent-protective device such as a fuse or circuit breaker when:

- a) The structure of the part provides the equivalent of a baffle;*
- b) The distance from the electrical part to the plane of the enclosure is greater than 12 inches (305 mm);*
- c) For ventilating openings in a vertical wall, no opening is more than 3/8 inch (9.5 mm) wide, and the total area of such openings located less than 12 inches from the floor in any 1 ft² (0.3 m²) area of the enclosure does not exceed 8 square inches (52 cm²); or*
- d) All openings in a vertical wall are protected by louvers, as long as the louvers allow an opening no more than 1/4 inch (6.4 mm) wide and are shaped to deflect external falling objects outward. See Figure 5.3.*

5.2.6 effective March 1, 1998

Figure 5.2
Relationship of baffle and electrical part to prevent emission

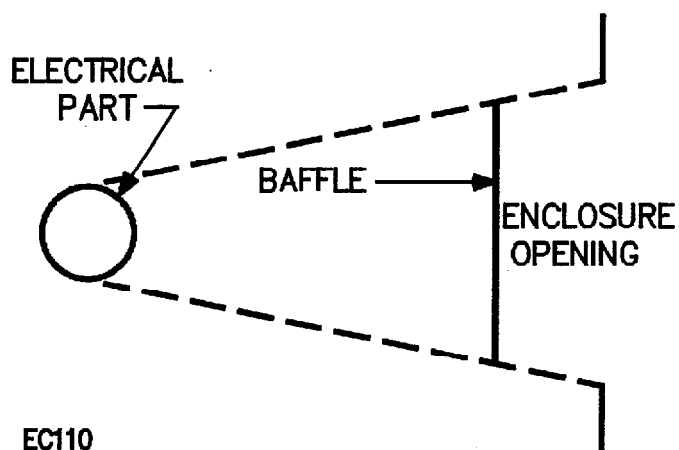
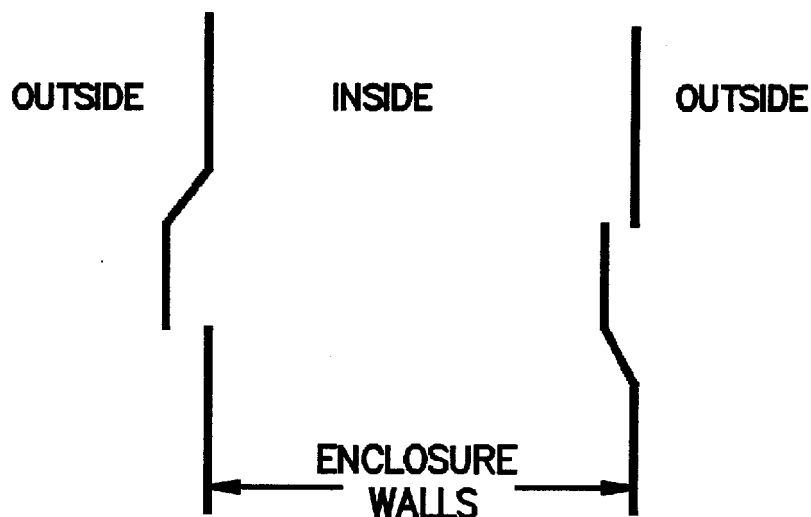


Figure 5.3
Louver constructions



6 Accessibility of Live Parts

6.1 General

6.1.1 The electrical parts of an appliance shall be located or enclosed so that persons are protected against unintentional contact with uninsulated live parts involving a risk of electric shock.

6.1.2 A risk of electric shock is determined to exist when the available open-circuit potential is more than 42.4 volts peak, and the available current through a 1500-ohm resistance is more than 5 milliamperes.

6.1.3 The following are not uninsulated live parts:

- a) A coil of a controller,
- b) A relay,
- c) A solenoid, and
- d) A transformer,

when they are provided with insulating overwraps at least 1/32 inch (0.8 mm) thick; enclosed motor windings; insulated terminals and splices; and insulated wire.

