UL 1563

STANDARD FOR SAFETY

Electric Spas, Equipment Assemblies, and Associated Equipment

UL Standard for Safety for Electric Spas, Equipment Assemblies, and Associated Equipment, UL 1563

Sixth Edition, Dated July 16, 2009

Summary of Topics

This revision of ANSI/UL 1563 dated September 10, 2020 includes the withdrawal and replacement of UL 508C with UL 61800-5-1; 29.2.1 and 32.1.2.

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

The revised requirements are substantially in accordance with Proposal(s) on this subject dated July 3, 2020.

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

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INTRODUCTION

1 Scope

1.1 These requirements apply to self-contained spas. They also apply to field-installed equipment assemblies, blowers, and controls for use with field-installed hot tubs, swimming pools, and non-self-contained spas. These products are for household or commercial use, indoors, outdoors, or both. All equipment is intended for installation and use in accordance with Article 680 of the National Electrical Code, NFPA 70.

1.2 These requirements also apply to field-installed accessories that have been investigated with the basic product.

1.3 These requirements do not apply to products covered by the following UL Standards:

a) Underwater Luminaires and Submersible Junction Boxes, UL 676;

b) Swimming Pool Pumps, Filters, and Chlorinators, UL 1081;

c) Electric Water Heaters for Pools and Tubs, UL 1261;

d) Personal Hygiene and Health Care Appliances, UL 1431 (professional hydrotherapy equipment – whirlpool bathtubs); and

e) Hydromassage Bathtubs, UL 1795.

2 Components

Section 2 revised and relocated as Section 7A.1

3 Units of Measurement

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

3.2 Unless indicated otherwise, all voltage and current values mentioned in this standard are root-mean-square (rms).

4 Undated References

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

5 Glossary

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

5.2 ACCESSIBLE PART – A part located so that it can be contacted by a person.

5.3 ACCESSIBLE TO THE OCCUPANT – Any surface or component within 5 feet (1.52 m) of the tub water, measured by any convenient method such as a measuring tape or a 5-foot flexible wire, cord, or string. The distance shall be measured with the service door closed and shall be the shortest path without piercing a permanent barrier such as the tub or skirt of a spa or the service door.

5.4 ACTUATION – Movement of the actuating member of the control by the user, by hand, by foot, or by any other human activity.

5.5 *Revised and relocated as 5.14.1*

5.6 BONDING TERMINAL – A pressure wire connector secured to the enclosure in which the power supply conductors are terminated, for the connection of a bonding conductor.

5.7 CLASS 2 CIRCUIT – A secondary circuit with an open circuit potential of not more than 30 volts rms (42.4 volts peak) supplied by a Class 2 transformer, or by a transformer and fixed impedance that together comply with all performance requirements for Class 2 transformers in the Standard for Low Voltage Transformers: General Requirements, UL 5085-1 and the Standard for Low Voltage Transformers: Class 2 and Class 3 Transformers, UL 5085-3.

5.8 COMMON BONDING GRID – A common bonding grid may be a copper grounding loop, metal reinforcing rods in a concrete or tile supporting pad, or a network of other local groundable metal that local inspection authorities evaluate to be in compliance with Section 680-26(B) of the National Electrical Code, ANSI/NFPA 70.

5.9 CONFORMAL COATING – An insulating coating that conforms to the configuration of the object that is coated. The coating is used as a covering to protect against environmental conditions.

5.9.1 CONTROL, AUTOMATIC ACTION – A device in which the transmission and operation of at least one function is produced by initiation which is not the result of manual actuation.

5.9.2 CONTROL, AUXILIARY – A device that provides a functional utility but is not relied on as an operational or protective control. The failure of an auxiliary control generally does not cause the operation of a protective control. An example of an auxiliary is one that controls the “on/off” state of spa lighting.

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

5.9.4 CONTROL, OPERATING – A device that starts or regulates the operation of an appliance during normal operation. The failure of an operational control generally causes the operation of a protective control. An example of an operating control is a temperature regulating control – a control that maintains the temperature of the spa water to a user-determined level.

5.9.5 CONTROL, PROTECTIVE – A device, the operation of which is intended to reduce the risk of electric shock, fire, or injury to persons during normal or abnormal operation of the appliance. During the evaluation of the protective control / circuit, the protective functions are verified under normal and single-fault conditions of the control.

