UL 923

STANDARD FOR SAFETY

Microwave Cooking Appliances

UL Standard for Safety for Microwave Cooking Appliances, UL 923

Seventh Edition, Dated May 1, 2013

Summary of Topics

The revisions to ANSI/UL 923 dated May 2, 2024, include the following changes in requirements:

> ***– Bottom Hinged Exception from Two Action Door Open Requirement; 36A.1.1(d), 36A.2.1, 36A.2.1A, 36A.2.4, 74.7, 74.8***

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

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated May 12, 2023 and October 13, 2023.

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The Department of Defense (DoD) has adopted UL 923 on June 29, 1990. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

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

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INTRODUCTION

1 Scope

1.1 These requirements cover household and commercial microwave cooking appliances operated in the Industrial, Scientific and Medical (ISM) bands of 915 ±25 and 2450 ±50 MHz, for use in ordinary locations in accordance with the National Electrical Code, NFPA 70, and rated not more than 600 V.

1.2 These requirements also cover microwave cooking appliances intended for built-in installation, side-by-side mounting, stacking, wall mounting and installation over ranges.

1.3 For the purpose of these requirements, commercial microwave cooking equipment is that usually found in commercial kitchens, restaurants, or other business establishments where food may be dispensed. Household microwave cooking equipment is that intended for household use.

1.4 These requirements also cover the microwave cooking portion of a household electric range. The combination is to comply with the Standard for Household Electric Ranges, UL 858.

2 Glossary

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

2.2 AUTOMATICALLY CONTROLLED APPLIANCE – An appliance is considered to be automatically controlled under any one or more of the following conditions:

a) If the repeated starting of the appliance, beyond one complete predetermined cycle of operation, is independent of any manual control;

b) If, during any single predetermined cycle of operation, the appliance is caused to stop and restart, or change operating modes one or more times; or

c) If, upon energizing the appliance, the initial starting of a motor may be intentionally delayed beyond normal, conventional starting.

2.3 CAVITY – That portion of the microwave cooking appliance in which food may be heated, cooked, or dried.

2.4 CLASS 2 CIRCUIT – An isolated secondary circuit involving a potential of not more than 42.4 V peak supplied by:

a) An inherently-limited Class 2 transformer;

b) A combination of an isolated transformer secondary winding and a fixed impedance or regulating network that together comply with the performance requirements for an inherently-limited Class 2 transformer;

c) A dry-cell battery having output characteristics not greater than those of an inherently-limited Class 2 transformer;

d) Any combination of (a), (b), and (c) that together comply with the performance requirements for an inherently-limited Class 2 transformer; or

e) One or more combinations of a Class 2 transformer and an overcurrent protective device that together comply with the performance requirements for a noninherently-limited Class 2 transformer.

A circuit derived from a line-connected circuit by connecting impedance in series with the supply circuit as a means of limiting the voltage and current is not considered to be a Class 2 circuit. See Secondary Circuits, Section 32.

2.5 CONTROL, AUTOMATIC ACTION – A control in which at least one aspect is non-manual.

2.6 CONTROL, AUXILIARY – A device or assembly of devices that provides a functional utility, is not relied upon as an operational or protective control, and therefore is not relied upon for safety. For example, an efficiency control not relied upon to reduce the risk of electric shock, fire, or injury to persons during normal or abnormal operation of the end product is considered an auxiliary control.

2.7 CONTROL, MANUAL – A device that requires direct human interaction to activate or rest the control.

2.8 CONTROL, OPERATING – A device or assembly of devices, the operation of which starts or regulates the end product during normal operation. For example, a thermostat, the failure of which a thermal cutout/limiter or another layer of protection would mitigate the potential hazard, is considered an operating control. Operating controls are also referred to as "regulating controls."

2.9 CONTROL, PROTECTIVE – A device or assembly of devices, the operation of which is intended to reduce the risk of electric shock, fire or injury to persons during reasonably anticipated abnormal operation of the appliance. For example, a thermal cutout/limiter, or any other control/circuit relied upon for normal and abnormal conditions, is considered a protective control. Protective controls are also referred to as "limiting controls" and "safety controls."

2.10 CONTROL, TYPE 1 ACTION – The actuation of an automatic control for which the manufacturing deviation and the drift (tolerance before and after certain conditions) of its operating value, operating time, or operating sequence has not been declared and tested under this standard.

2.11 CONTROL, TYPE 2 ACTION – The actuation of an automatic control for which the manufacturing deviation and the drift (tolerance before and after certain conditions) of its operating value, operating time, or operating sequence have been declared and tested under this standard.

2.12 CONTROLLED ENVIRONMENT – An environment relatively free of conductive contaminants, such as normal cooking vapors, carbon dust, and the like, that may be a result of the end-use equipment to which a control will be installed or may be due to the location of the end-use equipment, and protected against humidity and the formation of condensation. A controlled environment may be provided by means of a:

a) Hermetically sealed enclosure,

b) Encapsulation,

c) A conformal coating, or

d) A gasketed, tight-fitting enclosure or filter system preventing contamination in conjunction with a system preventing condensation (for example, the maintaining of the surrounding air at constant temperature and a suitably low relative humidity).

2.13 "CROWBAR" CIRCUIT – A circuit that causes an electrical overload to exist in the event certain other operations are not completed. The overload condition in turn causes an overcurrent or thermal device to function.

2.14 DOOR – The movable barrier that permits access to the cavity for placement or removal of food, and whose function is to prevent emission of microwave energy from the passage or opening which provides access to the cavity.

2.14.1 ELECTRICAL CONNECTION – The physical interface between two points in a circuit such as spade terminals, pin terminals, micro switch contacts, relay contacts, timer contacts, and crimped connections.

2.15 EQUIVALENT PLANE-WAVE POWER DENSITY – The square of the rms electric field strength divided by the impedance of free space (377 ohms).

2.15.1 FLAME CYLINDER – A projection of a vertical cylinder having a diameter of 20 mm and a height of 50 mm, placed above the center of the connection zone(s) and on top of any polymeric parts that are supporting current-carrying electrical connections as shown in Figure 12.2.

2.16 INTERLOCK – A device or system, either electrical, mechanical, or electromechanical, that serves to prevent exposure to an electric shock, or physical injury, or excessive radiation emission when a door, cover, or access panel is opened or removed.

2.17 INTERLOCK MONITOR – An electrical, mechanical, or electromechanical system that serves to render a microwave cooking appliance incapable of generating microwave energy in the event the designated primary or secondary interlock, or both does not perform its intended function.

2.18 MAGNETRON – A type of microwave generator usually used in microwave cooking appliances.

2.19 MICROWAVE ENCLOSURE – Refers to the inner cavity walls, the door, waveguide, and radiation shielding around magnetron filament connections.