6.1.4 An uninsulated live part, such as a terminal bus bar, and similar parts, not including film-coated wire, shall be no less than 1 inch (25.4 mm) from any opening in the enclosure of an appliance.

6.1.5 An opening that will not permit the entrance of a 3/4-inch (19.1-mm) diameter rod is allowed, except as noted in 6.1.4, when a probe as illustrated in Figure 6.1 cannot be made to touch any uninsulated live part or film-coated wire when inserted into the opening.

6.1.6 An opening that permits entrance of 3/4-inch (19.1-mm) diameter rod is allowed when there are no uninsulated live parts:

- a) Less than X inches from the perimeter of the opening and
- b) Within the volume generated by projecting the perimeter X inches normal to its plane.

X equals five times the diameter of the largest diameter rod that is capable of being inserted through the opening, and no less than 4 inches (102 mm). See Figure 6.2.

6.1.7 An uninsulated live part shall not be located behind an opening that is used to make an adjustment determined to be a function of user servicing when a 1/8-inch (3.2-mm) diameter straight rod can be made to touch the part when the rod is inserted through the opening and moved to all positions possible without producing an angle of more than 30 degrees between the rod and the line drawn between the center of the opening and the center of the face of the adjusting mechanism. The length of the rod beyond the opening is not to exceed the distance between the opening and the face of the adjusting mechanism by more than 3 inches (76 mm). See Figure 6.3.

6.1.8 During the examination of an appliance in connection with the requirements in 6.1.5 – 6.1.7, a part of the outer enclosure that is capable of being removed without the use of tools, or that must be opened or removed for user servicing, is to be disregarded – that is, it is not assumed that the part in question affords protection against the risk of electric shock. A warning marking is not determined to reduce the risk of electric shock.

[illegible]

Figure 6.2
Opening in enclosure - proportions exaggerated for clarity

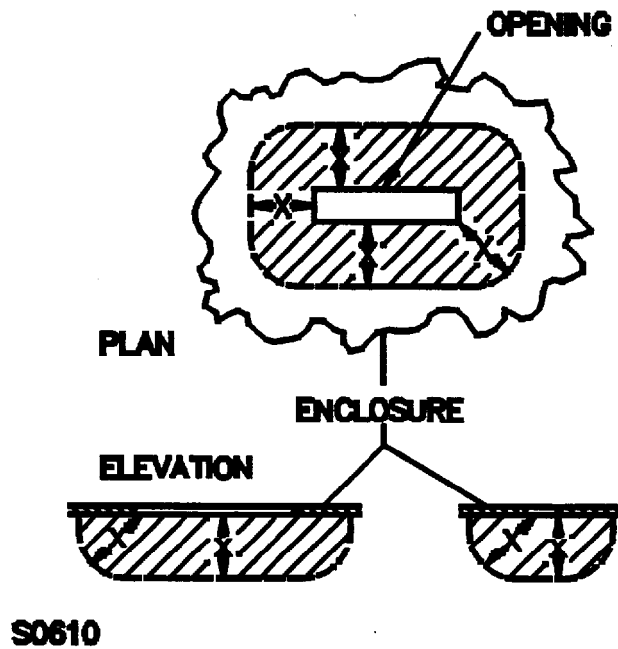
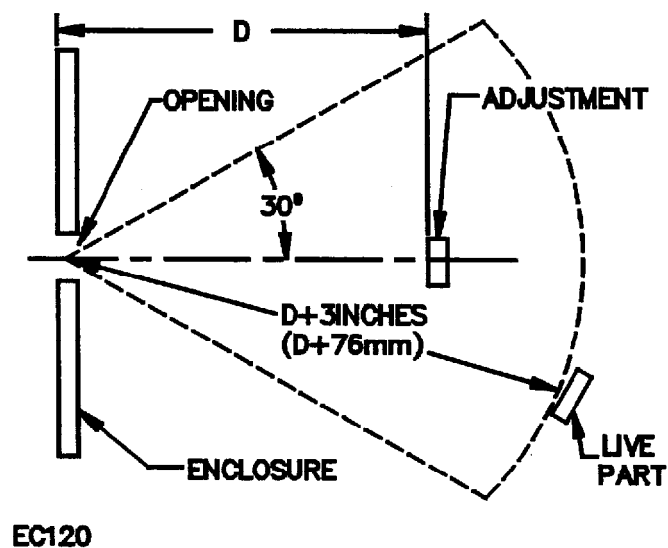