5.9.6 CONTROL, TYPE 2 ACTION – The actuation of an automatic control (see 5.9.1) for which the manufacturing deviation and the drift of its operating value, operating time, or operating sequence have been declared and tested under the Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1.

5.9.7 CONTROL, TYPE 2.D.H ACTION – This action is applicable to manual controls (see 5.9.3). The automatic action (i.e. tripping of the control) is independent of the manipulation or position of the manual reset/adjustment mechanism. The manipulation of the manual adjustment means will not allow for the reverse operation (resetting of a "tripped" control), even momentarily, while the excess or fault condition persists. This action is also referred to as trip-free action. The action of the control is such that the reverse operation (resetting) is possible if the manual reset mechanism is held in the reset position – i.e. the control will function as an automatic control if the reset button is held in the reset position. The control shall

not reset automatically at any temperature above -35°C (-31°F) with the reset mechanism in the normal position.

5.9.8 CONTROL, TYPE 2.D.J ACTION – This action is applicable to manual controls (see 5.9.3). The automatic action (i.e. tripping of the control) is independent of the manipulation or position of the manual reset/adjustment mechanism. The manipulation of the manual adjustment means will not allow for the reverse operation (resetting of the control), even momentarily, while the excess or fault condition persists. This action is also referred to as trip-free action.

5.10 CONTROLLED ENVIRONMENT – An environment that is relatively free from conductive contaminants, such as dust and carbon particles, and that is protected against humidity and condensation. A controlled environment may be provided by a hermetically sealed enclosure, encapsulation, or a conformal coating.

5.11 CONVERTIBLE UNIT – A spa or equipment assembly that is shipped from the factory with a power supply cord and that is intended for optional field conversion to a permanently-wired configuration.

5.12 DISCONNECTING MEANS – A suitably rated switch or circuit breaker that opens all ungrounded circuit conductors and that is readily accessible to the user of the unit.

5.13 DRY-FIRE – Fire resulting from dry operation of heating element intended to be continuously immersed.

5.14 ENCLOSURE – That part of a unit that renders inaccessible any part that may present a risk of electric shock, prevents emission of flame or molten material, or prevents unintentional contact with internal parts that may involve a risk of injury. Some examples are tub materials, skirting materials, electrical boxes, and barriers.

5.14.1 EQUIPMENT ASSEMBLY – A factory-assembled grouping of electrical components used to provide heating, filtering, aeration, or both filtering and aeration of water circulated in a field-supplied tub. An assembly can be either permanently connected or cord-and-plug connected.

5.15 GROUNDING TERMINAL – A designated pressure wire connector located within the field wiring compartment to terminate the equipment grounding conductor of the supply circuit.

5.16 HEATING ELEMENT – An unbroken length of resistance material used to electrically generate heat.

5.16.1 HOT TUB – See SPA, 5.28.

5.17 INTERLOCK – A device, system, or circuit used to de-energize electrical components or to stop moving parts that become exposed when a cover is removed or when an enclosure is opened.

5.18 ISOLATING TRANSFORMER – A transformer with one or more output windings electrically separated from the input winding and all other output windings.

5.19 LEAKAGE CURRENT COLLECTOR – Metal in the water-circulating system intended to provide a low-impedance path for leakage currents to ground.

5.20 OPEN MOTOR – A motor having ventilating openings that permit passage of external cooling air over and around the windings of the motor.

5.21 OPERATING TEMPERATURE VALUE – Value of temperature at which the temperature sensing control operates on a rise or fall of the temperature.

5.22 RISK OF ELECTRIC SHOCK – A risk of electric shock is considered to exist whenever the available current exceeds the limits specified in Table 5.1 when measured as described in the Available Current Test, Section 44. Other current waveforms than specified in Table 5.1 are considered to comply with the intent of this requirement if the maximum available current to ground does not exceed the startle current threshold and the maximum point-to-point current, when unreliable control isolation layers are removed, does not exceed the let-go current threshold as specified in IEC TS 60479-2, Effects of current on human beings and livestock – Part 2: Special aspects.

Table 5.1
Risk of electric shock limits

Location	Limit, milliamperes, 50 or 60 Hz AC	Limit, milliamperes, pure DC[b]
Current circulating in the water from two points immersed in the water	0.5	2.0
Spa water and ground	0.5	2.0
Any point accessible to the spa occupant and ground	0.5	2.0
Any point on the spa control and ground[a]	0.5	2.0
Any two points on the spa control, or between two controls[a]	5.0	30.0
NOTE: The 0.5 and 2.0 mA limits specified correspond to the startle current threshold. The 5.0 and 30 mA limits specified correspond to the let-go current threshold.		
[a] The outer layer of a membrane switch shall not be relied upon for mitigation of the risk of electric shock.		
[b] DC current is considered to be pure dc only if it is confirmed through test that the peak-to-peak value of ripple in the current is not more than 10 percent of the dc current.		