2.20 MICROWAVE RADIATION EMISSION – The microwave energy to which persons might be exposed during operation or user servicing of a microwave cooking appliance.

2.21 OVER-THE-COOKTOP MICROWAVE OVEN – Any appliance, including a combination microwave oven vent-hood fan, that may be located above a range, cooktop, or similar heating appliance. It also includes appliances that can be located on a vent-hood shelf above a range or cooktop.

2.21.1 POTENTIAL IGNITION SOURCES –

a) The magnetron waveguide;

b) High voltage or Line Voltage uninsulated and insulated terminals;

c) High voltage or Line Voltage printed circuit board traces;

d) High voltage or Line Voltage open coils/windings;

e) High voltage or Line Voltage open contacts;

f) High voltage or Line Voltage wiring not employing VW-1 insulation;

g) Any other component containing high voltage or Line Voltage;

h) Any exhaust opening in the oven cavity; or

i) Any circuit or component that has normal operating wattage >60W.

2.22 POWER OUTPUT CONTROL CIRCUIT – A control circuit that supervises and/or manages the power output and must operate repetitively and consistently to assure compliance with the normal and abnormal operation tests specified in Sections 38 – 66.

2.23 PRIMARY INTERLOCK – A designation for one of the oven door interlocks. The primary interlock is intended to de-energize the microwave generator upon opening the oven door, before microwave radiation emission exceeds the levels specified in 39.1.1.

2.24 PRIMARY CIRCUITS – The wiring and components that are conductively connected to the branch circuit.

2.25 SAFETY CIRCUIT – Any primary or secondary circuit that is relied upon to reduce a risk of fire, electric shock, injury to persons, or excessive radiation (microwave or x-radiation) emission. An interlock circuit, for example, is considered to be a safety circuit.

2.26 SECONDARY CIRCUIT – A secondary circuit is one that is supplied from an isolated secondary winding of a transformer.

2.27 SECONDARY INTERLOCK – A designation for one of the oven door interlocks. The operation of the secondary interlock is intended to prevent microwave radiation emission from exceeding the level specified in 39.1.1 when the door is opened.

2.28 STIRRER – That feature of a microwave cooking appliance that serves to continuously change the standing wave pattern within the oven cavity.

2.29 UNDER-CABINET MOUNTED MICROWAVE OVENS – A microwave cooking appliance that is installed under a cabinet and over a non-heat producing surface.

2.30 USER SERVICING – Any form of servicing that might be performed by personnel other than those who are trained to maintain the appliance. Some examples of user servicing are:

a) Cleaning any areas that are accessible without the use of tools;

b) Replacing lamps, fuses, or other parts that are accessible without the use of tools;

c) Adjustment of any controls that do not involve the use of tools; and

d) Any operation described or implied in the operator's manual, whether or not tools are required.

2.31 VIEWING SCREEN – That feature of a microwave appliance, usually part of the door assembly, that is opaque to microwave energy but visually transparent to provide for viewing the cavity contents.

2.32 VIEWING SCREEN BARRIER – An optically transparent material adjacent to a viewing screen, which serves to prevent insertion of a wire or other object into the cavity.

2.33 VOLTAGE, EXTRA LOW – A circuit involving a potential of not more than 32 VAC RMS (42.4 volts peak) or 30 volts direct current (dc), and supplied by:

a) A primary battery;

b) A National Electrical Code, ANSI/NFPA 70, standard Class 2 transformer;

c) A combination of a transformer and fixed impedance which, as a unit, complies with all performance requirements for a Class 2 transformer; or

d) A Class 2 Power Supply.

2.34 VOLTAGE CIRCUIT, HIGH – Any circuit involving potential greater than 600 volts.

2.35 VOLTAGE CIRCUIT, LOW OR LINE – Any circuit with characteristics in excess of those of an extra low-voltage circuit but less than that of a high voltage circuit.

CONSTRUCTION

3 General

3.1 A microwave cooking appliance shall be made and finished with the degree of uniformity and grade of workmanship that is practicable in a well-equipped factory.

4 Components

4.1 A component of a product covered by this standard shall:

a) Comply with the requirements for that component as indicated in the individual section(s) covering that component;

b) Be used in accordance with its rating(s) established for the intended conditions of use;

c) Be used within its established use limitations or conditions of acceptability; and

d) Additionally comply with the applicable requirements of this end product standard.

Exception No. 1: A component of a product covered by this standard is not required to comply with a specific component requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product;

b) Is superseded by a requirement in this standard; or

c) Is separately investigated when forming part of another component, provided the component is used within its established ratings and limitations.

Exception No. 2: A component complying with a component standard other than those cited in this standard is acceptable if:

a) The component also complies with the applicable component standard indicated in this standard; or

b) The component standard:

1) Is compatible with the ampacity and overcurrent protection requirements of the National Electrical Code, ANSI/NFPA 70, where appropriate;

2) Considers long-term thermal properties of polymeric insulating materials in accordance with the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B; and

3) Any use limitations of the other component standard is identified and appropriately accommodated in the end use application. For example, a component used in a household application, but intended for industrial use and complying with the relevant component standard may assume user expertise not common in household applications.

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

4.3 A component that is also intended to perform other functions, such as:

a) Overcurrent protection;

b) Ground-fault circuit-interruption;

c) Surge suppression;

d) Any other similar functions; or

e) Any combination thereof

shall comply additionally with the requirements of the applicable UL standard(s) that cover devices that provide those functions.

Exception: Where these other functions are not required for the application and not identified as part of markings, instructions, or packaging for the appliance, the additional component standard(s) need not be applied.

4.4 With regard to a component being additionally investigated, reference to construction and performance requirements in another UL end product standard is suitable where that standard anticipates normal and abnormal use conditions consistent with the application of this end product standard.

5 Frame and Enclosure

5.1 A microwave cooking appliance shall be so formed and assembled that it will have the strength and rigidity necessary to resist the abuses that it is likely to be subjected, without increasing the risk of fire, electric shock, injury to persons, or exposure to radiation emission in excess of the limits specified in these requirements due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts, or other serious defects.

5.2 The enclosure of a microwave cooking appliance shall house all electrical parts, except a supply cord, that may cause a fire, electric shock, injury to persons, or exposure to radiation emission in excess of the limits specified in these requirements under any condition of use. No dependence shall be placed on adjacent walls or adjacent equipment to complete an enclosure. If a microwave cooking appliance is intended for permanent installation (intended for permanent connection to the power supply), the appliance shall be provided with means for mounting in the intended manner and shall be furnished with any necessary fittings, such as brackets, hangers, or sleeve.