Figure 6.3
Accessibility of live part through adjustment opening



6.1.9 A fuseholder or a circuit breaker shall not be accessible from outside the appliance without opening a door or a cover.

Exception: The operating handle of a circuit breaker or the insulating cap of an extractor-type fuseholder is allowed to project outside the enclosure when a shield or guard is provided to reduce the risk of spillage of hot oil on the handle or cap.

6.1.9 effective March 1, 1998

6.1.10 Except as indicated in 6.1.11 and 6.1.12, the door or cover of an enclosure shall be hinged:

- a) When it gives access to any fuse, circuit-breaker handle, or manually resettable lever of a temperature control in other than a low-voltage circuit and
- b) When uninsulated live parts are exposed during the replacement of the fuse or resetting of the manually resettable device.

Such a door or cover shall also be provided with an automatic latch or the equivalent, and, when live parts other than the screw shell of a plug fuseholder are exposed inside the enclosure, shall be provided with a captive screw or equivalent means, requiring the use of a tool to open, and to reliably secure the door or cover in place. See 6.1.13 and 6.1.14.

6.1.11 A hinged cover is not required for a device in which the only fuses enclosed are:

- a) Control circuit fuses, as long as the fuses and control circuit loads (other than a fixed control circuit load, such as a pilot lamp) are within the same enclosure or
- b) An extractor type fuse with its own enclosure that is accessible without exposing live parts other than a fuse contact of the fuseholder.

6.1.12 The removable portion of a fused pullout switch that complies with the requirements in 6.1.1 – 6.1.7, 6.1.16, and 6.1.17 is determined to be a reliable cover for the fuseholder and is not required to comply with the requirements in 6.1.11.

6.1.13 A spring latch, a magnetic latch, a dimple, or other mechanical arrangement that holds the door closed and requires effort on the user's part to open is determined to provide the "automatic latching means" for holding the door closed as required in 6.1.11.

6.1.14 A cover interlocking mechanism that:

- a) Must be engaged in the closed position of the cover before any uninsulated live part is energized and
- b) Secures the cover in the closed position, when provided as the sole means for securing the door or cover closed,

is determined to comply with the requirement for an automatic latch in 6.1.10.

6.1.15 A screw with a knurled and slotted head (for securing with a screwdriver) and that is capable of being manually turned shall not be provided as a required enclosure securing means.

6.1.16 A door or cover giving direct access to fuses in other than a low-voltage circuit shall shut closely against a 1/4 inch (6.4 mm) rabbet or the equivalent, or shall have either turned flanges for the full length of four edges or angle strips fastened to it. Flanges and angle strips shall fit closely with the outside of the wall of the box proper and shall overlap the edges of the box no less than 1/2 inch (12.7 mm).

Exception: A construction that affords equivalent protection or a combination of flange and rabbet is permitted.

6.1.17 A strip used to provide a rabbet and an angle strip fastened to the edges of a door shall be secured:

- a) At no less than two points,
- b) No more than 1-1/2 inches (38 mm) from each end of each strip, and
- c) At points between these end fastenings no more than 6 inches (152 mm) apart.