5.23 RISK OF FIRE – A risk of fire is considered to exist when the power limitations of a Class 2 circuit as defined in the Standard for Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers, UL 5085-3, are exceeded.

5.24 SAFETY CIRCUIT – A circuit that is relied upon to reduce the risk of fire, electric shock, unintentional contact with moving parts, or other casualty hazard (such as hyperthermia). Examples include, but are not limited to:

a) An interlock circuit used to prevent the risk of electric shock and/or injury to persons;

b) A circuit which limits current to accessible parts;

c) A circuit which limits the wattage to a limited-energy circuit;

d) A temperature-limiting control;

e) A temperature-regulating control; and

f) A dry-fire control.

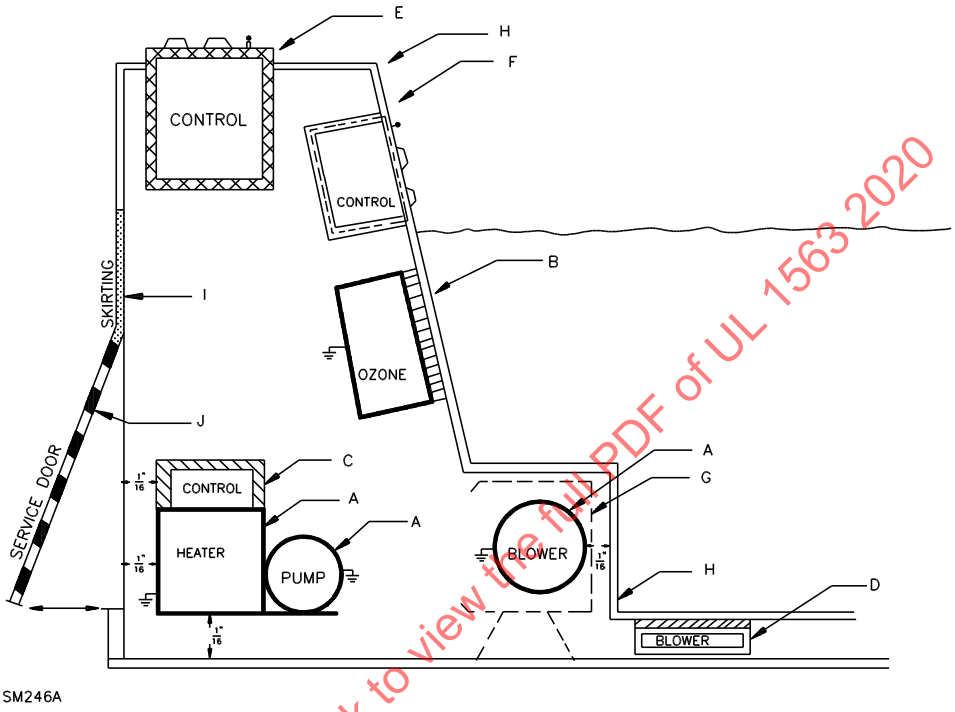
5.24.1 SAFETY CRITICAL FUNCTION – Control, protection and monitoring functions which are being relied upon to reduce the risk of fire, electric shock or casualty hazards.

5.25 SECONDARY CIRCUIT – A circuit supplied from an output winding of an isolating transformer.

5.26 SELF-CONTAINED SPA – A portable spa in which all control, water-heating, and water-circulating equipment is an integral part of the product. Self-contained spas may be permanently wired or cord connected. See Figure 5.1 for an example of a self-contained spa.

Figure 5.1

Example of self-contained spa



A – Grounded metal with spacings to material accessible to the occupant (see 12.4).

B – Grounded metal with insulation in lieu of spacings to material accessible to the occupant (see 12.4).

C – Nonmetallic enclosure of live parts[a] with spacings to material accessible to the occupant (see 8.3.3 and 12.5).

D – Nonmetallic enclosure of live parts[a] with insulation in lieu of spacings to material accessible to the occupant (see 8.3.3 and 12.5).