5.3 Among the factors that shall be taken into consideration when an enclosure is being evaluated are its:

a) Mechanical strength,

b) Resistance to impact,

c) Moisture-absorptive properties,

d) Combustibility,

e) Resistance to corrosion, and

f) Resistance to distortion at temperatures to which the enclosure may be subjected under conditions of use. For a nonmetallic enclosure, all of these factors shall be considered with respect to thermal aging.

5.4 An enclosure constructed of polymeric material shall comply with the requirement in 12.3. A metal enclosure or enclosure part shall be tested in accordance with Metal Enclosure Impact Test, Section 47, for resistance to impact.

5.5 Cast- and sheet-metal portions of the enclosure shall be no thinner than indicated in Table 5.1 unless the enclosure is found to be acceptable when evaluated under considerations such as are mentioned in 5.3 and 5.6.

5.6 In addition to being considered with reference to the factors mentioned in 5.3, an enclosure of sheet metal shall be evaluated with respect to its size and shape, the thickness of metal and its acceptability for the particular application, considering the intended use of the appliance.

Table 5.1
Minimum acceptable thickness of metal enclosure

Metal	At small, flat, unreinforced surfaces and at surfaces that are reinforced by curving, ribbing, or the like, (or are otherwise of a shape and/or size to provide acceptable physical strength)		At surfaces to which a wiring system is to be connected in the field		At relatively large unreinforced flat surfaces	
	in	(mm)	in	(mm)	in	(mm)
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)
Uncoated sheet steel	0.026	(0.66)	0.032	(0.81)[a]	0.026	(0.66)
Galvanized sheet steel	0.029	(0.74)	0.034	(0.86)[a]	0.029	(0.74)
Nonferrous sheet metal	0.036	(0.91)	0.045	(1.14)	0.036	(0.91)

[a] Sheet steel of a thickness less than that mentioned, but not less than 0.026 in (0.66 mm) if uncoated steel or not less than 0.029 in (0.74 mm) if galvanized steel, is acceptable if the area surrounding the knockout has a thickness not less than 0.053 in (1.35 mm).

5.7 If openings for exhaust ventilation are provided in the enclosure of a microwave cooking appliance they shall be so located that they will not vent into concealed spaces of a building structure, such as into false-ceiling space or into hollow spaces in the wall, when the appliance is installed as intended.

5.8 The microwave enclosure of a microwave cooking appliance shall be so constructed as to prevent microwave radiation emission in excess of the values specified in 39.1.1.

5.9 With reference to 5.8, there shall be no openings in external surfaces of an appliance that will enable insertion of an insulated wire of any diameter into the cavity, wave guide, or other microwave-energy-containing spaces while the door is closed, provided the wire, when inserted, could consist of two straight segments forming an obtuse angle of not less than 170 degrees. The appliance is to be fully assembled during the examination except for parts that are removable without the use of tools. Typically, a solid wire approximately 0.04 in (1.0 mm) in diameter is used to determine possible insertion paths. The rotating fan blade of a blower motor in the direct line of sight to a small hole or crack leading to a microwave containing space is considered an acceptable barrier to the insertion of a wire.

Exception: Entry of a wire of any diameter may be considered acceptable if it can be demonstrated that the insertion of any such wire will not result in an equivalent plane-wave power density of microwave radiation in excess of 1 mW/cm^2 at any point 5 cm or more from the external surface of the enclosure when subjected to the Microwave Radiation Emission Test, Section 39, with all interlocks in the circuit.

5.10 A countertop microwave cooking appliance that employs electrical components or internal wiring located below an opening that is more than 45 degrees from the vertical plane on the top of a countertop microwave oven shall comply with Spillage on Horizontally-Mounted Openings, Section 53.

6 Accessibility of Live Parts

6.1 The electrical parts of an appliance shall be so located or enclosed that persons are protected against unintentional contact with uninsulated live parts. The method of evaluating openings in the enclosure is given in 6.2 – 6.6.

6.2 An opening in the enclosure of an appliance that will not permit entrance of a rod 1 in (25.4 mm) in diameter is acceptable if a probe as illustrated in Figure 6.1, when inserted into the opening, cannot be made to touch any part where leakage current to earth ground, or to other accessible parts, would exceed the levels specified in 38.1.

6.3 With respect to the requirement in 6.2, the probe may be articulated into any configuration and may be rotated or angled to any position before, during, or after insertion into the opening; and the penetration may be to any depth allowed by the opening size, including minimal depth combined with maximum articulation.

6.4 An opening that has a minor dimension of 1 in (25.4 mm) or more, in an enclosure, as illustrated in Figure 6.2, is acceptable if, within the enclosure, there is no uninsulated live part or film-coated wire less than, R distance from the inside edge of the perimeter of the opening and X distance from the plane of the opening. T equals the enclosure thickness, R equals X minus T, and X equals five times the diameter of the largest round rod that can be inserted through the opening but not less than 6-1/16 in (154 mm). In evaluating an opening, any barrier located within the volume is to be ignored unless it intersects the boundaries of the volume in a continuous, closed line.