6.2 Protection of service personnel

6.2.1 An uninsulated live part involving a risk of electric shock and a moving part within the enclosure that involves a risk of injury to persons shall be located, guarded, or enclosed in accordance with 6.1.1 – 6.1.7, 28.1 – 28.3, 29.1, and 29.2 when the service function is being performed, to reduce the risk of unintentional contact by service personnel performing electrical or mechanical service functions that have to be performed with the equipment energized.

6.2.2 Mechanical service functions that are capable of being performed with the equipment energized include:

- a) Adjusting a valve,
- b) Adjusting the setting of a temperature or a pressure control with or without marked dial settings,
- c) Resetting a control trip mechanism, and
- d) Operating a manual switch.

A factory-set-and-sealed control is not determined to be adjustable.

6.2.3 Electrical service functions that are capable of being performed with the equipment energized include examination, adjustment, servicing, or maintenance (not including measuring voltage) of fuses, adjustable or resettable pressure or temperature controllers, manual switching devices, and clock timers.

7 Adhesives Used to Secure Parts

7.1 An adhesive that is relied upon to reduce a risk of fire, electric shock, or injury to persons shall comply with the requirements for adhesives in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. When an adhesive is located where it is capable of coming in contact with cooking oil, it shall be evaluated to determine the long-term effects of such contact.

7.1 effective March 1, 1998

7.2 The requirement in 7.1 also applies to an adhesive used to secure a conductive part including a nameplate, that is capable of, when loosened or dislodged:

- a) Energizing an accessible dead metal part,
- b) Making a live part accessible,
- c) Reducing spacings below the minimum values specified in Table 26.1, or
- d) Short-circuiting live parts.

7.2 effective March 1, 1998

8 Protection Against Corrosion

8.1 Iron and steel parts shall be protected against corrosion by enameling, galvanizing, painting, plating, or other equivalent means when corrosion of such parts results in a risk of fire, electric shock, or injury to persons.

Exception No. 1: Surfaces of sheet steel and cast iron parts within an enclosure are not required to be so protected when the oxidation of iron or steel due to the exposure of the metal to air and moisture is not appreciable – thickness of metal and temperature also being factors.

Exception No. 2: Bearings, laminations, or minor parts of iron or steel, such as washers, screws, and similar parts are not required to be so protected.

Exception No. 3: A sheath of a heating element of other than an immersion-type heater is not required to be so protected.

9 Mechanical Assembly

9.1 General

9.1.1 An appliance shall be assembled so that it is not adversely affected by the vibration of normal operation.

9.1.2 A switch, a fuseholder, a lampholder, an attachment-plug receptacle, a motor-attachment plug, or other component that is handled by the user shall be mounted securely and shall be prevented from turning.

Exception: A switch that complies with (a) – (d) is not required to be prevented from turning:

- a) The switch is of a plunger, slide, or other type that does not tend to rotate when operated. A toggle switch is subjected to forces that tend to turn the switch during operation of the switch.*
- b) The method used to mount the switch is such that operation of the device does not loosen the switch.*
- c) Spacings are not reduced below the minimum values specified in Table 26.1 when the switch rotates.*
- d) Operation of the switch is by mechanical means rather than by direct contact by persons.*

9.1.3 The means to prevent turning required by 9.1.2 shall consist of more than friction between surfaces – for example, a lock washer, properly applied, is allowed to be used as the means to prevent turning of a device having a single-hole mounting means.

9.1.4 Uninsulated live parts shall be secured to the base or surface so that they are prevented from turning or shifting in position when such motion is capable of resulting in a reduction of spacing below the minimum values specified in Spacings, Section 26.

9.2 Shipping

9.2.1 An appliance shall be completely assembled when it leaves the factory.

Exception No. 1: Components that are capable of being assembled without the use of tools, and parts that are not required to prevent a risk of fire, electric shock, or injury to persons during operation of the appliance are not required to be assembled.