E – Nonmetallic enclosure of live parts[a] accessible to the occupant (see 8.3.3 and 12.6).

F – Nonmetallic enclosure of live parts[b] accessible to the occupant (see 8.3.3 and 12.7).

G – Alcove/shroud used to support components (see 8.3.5).

H – Tub material (see 8.3.4).

I – Skirting (see 8.3.1, 8.3.2, and 8.3.4).

J – Service door (see 8.1.5, 8.3.1, 8.3.2, and 8.3.4).

[a] Live parts that present a risk of electric shock (see 5.22).

[b] Live parts that do not present a risk of electric shock.

5.27 SKIMMER – A suction opening intended to remove floating debris from the water surface and to be installed where part of the water intake opening is open to atmospheric pressure.

5.28 SPA – A product intended for the immersion of persons in heated water circulated in a closed system, and not intended to be drained and filled with each use. A spa usually includes a filter, a heater (electric, solar, or gas), a pump or pumps, and a control, and may also include other equipment such as lights, blowers, and water sanitizing equipment.

5.29 TEMPERATURE SETTING BY THE USER – Any selection of an operating temperature value by actuation performed by the user.

5.30 TOTALLY ENCLOSED MOTOR – A motor that is enclosed to prevent the free exchange of air between the inside and outside of the enclosure but not necessarily sufficiently enclosed to be airtight.

5.31 UNIT – A collective term used to designate all products covered by this standard; such as a self-contained spa, equipment assembly, blower, and control.

5.32 *Deleted*

6 Accessories

6.1 An accessory intended for field installation shall comply with the applicable requirements in this standard and shall be constructed so that it can be installed and used without the need for altering wiring, enclosure, or other features of the basic unit that are relied upon to reduce the risk of fire, electric shock, or injury to persons.

6A Safety Critical Functions

6A.1 Any function involved in the control, protection, and monitoring of safety-related attributes of a pump whereby a loss/malfunction of its functionality would represent an unacceptable risk of fire, electric shock, or casualty hazards would be considered a Safety Critical Function.

6A.2 Electronic circuits that manage a Safety Critical Function shall be:

a) Reliable as defined as being able to maintain the Safety Critical Function in the event of single defined component faults and

b) Not susceptible to electromagnetic environmental stresses encountered in the anticipated environments of the appliance.

6A.3 Electronic circuits managing Safety Critical Functions shall comply with:

a) Supplement SB; or

b) the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1 and it's Part 2's as specified in this standard. The function shall be considered Class B. When utilizing UL 60730-1, surge protective devices are defeated for the EMC immunity testing unless they are provided with spark gaps (gas tube surge suppressors); or

c) The requirements in Appendix B for circuits providing the Safety Critical heater functions relating to the risk of hyperthermia, scalding and loss of water flow (dry-fire protection).

6A.4 Functions specified in Table 6A.1 represent the common safety critical circuit functions of spas. It is not intended to represent all possible Safety Critical Functions.

Table 6A.1
Safety Critical Functions

Function[a]	Hazard	Location of parameters and tests
Motor running overload protection	Risk of fire or electric shock	Section 29.2
Motor locked rotor protection	Risk of fire or electric shock	Section 29.2
Motor short circuit protection	Risk of fire or electric shock	Section 29.2
Temperature regulating control	Hyperthermia	Section 35
Temperature limiting control	Scalding	Section 36
Water-Flow Controls (dry-fire protection)	Risk of fire, electric shock, or scalding	37.4

[a] Functions specified in the table represent the common safety critical circuit functions of spas. It is not intended to represent all possible safety critical functions. Any function involved in the control, protection, and monitoring of safety-related attributes of a product whereby a loss/malfunction of its functionality would represent an unacceptable risk of fire, electric shock, or casualty hazards would be considered a Safety Critical Function.

CONSTRUCTION

7 General

7.1 A unit shall be evaluated for both indoor and outdoor use unless marked "For Indoor Use Only" or "For Outdoor Use Only."

7.2 A unit that uses a gas heater shall be marked "For Outdoor Use Only" unless an investigation shows that the unit vents heat and exhaust in a manner that complies with the applicable building code.

7A Component Specifications

7A.1 General

7A.1.1 Except as indicated in 7A.1.2, a component of a product covered by this standard shall comply with the requirements for that component as indicated in this Section.

7A.1.2 A component is not required to comply with a specific requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or

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

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

7A.1.3 A component shall be used in accordance with its rating established for the intended conditions of use.