Figure 6.1

Accessibility probe

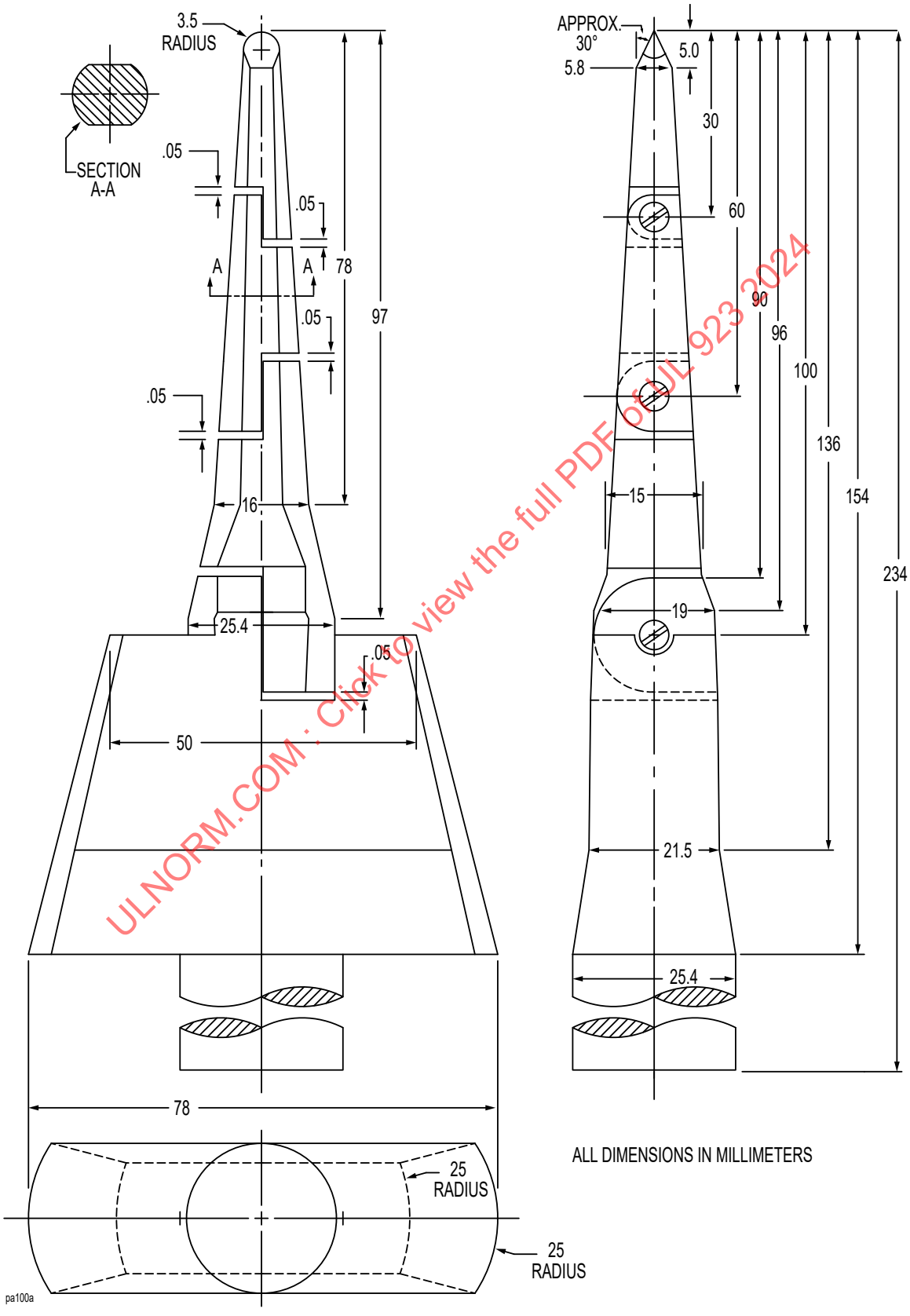
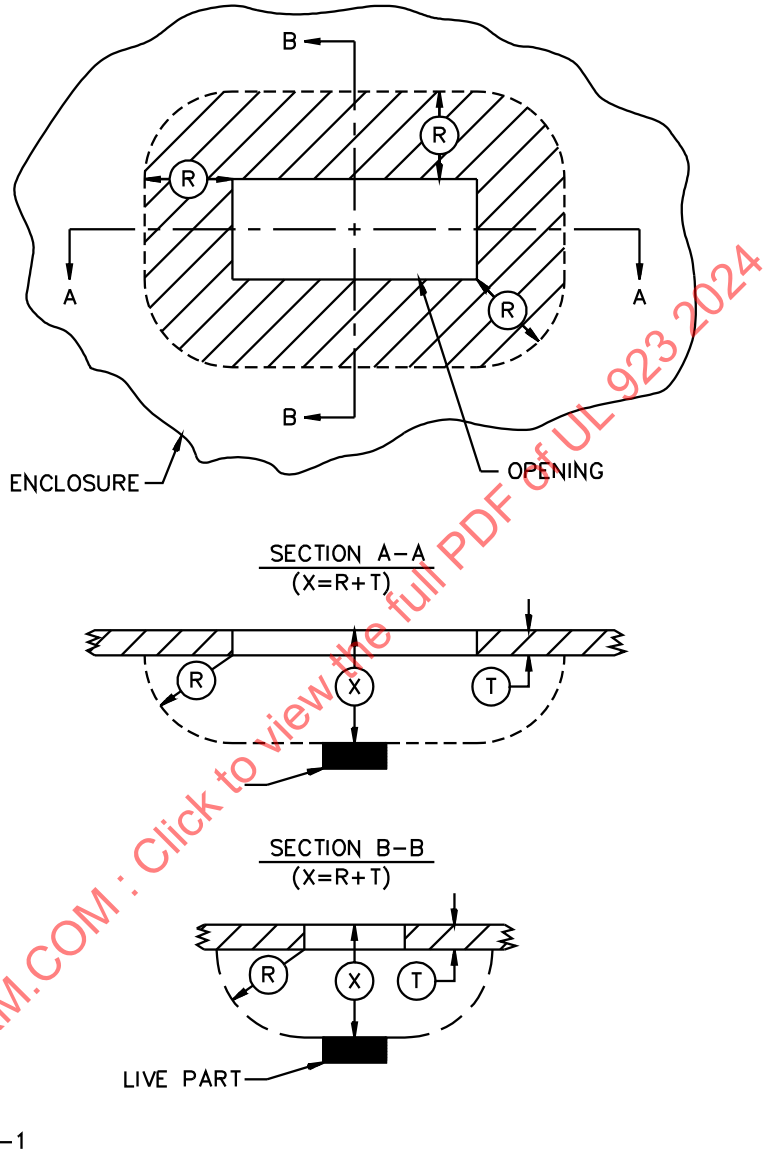


Figure 6.2

Opening in enclosure

Proportions exaggerated for clarity



6.5 In connection with the requirements in 6.1 – 6.4, a part of the outer enclosure that may be removed without the use of tools by the user of the appliance (for the attachment of accessories, to allow access to means for making operating adjustments, or for other reasons) is to be disregarded – that is, it is not to be assumed that the part in question affords protection against electric shock. A warning marking, such as that specified in 71.1.8 is not considered to eliminate this condition.

6.6 With reference to 6.7 and 6.8, the outer enclosure of a household counter-top appliance that requires removal for servicing is to be removed when determining compliance with the requirements.

6.7 A component (such as a lampholder, fuseholder, circuit breaker, or the like) intended to be user serviceable shall be so located that persons replacing or resetting the component in a line-voltage circuit cannot unintentionally touch an uninsulated live part.

Exception: The requirement does not apply to the screwshell or center contact of a screwshell lampholder or to the clips of a fuseholder that is associated with the component being replaced.

6.8 Uninsulated live parts of the line or high voltage circuits shall be individually insulated, guarded, or located such that the probe illustrated in Figure 6.3 cannot contact live parts with the outer enclosure removed.

Exception No. 1: This requirement does not apply to enamel-coated line or low voltage connected coil windings. The secondary voltage coil of the magnetron transformer shall not be exempt from the requirement.

Exception No. 2: An interlock system may be provided in lieu of insulating, guarding, or locating the live parts if the system disconnects all poles of the power supply, and the live parts that can be contacted by the probe are reliably deengerized. The actuator for such an interlock shall be concealed and not obvious to the person servicing the microwave oven.