Exception No. 2: A heating element with integral blades for plugging into a receptacle, and the legs or the mounting brackets of an appliance is allowed to be shipped detached from the remainder of the appliance when packed in the same overall carton, or when the separate cartons are secured together – such as by steel strapping or strong tape – so that they do not become separated during the shipment. See 69.2.

9.2.1 effective March 1, 1998

10 Supply Connections

10.1 Permanently-connected appliances

10.1.1 An appliance intended for permanent connection to the power supply shall be constructed so that it is capable of being readily and permanently connected to one of the wiring systems covered in Article 3 of the National Electrical Code, ANSI/NFPA 70.

10.1.2 An appliance intended for permanent connection to the building structure shall be provided with means for permanent connection to the branch-circuit supply.

10.1.3 Filters that are permanently connected to an electrical source of supply shall not be provided with casters nor require movement of the supply connections during the filtering process or routine cleaning.

10.1.4 There shall be a flat surface surrounding a knockout. The flat surface shall have an area for assembly to the appliance of a length of standard rigid metallic conduit of a size corresponding to the size of the knockout, and shall have a minimum diameter in accordance with Table 10.1. For metal thickness at a knockout or opening, see 5.1.7.

Table 10.1
Dimensions associated with openings for conduit

Unthreaded openings					Threaded openings			
Trade size of conduit, inches	Nominal knockout diameter,		Minimum diameter of flat surface at knockout,		Throat diameter, inches (mm)			
	inches	(mm)	inches	(mm)	Minimum		Maximum	
1/2	7/8	22.2	1.140	28.96	0.560	14.22	0.622	15.80
3/4	1-3/32	27.8	1.420	36.07	0.742	18.85	0.824	20.93
1	1-23/64	34.5	1.770	44.96	0.944	23.98	1.049	26.64
1-1/4	1-23/32	43.7	2.281	57.94	1.242	31.55	1.380	35.05
1-1/2	1-31/32	50.0	2.598	65.99	1.449	36.80	1.610	40.89
2	2-15/32	62.7	3.175	80.65	1.860	47.24	2.067	52.50
2-1/2	3	76.2	3.562	90.47	2.222	56.44	2.469	62.71

10.1.5 The diameter of a knockout shall accommodate conduit of the trade size for which the knockout is intended. See Table 10.1.

10.1.6 A terminal compartment intended for permanent connection to the power supply shall be attached to the appliance so as to be prevented from turning with regard thereto.

10.1.7 A wiring compartment for field-wiring connections shall be of a volume that accommodates the wiring of the size indicated in 10.1.13, and conduit and fittings sized for the wire in accordance with the National Electrical Code, ANSI/NFPA 70.

10.1.8 A terminal compartment shall be located so that when conduit connections are made, internal wiring and electrical components shall not be exposed to mechanical abuse and strain. After the unit has been installed as intended, supply connections shall be accessible for inspection without exposing internal wiring and electrical components to mechanical abuse or strain.

10.1.9 Provision for inspection of connections on the rear or bottom of a floor-mounted appliance is not allowed. Access is to be determined when the appliance is installed in accordance with the manufacturer's instructions.

10.1.10 No electrical component shall be mounted on a part that must be removed for the examination or installation of field-wiring connections unless the internal wiring is provided with a method of quick disconnection.

10.1.11 A field-wiring terminal is a terminal to which a supply or other wire is capable of being connected by an installer in the field, unless the wire is provided as part of the appliance and a pressure terminal connector, soldering lug, soldered loop, crimped eyelet, or other means for making the connection is factory-assembled to the wire.

10.1.12 Ampacity of field wiring conductors is to be determined using the appropriate tables in the National Electrical Code, ANSI/NFPA 70. Wire smaller than the uncorrected values for 60°C (140°F) conductors (for appliances rated 100 amperes or less) or 75°C (167°F) conductors (for appliances rated more than 100 amperes) shall not be used. See 10.1.15 and 69.5.