7A.1.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

7A.1.5 Components shall be suitable for the intended use and installation environment. This suitability shall assume the following installation parameters.

a) Outdoor, Pollution Degree III installations.

b) Overvoltage Category II as specified in the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840.

7A.1.6 Components not anticipated by the requirements of this Standard, not specifically covered by a component standard of Component Specifications, Section 7A, and which pose a potential risk of electric shock, fire or casualty hazard shall be additionally investigated. Reference to other product standards is appropriate where those standards anticipate normal and abnormal use conditions consistent with the application of this Standard.

7A.2 Quick-connect wire connectors

7A.2.1 Quick-connect type wire connectors shall be suitable for the wire size, type (solid or stranded), conductor material (copper or aluminum) and the number of conductors terminated. If insulated, they shall be rated for the voltage and temperature of the intended use. They shall be applied per the installation instructions of the wire connector manufacturer.

7A.2.2 Quick-connect type wire connectors shall comply with the Standard for Electrical Quick-Connect Terminals, UL 310.

7A.3 Terminal blocks

7A.3.1 Terminal blocks shall comply with:

a) The Standard for Terminal Blocks, UL 1059, or

b) The Standard for Low-Voltage Switchgear and Controlgear – Part 7-1: Ancillary Equipment – Terminal Blocks for Copper Conductors, UL 60947-7-1, or

c) The Standard for Low-Voltage Switchgear and Controlgear – Part 7-2: Ancillary Equipment – Protective Conductor Terminal Blocks for Copper Conductors, UL 60947-7-2, or

d) The Standard for Low-Voltage Switchgear and Controlgear – Part 7-3: Ancillary Equipment – Safety Requirements for Fuse Terminal Blocks, UL 60947-7-3.

7A.3.2 The UL 60947-7-x Standards are used in conjunction with the Standard for Low-Voltage Switchgear and Controlgear – Part 1: General Rules, UL 60947-1.

7A.3.3 Terminal blocks shall be suitable for the number of conductors per termination, wire size, type (solid or stranded), conductor material (copper or aluminum), voltage and current of the intended use.

7A.4 Wire connectors

7A.4.1 Wire connectors shall be suitable for the wire size, type (solid or stranded), conductor material (copper or aluminum) and the number of conductors terminated. If insulated they shall be suitable for the voltage and current of the intended use. They shall be applied per the installation instructions of the wire connector manufacturer.

7A.4.2 Wire connectors shall comply with the Standard for Wire Connectors, UL 486A-486B, or the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E.

7A.5 Button or coin cell batteries of lithium technologies

Relocated to Clause 37.9.

8 Frame and Enclosure

8.1 General

8.1.1 An enclosure shall be provided to house all electrical parts that may cause a risk of fire, electric shock, or injury to persons under any conditions of operation.

8.1.2 A unit shall be formed and assembled so that it will have the strength and rigidity necessary to resist the abuses to which it is likely to be 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.

8.1.3 Unless marked "For Indoor Use Only," a unit shall be subjected to the simulated rain test described in 54.4.1. A switch, circuit breaker, fuseholder, or similar device and any opening associated with an operating handle shall be shielded from rain.

8.1.4 The shielding specified in 8.1.3 shall be formed of material intended for use as an enclosure, as described in 8.2.1 – 8.3.1, and shall not be detachable from the enclosure without the use of tools.

8.1.5 A service door in a spa shall be held in the closed position by a positive means, such as:

a) A hinged door that is held closed by a magnetic or mechanical latch;

b) A sliding type door; or

c) A non-hinged or non-sliding door that is held in place by a magnetic or mechanical latch or screws complying with 9.6. Also see 39.8.

Exception: This requirement does not apply to a service door providing access only to nonelectrical equipment or to controls that comply with the requirement in 12.6 or 12.8.

8.2 Metal enclosures

8.2.1 The outer enclosure of a unit intended for outdoor use, if of sheet metal, shall not be less than 0.032 inch (0.81 mm) thick if uncoated steel, not less than 0.034 inch (0.86 mm) thick if galvanized steel, and not less than 0.045 inch (1.14 mm) thick if nonferrous. The enclosure shall also comply with Resistance to Corrosion, Section 13.