Exception No. 3: Non-removable type fasteners or other means of securing the outer enclosure to the oven may be provided in lieu of insulating guarding, locating or interlocking the live parts if:

a) The securing means if determined through trial removal to be unlikely to be removed,

b) The securing means is provided with a tool interface that will not accommodate a slotted, a Phillips, a square, or torx driver, or wrench of any type for removal,

c) The securing means has a curved head that cannot be gripped by pliers. A securing means provided with a maximum 0.020-in (0.50-mm) radius curve above the exposed outer surface of the appliance to which the securing means is affixed is considered as not be capable of being gripped,

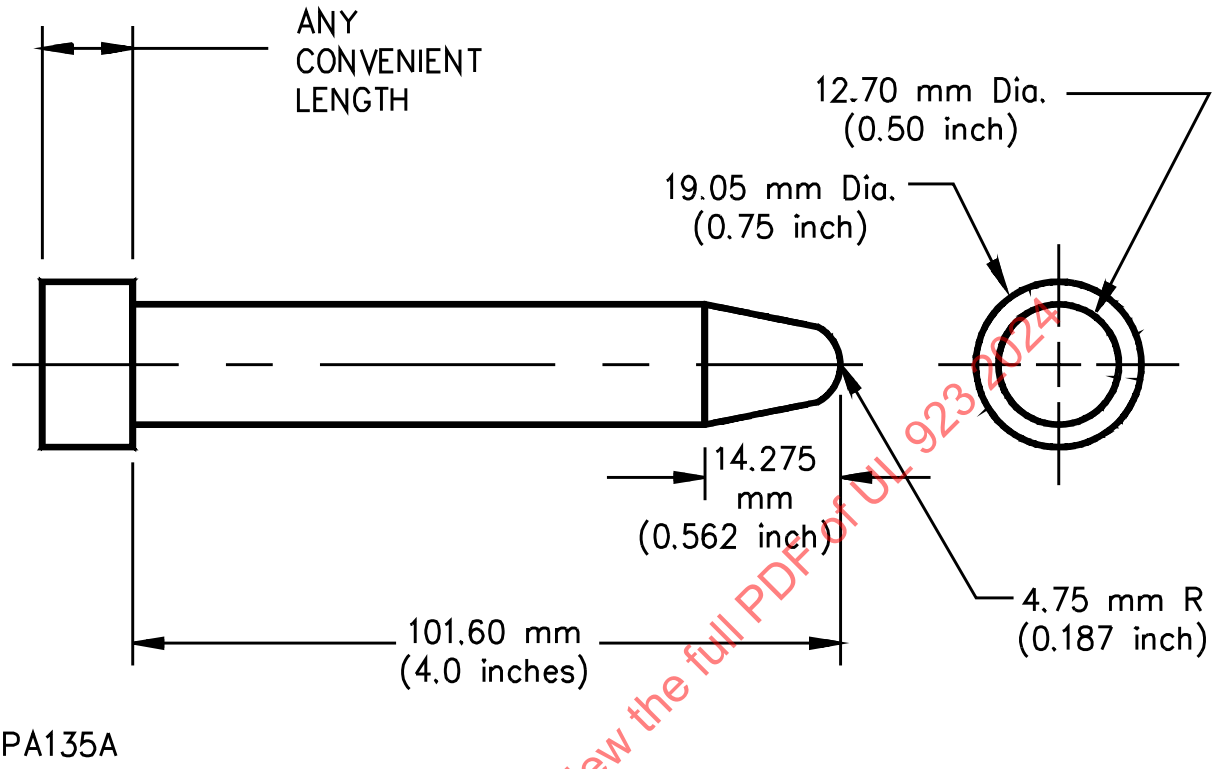
d) A minimum of two such securing means are provided,

e) The securing means are located such that removal of the non tamper-resistant screws will not allow access to the high voltage circuits (such as at the bottom of the enclosure), and

f) The appliance is marked in accordance with 73.23.

Figure 6.3

Probe for uninsulated live parts



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7 Protection Against Injury

7.1 General

7.1.1 A moving part, such as the rotor of a motor, a chain, a pulley, a belt, or a gear, shall be enclosed or guarded to reduce the risk of injury to persons.

7.1.2 With reference to the requirement in 7.1.1, the degree of protection required of the enclosure depends upon the general construction and intended use of the appliance. The factors to be taken into consideration in determining the acceptability of an exposed moving part are:

a) The degree of exposure;

b) The sharpness of the moving part;

c) The likelihood of unintentional contact with the moving part;

d) The speed of movement of the part; and

e) The likelihood of a finger, an arm, or clothing being drawn into the moving part (such as at points where gears mesh, where a belt travels onto a pulley, or where moving parts close in a pinching or shearing action).

7.1.3 A microwave cooking appliance, and any item furnished with the appliance, shall have no sharp edge, burr, point, or spike inside or outside the appliance that may cause injury during use, including a cleaning operation.

7.1.4 Materials employed in the construction of the appliance depended upon for protection against injury shall be acceptable for the particular use. See 5.1 and 5.3.

7.2 Strength of mounting

7.2.1 A support bracket, hanger, or the like, of a wall-mounted appliance, shall not weaken, crack, or break; and shall support the oven and mounting bracket assembly when subjected to the conditions described in Strength of Mounting Test, Section 65.

7.3 Fans

7.3.1 A removable filter that complies with the requirements in Filters, Section 29, is acceptable as a guard of a fan.

7.3.2 A side of a fan need not be guarded provided that:

a) The appliance is marked as specified in 73.27; and

b) The installation instructions are such that, when installed per the instructions, an opening allowing the user access to an unguarded side of a fan is at least 7 ft (2.13 m) above the floor.

8 Mechanical Assembly

8.1 A switch, a fuseholder, a lampholder, an attachment plug receptacle, a power inlet (motor attachment cap), or other component that is handled by the user shall be mounted securely and shall be prevented from turning. See 14.3.

Exception: The requirement that a switch be prevented from turning may be waived if all four of the following conditions are met:

a) The switch is of a plunger, slide, or other type that does not tend to rotate when operated. A toggle switch is considered to be subject to forces that tend to turn the switch during operation of the switch;

b) The means of mounting the switch makes it unlikely that operation of the switch will loosen the switch;

c) Spacings are not reduced below the minimum acceptable values and there is no stress on internal wiring or terminals of internal wiring if the switch moves; and

d) Intended operation of the switch is by mechanical means rather than by direct contact by persons.

8.2 The means by which the turning mentioned in 8.1 is prevented is to consist of more than friction between surfaces – for example, a lock washer, properly applied, is acceptable as the means to prevent turning of a device having a single-hole mounting means.