10.1.13 A permanently-connected appliance shall be provided with wiring terminals or leads for the connection of conductors having an ampacity no less than 125 percent of the current input of the appliance when tested in accordance with 38.2 or 38.3, whichever causes the higher input. See 10.1.12.

Exception: An appliance is allowed to be provided with terminals or leads for the connection of conductors having an ampacity not less than the current input of the appliance when it complies with the Average Current Input Test, Section 39.

10.1.14 Pigtail leads provided for connection to the branch-circuit supply shall have an ampacity rating no less than that of a conductor of the next smaller size than that intended for the rating of the appliance. See 10.1.12 and 10.1.15.

10.1.15 It is to be assumed that wire having the specified temperature rating is intended to be installed for the power-supply conductors to an appliance marked in accordance with 69.3 and 69.4. Otherwise, it is to be assumed that 60°C (140°F) wire shall be used for connection to an appliance rated 100 amperes or less and that 75°C (167°F) wire shall be used for an appliance rated more than 100 amperes.

10.1.15 effective March 1, 1998

10.1.16 When terminals of unequal sizes are provided because of unbalanced loads, each terminal shall be sized to accept a conductor having an ampacity of at least 125 percent of the total current that will be carried by the conductor connected to that terminal as determined by 10.1.13. See 10.1.12 and 69.4.

Exception: An appliance is allowed to be provided with terminals or leads for the connection of conductors having an ampacity not less than the current input of the appliance when it complies with the Average Current Input Test, Section 39.

10.1.17 The free length of a lead intended to be field connected to the supply lead inside an outlet box or field-wiring compartment shall be 6 inches (152 mm) or greater.

Exception: Field-wiring supply connections enclosed in a motor terminal box or wiring compartment is allowed to have a free length of less than 6 inches.

10.1.18 A field-wiring terminal shall be prevented from turning or shifting in position by means other than friction between surfaces. This shall be accomplished by two screws or rivets, by square shoulders or mortises, by a dowel pin, lug or offset, by a connecting strap or a clip fitted into an adjacent part, or by some other method determined to be equivalent.

10.1.19 A field-wiring terminal shall be provided with a soldering lug or pressure wire connector firmly bolted or held by a screw.

Exception: A wire binding screw is allowed to be used at a wiring terminal intended to accommodate a No. 10 AWG (5.3 mm²) or smaller conductor when upturned lugs, cupped washers, or the equivalent are provided to hold the wire in position.

10.1.20 Each upturned lug or cupped washer referred to in the Exception to 10.1.19 shall be capable of retaining a power-supply conductor corresponding in size to that specified in 10.1.13, and no smaller than No. 14 AWG (2.1 mm²), under the head of the screw or the washer.

10.1.21 A wire-binding screw at a wiring terminal shall be no smaller than No. 10 (4.8 mm diameter), with no more than 32 threads per inch.

Exception No. 1: A No. 8 (4.2 mm diameter) screw is allowed to be used at a terminal intended only for the connection of a No. 14 AWG (2.1 mm²) conductor.

Exception No. 2: A No. 6 (3.5 mm diameter) screw is allowed to be used for the connection of a No. 16 or No. 18 AWG (1.3 or 0.82 mm²) control-circuit conductor.

10.1.22 It shall be noted that No. 14 AWG (2.1 mm²) is the smallest conductor that is allowed to be used for branch-circuit wiring and thus is the smallest conductor that is to be anticipated at a terminal for connection of a branch-circuit conductor.

10.1.23 A terminal plate tapped for a wire-binding screw shall be of metal no less than 0.030 inch (0.76 mm) thick.

10.1.24 There shall be no less than two full threads in the metal of the terminal plate tapped for a wire-binding screw. The metal is allowed to be extruded at the tapped hole to provide two full threads.