8.2.2 An enclosure of sheet metal, other than that covered in 8.2.1, shall be evaluated with regard to its size, shape, and thickness, considering the intended use of the complete unit. Sheet steel shall have a thickness of not less than 0.026 inch (0.66 mm) if uncoated when measured, or 0.029 inch (0.74 mm) if galvanized. Nonferrous sheet metal shall have a thickness of not less than 0.036 inch (0.91 mm).

Exception: Any relatively small area or surface that is curved or otherwise reinforced may be thinner than specified if the construction results in equivalent strength and rigidity.

8.2.3 Cast metal portions of an enclosure shall be no thinner than indicated in Table 8.1.

Table 8.1
Minimum thicknesses of enclosure metal

Metal	At small, flat unreinforced surfaces and at surfaces that are reinforced by curving, ribbing, or the like (or are otherwise of a shape or size or both) to provide physical strength,		At relatively large unreinforced flat surfaces,	
	inch	(mm)	inch	(mm)
Die-cast	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

8.3 Nonmetallic enclosures

8.3.1 Among the factors taken into consideration when evaluating the acceptability of a nonmetallic material, other than a polymeric material, when used to enclose grounded metal or live parts are:

a) Mechanical strength;

b) Resistance to impact;

c) Moisture absorptive properties;

d) Combustibility; and

e) Resistance to distortion at temperatures to which the material may be subjected under conditions of normal or abnormal use.

8.3.2 Wooden skirting material used as a barrier to grounded metal shall be minimum 1/4 inch (6.4 mm) thick.

Exception: Wood that is less than 1/4 inch thick may be used as a barrier to grounded metal if the material complies with the impact test described in 56.1. The test may also be used whenever referee tests for the integrity of a material are necessary.

8.3.3 A polymeric material used as the enclosure of live parts, or as a barrier in lieu of spacings shall comply with the applicable requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, based on the application and, if intended to be exposed to sunlight, it shall also be investigated for resistance to the ultraviolet light exposure requirements as specified in UL 746C, except flammability after conditioning is not considered.

8.3.3.1 The polymeric housing of a component is not considered to be an appliance enclosure unless this part is the sole insulation (excluding air) between a live part and an external surface of the appliance.

8.3.4 A polymeric material used as a barrier to grounded metal (such as the tub and skirting material) shall:

a) Be resistant to impact as specified in the Test for Resistance to Impact, Section 56; and

b) When used outdoors, be resistant to the ultraviolet light exposure requirements as specified in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, except that flammability after conditioning is not considered.

Exception No. 1: A polymeric material that is minimum 1/4 inch thick need not be subjected to the Test for Resistance to Impact.

Exception No. 2: Polymeric spa skirting is not required to comply with the requirements in 8.3.4 when:

a) It is used for aesthetic purposes only and is not relied upon to serve as an enclosure of live parts, a barrier to grounded metal, or provide protection from elements of outdoor use, such as water exposure. Examples include use of polymeric materials with wood backing (or other suitable material) where the wood (or other suitable material) serves as the enclosure or the barrier to provide the necessary weather and accessibility protection; or

b) An alcove, cowling, shroud, or similar structure is used that completely encloses all electrical components under the spa skirt; or

c) All components such as pumps, blowers, spa controls, interconnecting cords, and similar parts have been evaluated for outdoor use and are not accessible to the tub occupant.

8.3.5 An alcove, cowling, shroud, or similar structure used under the skirt of a spa to support components or as a supporting framework shall have a minimum flame rating of HB or HBF. The material shall be suitable for the temperatures to which it is subjected to under conditions of normal use. Additional factors taken into consideration when evaluating its acceptability include but are not limited to:

a) Mechanical strength and

b) Resistance to impact.

8.3.6 The polymeric materials specified in 8.3.3 and 8.3.4, when molded or fabricated by a source other than the manufacturer of the unit, shall comply with the requirements in the Standard for Polymeric Materials – Fabricated Parts, UL 746D.

8.3.7 A polymeric enclosure, barrier, or similar part enclosing or protecting a component which presents a risk of electric shock (as defined in 5.22) and/or injury to persons due to its location or intended use under normal or abnormal use, or that may be used as a seat, step, or support structure facilitating entry or exit from the spa, shall comply with the applicable structural integrity tests as specified in Structural Integrity Tests, Section 62.

Exception: Small parts such as spa side controls or other similar parts that are unlikely to be subjected to the loading effects anticipated by the structural integrity tests shall be subjected to the Test for Resistance to Impact, Section 56.