8.3 If a factory installed part of an appliance is normally removed from the appliance by the installer to convert the appliance from one type of installation to another, (for example, counter top installation to built-in), and the part is not replaced during such conversion, the appliance shall, with the part removed, comply with all requirements in this standard that apply to all types of installation for which the appliance is intended.

9 Protection Against Corrosion

9.1 Iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means if corrosion of such parts would be likely to result in a risk of fire, electric shock, injury to persons, or excessive radiation emission.

Exception: This requirement does not apply to bearings, laminations, or minor parts of iron or steel, such as washers or screws. The sheath of a heating element need not be protected against corrosion.

9.2 If the oxidation of iron or steel due to the exposure of the metal to air and moisture is not likely to be appreciable – thickness of metal and temperature also being factors – surfaces of sheet steel and cast iron parts within an enclosure may not be required to be protected against corrosion.

10 Interlocks

10.1 Opening the door of a microwave cooking appliance shall operate a minimum of two door interlocks. At least one door interlock on a fully assembled microwave oven shall not be operable by any part of the human body, or any object with a straight insertable length of 3.9 in (99.6 mm). Such an interlock shall also be concealed (not within line-of-sight), unless its actuation is prevented when access to the interlock is possible. Any visible actuator or device to prevent actuation of this interlock shall not be removable without disassembly of the oven or its door. For magnetically operated interlocks see 57.1 and 57.2 also.

10.2 The interlocks designated as primary and secondary shall prevent microwave radiation emission in excess of the requirements in 39.1.1 for the primary and secondary interlocks under the normal operating conditions described in this standard.

11 Interlock Monitors

11.1 An interlock monitor circuit shall be provided as part of the microwave cooking appliance and shall comply with the applicable constructional requirements of 11.2 – 11.4, and test requirements in Interlock Monitor Circuit Test, Section 49.

11.2 An interlock monitor circuit component or system shall not serve as one of the door interlocks. Door interlock malfunctions shall not disrupt the monitoring function of the interlock monitor circuit.

Exception: With reference to the first sentence of 11.2, a multiple circuit switch employing separate contact sets serving as door interlock and monitor switches may be acceptable provided:

a) The presence of the interlock contact set does not increase the probability of malfunction of the monitoring function of the monitor contact set; and

b) There are no common-mode malfunctions that could lead to or result in malfunction of the monitoring function of the monitor contact set and an unacceptable operation of the interlock, unless there are at least two other operable door interlocks in the appliance.

11.3 Any overcurrent device or fusible element necessary for proper operation of a monitor circuit, such as a crowbar circuit, shall be provided in the appliance and located where it is not accessible to the user without the use of tools.

11.4 The means of monitoring one or both of the required interlocks shall cause the microwave generator of a microwave cooking appliance to become inoperable until the appliance is serviced by qualified service personnel if any interlock being monitored fails to perform its required function with all other control devices in the monitor circuit set to the closed position. Instructions for servicing associated with the

operation of the interlock monitor shall be provided for the serviceman, but shall not be provided for the user as part of the user operating instructions packaged with the product. See 76.2.

12 Polymeric Materials

12.1 Polymeric materials employed in the construction of gaskets, spacers, dielectric media of wave traps, or other structural parts of a microwave cooking appliance shall be investigated for the application if the partial or total deterioration of such parts could result in microwave radiation emission exceeding the limits specified in 39.1.1.

12.2 Compliance with 12.1 is determined by subjecting the specific construction to the test described in 45.1.1 – 45.5.7 and 48.1.1 – 48.4.1.

12.3 A polymeric material enclosure of electrical parts shall comply with the requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, as applicable to polymeric enclosures.

Exception No. 1: A minimum impact of 5 ft-lbf (6.8 J) shall apply to all microwave cooking appliances when determining the impact resistance of a polymeric material enclosure of live parts.

Exception No. 2: An enclosure of Class 2 circuits – see Secondary Circuits, Section 32 – shall be treated as a decorative part, see 12.6.

Exception No. 3: For the abnormal operation and severe conditioning test of UL 746C, the appliance enclosure is to be evaluated under the abnormal operation tests specified in Abnormal Operation Tests, Section 54, and Potato Fire Containment Test, Section 64A.2, of this standard.

12.4 A polymeric material that only limits access to microwave energy-containing spaces to comply with 5.8 and 5.9, and does not serve to retard propagation of flame initiated within appliance, or to prevent accessibility to parts which may present risk of electric shocks and injury, shall comply with the following:

a) Impact Test – In accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. An impact of 2 ft-lbf (2.7 J) is to be applied. As a result of this test, the appliance shall comply with 5.8 and 5.9;

b) Mold Stress-Relief Distortion – In accordance with UL 746C. As a result of this test, the appliance shall comply with 5.8 and 5.9;

c) Abnormal Conditions – See Abnormal Operation Tests, Section 54; and

d) Flammability – The material shall be classed as minimum HB, in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

12.5 When determining compliance with the enclosure requirements of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C:

a) A microwave cooking appliance is to be considered an unattended, stationary appliance;

b) A microwave oven intended for indoor use shall be considered subject to normal room temperature environmental conditions.

12.6 Decorative parts of or on the electrical enclosure constructed of polymeric materials shall comply with the flammability requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, as applicable to decorative parts of enclosures.

Exception No. 1: Polymeric materials that are located entirely external to a metallic enclosure of the appliance need not be classed HB minimum, in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, provided:

a) The metallic enclosure complies with the requirements in 5.5; and

b) The polymeric material does not cover any openings in the metallic enclosure.

Exception No. 2: Polymeric parts not more than 0.010-in (0.25-mm) thick need not be classed HB, minimum.

12.7 Except where superseded by other requirements in this standard, polymeric materials shall have a flammability classification of HB minimum, when tested in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

Exception No. 1: Materials covered by one or more of the exceptions to 12.6 need not be classed HB, minimum.

Exception No. 2: Parts of a fixed or stationary appliance are not required to be made of a material classed HB, minimum, provided the part does not occupy a volume greater than 0.24 in^3 (4 cm^3), does not have any dimension greater than 2.4 in (60.1 mm), and is located so it cannot propagate flame from one area to another or bridge between a possible source of ignition and other ignitable parts.

12.8 Polymeric materials that serve as direct or indirect support of live parts, or an electrical or mechanical barrier shall comply with the requirements for electric insulation in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. An impact of 5 ft-lbf (6.8 J) is to be used for the applicable tests.

12.8.1 Polymeric material within 50 mm of any ignition source specified in 2.21.1 shall meet the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94 V0 minimum.

Exception No. 1: Polymeric material may be HB minimum, provided the part does not occupy a volume greater than 0.122 in^3 (2 cm^3), does not have any dimension greater than 2.4 in (60.1 mm), and is located so it cannot propagate flame from one area to another or bridge between a possible source of ignition and other ignitable parts.