10.1.25 A permanently-connected appliance rated 125 or 125/250 volts (3-wire) or less, provided with a single-pole switch or a single-pole overcurrent-protective device other than an automatic control without a marked "off" position, shall have one terminal or lead identified for the connection of the grounded conductor of the supply circuit.

10.1.26 A field-wiring terminal intended for the connection of a grounded-supply conductor shall be identified by means of a metallic coating that is substantially white in color and shall be easily distinguishable from the other terminals, or proper identification of the terminal for the connection of the grounded conductor shall be clearly shown in some other manner, such as on an attached wiring diagram.

10.1.27 When wire leads are provided instead of terminals, the surface of the lead intended to be connected to the grounded conductor of the supply circuit shall be finished to show white or natural gray color and shall be easily distinguishable from the other leads.

10.2 Cord-connected appliances

10.2.1 A power-supply cord shall be Type SO, SOO, STO, STOO, SEO, SJO, SJOO, SJTO, SJTOO, SJEO, HSO, HSOO, HSJO, or HSJOO.

Exception: Type HPN cord is allowed to be used when:

- a) *The appliance is intended for counter-top use and*
- b) *The weight of the appliance is not more than 15 pounds (6.8 kg).*

10.2.1 effective March 1, 1998

10.2.2 Where the individual conductors of a power supply cord of a type other than SOO, STOO, SJOO, SJTOO, HSOO, or HSJOO are separated from the outer jacket within the appliance, they are to be treated as non-oil resistant internal wiring. See 15.2.1.

10.2.2 effective March 1, 1998

10.2.3 The maximum length of a power supply cord shall be as shown in Table 10.2. A separable cord set shall not be used.

Exception: A separable cord set that connects to the appliance using a non-standard plug and receptacle is allowed to be used when:

- a) *The unit is provided with casters and is intended to be moved during normal use;*

- b) The plug and receptacle are rated for disconnection under a load at least equal to the load carried by the cord during the input test described in 38.2 or 38.3, whichever is higher;
- c) No live parts are exposed to contact when the cord is disconnected from the appliance; and
- d) The connection point to the appliance is located, protected, or both to reduce the likelihood of spillage of hot oil on live parts of the receptacle and attachment plug.

10.2.3 effective March 1, 1998

Table 10.2
Length of attached cord

Appliance type	Maximum length of cord,	
	inches	(mm)
Under-fryer filters and central filters	18	457
All other filters	6	152

Table 10.2 effective March 1, 1998

10.2.4 A cord-connected appliance provided with casters shall also be provided with a cord spool, brackets, or equivalent means for storing the cord when not in use. A cover or enclosure shall protect the cord from contact with oil when the cord is stored.

Exception No. 1: When a separable cord set is used, an enclosed compartment without a spool or brackets is allowed to be provided for cord storage.

Exception No. 2: A cord provided with an under-fryer filter is not required to be provided with a cover or enclosure when equivalent protection is provided by the structure of the fryer; however, provision shall be made for storing the cord. When the cord is capable of reaching the bottom of the casters of the filter, the cord shall be secured on a hook or similar part that shall be provided on the filter.

10.2.4 effective March 1, 1998

10.2.5 Where the outer jacket has been removed from Type HSOO or HSJOO cord within the appliance, a close-fitting oil-resistant sleeving rated for the temperature shall be provided around the asbestos insulation.

Exception: A glass string, tape wrap, a close-fitting fiber sleeving, or equivalent means rated for the temperature is allowed to be used in lieu of oil-resistant sleeving to retain the asbestos insulation on the individual conductors when:

- a) The portion of the conductors without the outer jacket is not located within 2 inches (51 mm) of enclosure openings and
- b) No more than 3 inches (76 mm) of the asbestos insulation is exposed on any one conductor.

10.2.6 The jacket of Type HSO or HSJO cord is not to be removed within the strain relief.

10.2.7 The voltage rating of the cord and the fittings shall be no less than that of the appliance.