8.4 Drainage

8.4.1 An enclosure shall be constructed so that there will be no reduction in the effectiveness of the electrical insulation due to breakdown of water connections or shaft seals, flooding onto a mounting surface or within the outer enclosure, or rupture of a boot, diaphragm, shaft seal, or the like, as determined in the Water Exposure Test, Section 54.

8.4.2 An enclosure of an outdoor unit containing an electrical component, other than for a motor having a sealed housing, shall have provision for drainage when there is a knockout or unthreaded opening in the enclosure, or when there is risk of condensation accumulation.

8.4.3 The lowest portion of any live part in a hot tub or spa shall be at least 4 inches (102 mm) above the surface on which the unit will ultimately be installed.

8.4.4 An enclosure shall be provided with means for drainage so that there will be no submersion of components as determined in the Water Exposure Test, Section 54.

8.5 Mounting pads or holes

8.5.1 Mounting pads or holes for wall mounting of an assembly shall be external to the enclosure unless the assembly is marked for indoor use only, as indicated in 70.1.

8.5.2 A unit intended for permanent connection shall be provided with means for mounting or support. Fittings necessary for proper mounting, such as brackets, hangers, or the like, shall be furnished with the unit.

8.6 Barriers

8.6.1 The enclosure shall reduce the risk of molten metal, burning insulation, flaming particles, or the like falling on combustible materials, including the surface upon which the unit is supported.

Exception: A permanently connected unit not intended for mounting on combustible surfaces may have an open bottom if it is marked in accordance with 72.2.2 or 72.3.2, as applicable.

8.6.2 The requirement in 8.6.1 necessitates use of a barrier of combustion-resistant material:

a) Under a motor unless:

1) The structural parts of the motor or of the overall unit provide the equivalent of such a barrier;

2) The protection provided with the motor is such that no burning insulation or molten material falls to the surface that supports the unit when the motor is energized under each of the following four fault conditions, applied separately:

i) Main winding opened;

ii) Starting winding opened;

iii) Starting switch short circuited; and

iv) For a permanent-split-capacitor motor, the capacitor short circuited (the short circuit is to be applied before the motor is energized, and the rotor is to be locked); or

3) The motor is provided with a thermal motor protector (a protective device that is sensitive to both temperature and current) that will reduce the risk of the temperature of the motor windings from becoming more than 125°C (257°F) under the maximum load under which the motor will run without causing the protector to cycle, and from becoming more than 150°C (302°F) with the rotor of the motor locked.

b) Under wiring unless it is of the flame-retardant type. Neoprene- or thermoplastic-insulated wires are considered to be of this type.