Exception No. 2: Polymeric materials may be HB minimum, provided that the unit fails safe and the material is ignited during the applicable Forced Failure Fire Containment Tests of the ignition source in Section 64A.

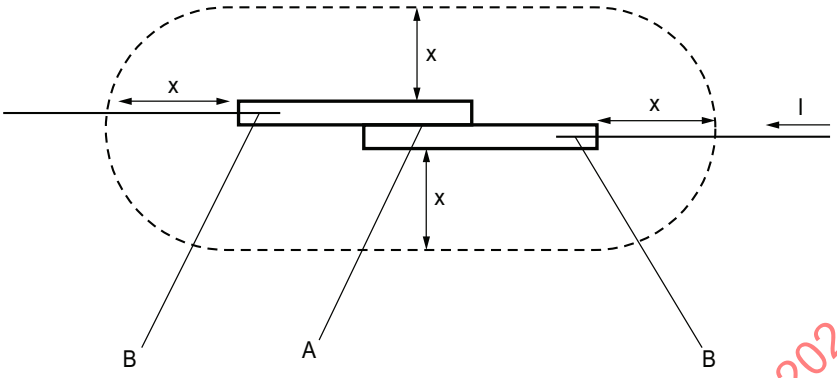
Exception No. 3: Polymeric materials may be HB minimum, provided that a metal sub-enclosure houses the ignition source fully and has a thickness as specified in 5.5 provided:

a) The polymeric material does not cover any openings in the metallic enclosure other than those of minimum size for the passage of the display, control shaft or rods; and

b) All other openings shall be judged on the basis of the necessity for their existence. On any one surface, the minor dimension of an opening shall not exceed 3/8 in (9.5 mm) and the maximum area shall not exceed 0.25 in^2 (161 mm^2). The area may be increased to a maximum of 1.0 in^2 (645 mm^2) if a barrier of metal or 5V material is secured in place and interposed between ignition sources and flammable material. In any case, the maximum aggregate area of all openings in any one surface shall not exceed 1.0 in^2.

Figure 12.1

Definition of “within 3 mm of an electrical connection”



“Within 3 mm of an electrical connection” means falling within the dotted boundary formed by the cylinder with hemispherical ends, as shown in the above drawing.

A – Terminal connection zone

B – Wire crimp connection zone

I – Current through the connection

X – Distance from the connection

12.8.2 With reference to 12.8.1, polymeric materials located within 3 mm of an electrical connection where the total circuit load is greater than 60 watts during normal operation shall have a flammability classification as follows:

a) A minimum V-0 or VTM-0, in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, or

b) A minimum SC-0 or SCTC-0, in accordance with the Standard for Tests for Flammability of Small Polymeric Component Materials, UL 1694, or

c) A minimum glow wire ignition temperature (GWIT) of 775°C according to Fire Hazard Testing – Part 2-13: Glowing/Hot-wire Based Test Methods – Glow-wire Ignition Temperature (GWIT) Test Method for Materials, IEC 60695-2-13, or

d) The material withstands the glow-wire test (GWT) according to Fire Hazard Testing – Part 2-11: Glowing/Hot-wire Based Test Methods – Glow-wire Flammability Test Method for End-products (GWEPT), IEC 60695-2-11 with a minimum test severity of 750°C, and during the test, flames persists for no longer than 2 seconds.

12.8.3 With reference to 12.8.1, all polymeric materials located within the envelope of a vertical cylinder having a diameter of 20 mm and a height of 50 mm, placed above the center of the connection zone and on top of the polymeric parts that are supporting current-carrying electrical connections where the total circuit load is greater than 60 watts during normal operation shall have a flammability classification as follows:

a) A minimum of V-0, VTM-0, or HF-1, in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, and Fire Hazard Testing – Part 11-10: Test Flames – 50 W Horizontal and Vertical Flame Test methods, IEC 60695-11-10, or

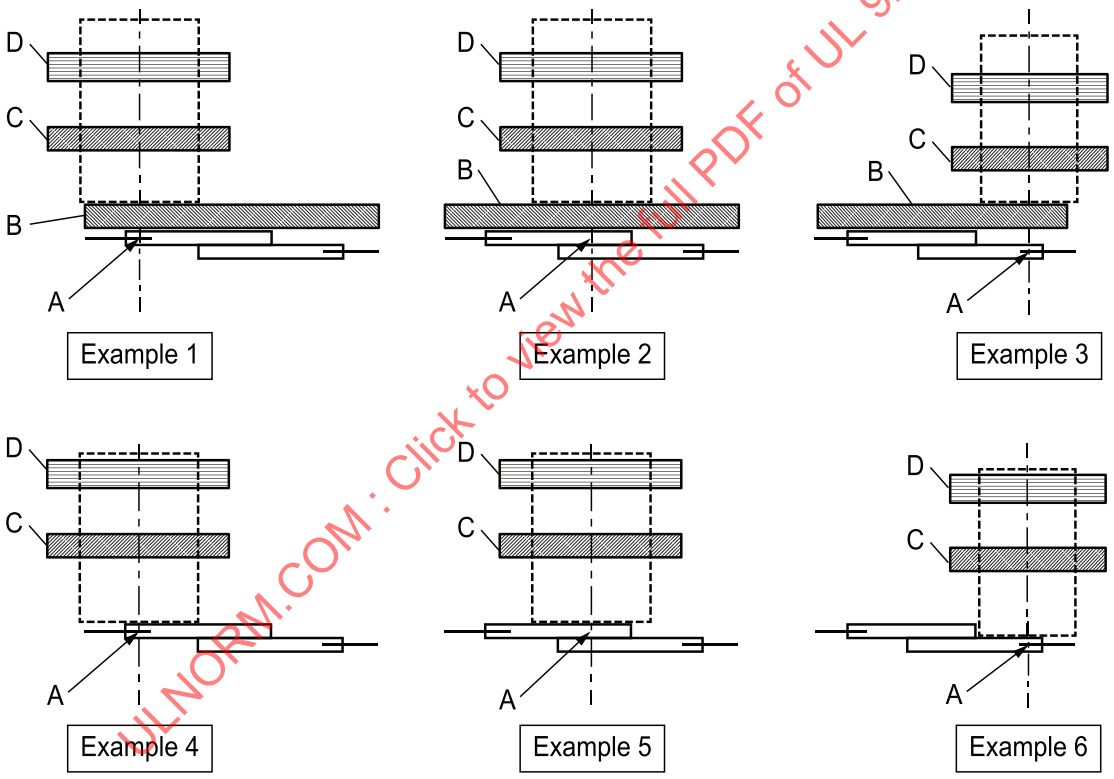
b) A minimum of SC-0 or SCTC-0, in accordance with the Standard for Tests for Flammability of Small Polymeric Component Materials, UL 1694, or

c) A minimum VW-1 for wire, tubing, sleeving and tape in accordance with 16.1.2.1.

12.8.4 With reference to 12.8.3 and Figure 12.2, the flame cylinder shall be placed above the center of each connection zone and on top of any polymeric parts that are supporting current-carrying connections as shown in Examples 1-3 of Figure 12.2. In the case of uninsulated connections, the flame cylinder shall be placed above the center of each connection zone and directly on top of current-carrying conductors as shown in Examples 4-6 of Figure 12.2. The flame cylinder shall project through all metallic and non-metallic material. If "C" is intended to act as a barrier to "D", then the adequacy of the barrier shall be demonstrated by testing as described in Nichrome Wire Ignition Tests, Section 64A.6.

Figure 12.2

Placement of flame cylinder



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A – Center of connection zone

B – Non-metallic material supporting current carrying connection

C – Metallic or non-metallic material

D – Metallic or non-metallic material

12.9 An adhesive material that is used to secure a portion of an enclosure, electrical or thermal insulation, an electrical component, an internal barrier (such as film, door screen, or the like), a mechanical component of a door interlock system, or a part that affects the routing of a cooling air stream shall comply with the requirements for adhesives in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

Exception: An adhesive need not comply with the requirements in UL 746C if the appliance complies with all of the requirements in this standard under all conditions of complete or partial failure of the adhesive.

12.10 With respect to 12.9, the as-received bond strength of the adhesive shall be not less than four times the strength necessary to perform its intended function, but in no case shall the as-received bond strength be less than 2 lbf/in^2. For an adhesive used with a flexible substrate, the as-received bond strength shall be not less than 2 lbf/in width.

12.11 With respect to 12.9, adhesive test samples shall be subjected to temperature, humidity, and cyclic conditioning. In addition, adhesive materials that may be exposed to food or cooking vapors during normal operation shall be subjected to corn oil exposure conditioning consisting of ten specimen samples immersed in corn oil for 7 days at the maximum adhesive temperature measured during the test specified in Temperature Test, Section 41.

12.12 A polymeric duct or grill that prevents exhaust air from venting into a concealed space of a building structure (see 5.7) shall comply with the following tests in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. As a result of these tests there shall not be cracking, warpage, or other distortion to the extent that a solid 18 AWG (0.82 mm^2) uninsulated wire can be inserted into any opening in the duct or grill.

a) ENCLOSURE IMPACT – When conducting the Resistance to Impact test, an impact of 2 ft-lbf (2.7 J) is to be applied to any surface that is exposed to a blow during normal use (not including during installation). A grill, and a duct provided as part of a counter top appliance and intended to become part of the built-in ductwork, are examples of surfaces exposed to a blow during normal use.

b) MOLD STRESS-RELIEF DISTORTION – Mold stress-relief distortion tests are required for all applications. However, a repeated input test after the Mold Stress-Relief Distortion Test is not required.

c) ABNORMAL OPERATION – For the abnormal operation and severe conditions tests, the material is to be investigated for compliance with the Abnormal Operation Tests, Section 54.

d) FLAMMABILITY – The duct assembly shall be subjected to the 500 w (125 mm) Vertical Burning Test, or shall have a flammability classification of 5VA (as classed by the vertical burning rate test described in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94). A duct or grill that only exhausts air other than oven cavity exhaust shall have a flammability classification of 5VA.

Exception: A polymeric duct or grill that exhausts air directly from the oven cavity is not prohibited from having a flammability classification of V-0 (as classed by the vertical burning rate test described in UL 94) when the appliance is provided with a manual reset temperature limiting control or a thermal cutoff that is located adjacent to the duct or grill, complies with the applicable requirements for appliance limit controls in the Standard for Temperature-Indicating and -Regulating Equipment, UL 873, or in the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1, and the Standard for Automatic Electrical Controls – Part 2-9: Particular Requirements for Temperature Sensing Controls, UL 60730-2-9; or with the Standard for Thermal-Links – Requirements and Application Guide, UL 60691, and functions to de-energize the entire appliance when subjected to the Potato Fire Containment Test, Section 64A.2, with the

potato or potatoes located as close to the duct or grill as possible. See 59.1 for the applicable manual reset control endurance test.

12.13 A duct or grill as described in 12.12 may be part of the appliance or provided as a separately supplied accessory intended for field installation in or on the appliance to convert it from a counter top installation to a wall-mounted or built-in installation. The duct or grill, including a separately supplied accessory, is to be mounted as intended during the tests specified in 12.12.

13 Supply Connections

13.1 Permanently-connected appliances

13.1.1 General

13.1.1.1 A microwave appliance intended for permanent connection to the power supply shall be so constructed that it can be readily and permanently connected to one of the wiring systems that, in accordance with the National Electrical Code, ANSI/NFPA 70, would be acceptable for the appliance.

13.1.1.2 An appliance intended to be built-in or recessed may be provided with 3 – 8 ft (0.91 – 2.44 m) of flexible metal conduit with leads and a grounding conductor installed to facilitate servicing and installation. The flexible conduit need not terminate in an outlet box at the free end but an antishort bushing is to be installed and retained reliably.

13.1.1.3 Sheet metal to which a wiring system is to be connected in the field, shall have a thickness of not less than that specified in Table 5.1.

13.1.1.4 A wiring compartment for field-wiring connections shall be of size to accommodate such connections.

13.1.1.5 If inspection indicates a compartment volume may not be large enough to accommodate the intended wiring, a trial installation is to be made using wires of the size indicated in 13.1.2.1 and conduit and fittings sized for the wire in accordance with the National Electrical Code, ANSI/NFPA 70.

13.1.1.6 The location of a terminal box or compartment in which branch-circuit connections to a permanently wired appliance are to be made shall be such that these connections can be readily inspected without disturbing the wiring or the appliance after the appliance has been installed as intended. See also 13.1.1.7.

13.1.1.7 An outlet or terminal box mounted integrally with a permanently connected, built-in or wall-mounted, microwave cooking appliance shall be so located that the power-supply connections can be inspected without the necessity of moving the appliance to the extent that it will not be supported by the building structure only.

13.1.1.8 No electrical component shall be mounted on a part that must be removed for the examination of field-wiring connections.

13.1.1.9 A terminal compartment intended for connection of a supply raceway shall be so attached to the appliance as to be prevented from turning with respect thereto.

13.1.2 Field wiring terminals and leads

13.1.2.1 A microwave cooking appliance intended for permanent connection to the power supply shall be provided with wiring terminals or leads for the connection of conductors. Each terminal or lead shall be