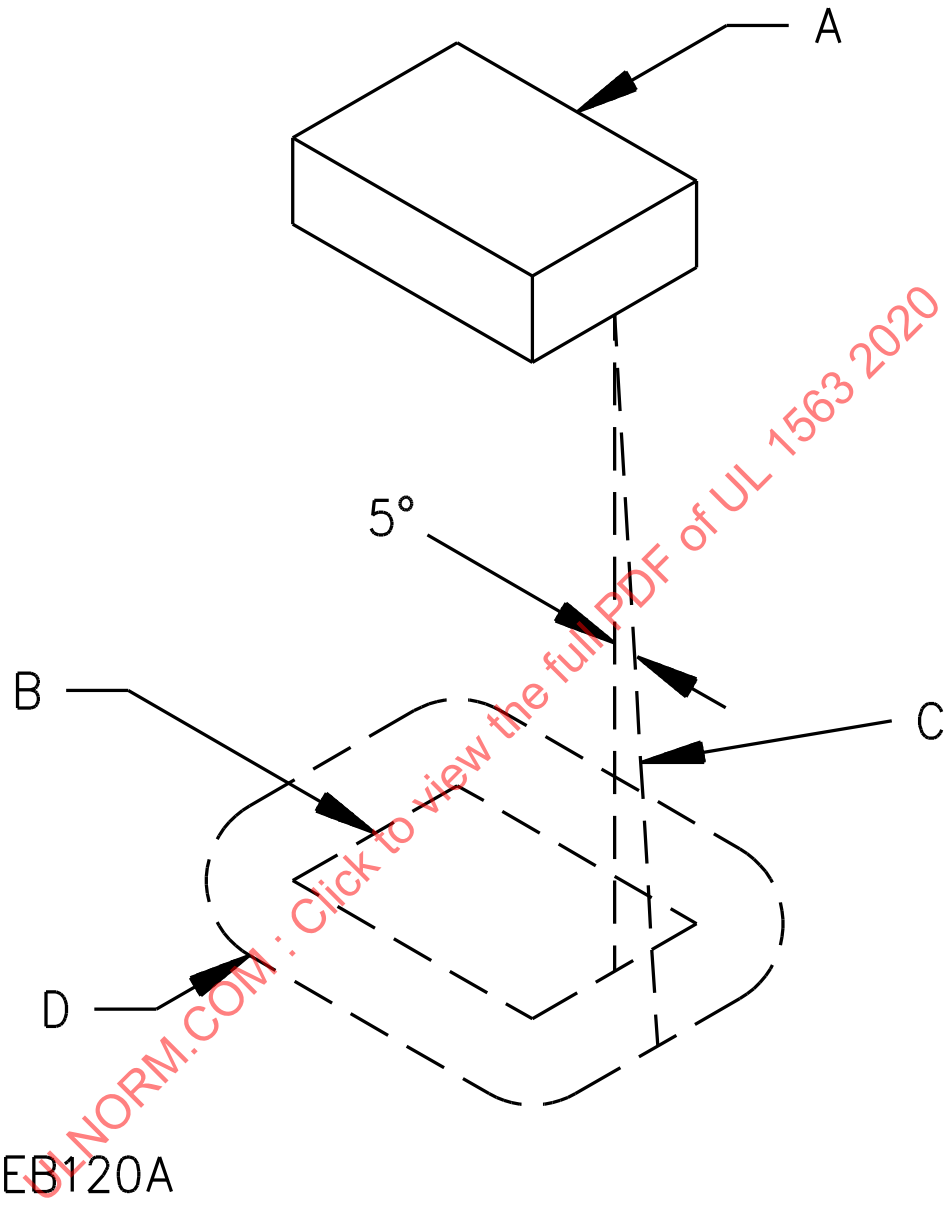
8.6.3 The requirement in 8.6.1 necessitates that a switch, transformer, relay, solenoid, or the like be individually and completely enclosed other than at terminals, unless it can be shown that malfunction of the component would not result in a risk of fire, or unless there are no openings in the bottom of the enclosure. An opening in the bottom of the enclosure shall not be located directly below field- or factory-made splices or overload or overcurrent protective devices.

8.6.4 The barrier mentioned in 8.6.2 shall be horizontal, shall be located as indicated in Figure 8.1, and shall not have an area less than that described in the figure. Openings for drainage, ventilation, or the like

may be employed in the barrier, provided such openings would not increase the risk of molten metal, burning insulation, or the like falling on combustible material.

Figure 8.1

Location and extent of barrier



A – Region to be shielded by barrier. This shall consist of the entire component if it is not otherwise shielded, and shall consist of the unshielded portion of a component which is partially shielded by the component enclosure or equivalent.

B – Projection of outline of component on horizontal plane.

C – Inclined line that traces out minimum area of barrier. When moving, the line is always:

1) Tangent to the component,

2) 5 degrees from the vertical, and

3) So oriented that the area traced out on a horizontal plane is maximum.

D – Location (horizontal) and minimum area for barrier. The area is that included inside the line of intersection traced out by the inclined line C and the horizontal plane of the barrier.

8.6.5 The barrier specified in 8.6.2 shall have a minimum flammability rating of 5VA in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

8.7 Ventilating openings

8.7.1 An opening in an enclosure for ventilation or for the dissipation of heated air shall be provided with one or more baffles to reduce the risk of emission of flame, molten metal, or burning insulation.

Exception No. 1: An opening in the bottom of the enclosure need not be provided with baffles unless otherwise required by 8.6.1 – 8.6.4.

Exception No. 2: In a compartment other than one that houses an overload or overcurrent protective device, the baffles may be omitted if the opening is in a vertical wall and is a maximum of 3/8 inch (9.5 mm) wide.

9 Mechanical Assembly

9.1 A unit shall be assembled so that it will not be adversely affected by the vibration of operation. Brush caps shall be tightly threaded or otherwise designed so as not to loosen.

9.2 A switch, a lampholder, an attachment plug receptacle, a motor attachment plug, or similar component shall be mounted securely and shall be prevented from turning.

Exception No. 1: 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 or other type that does not tend to rotate when operated (a toggle switch is considered to be subjected to forces that tend to turn the switch during operation of the switch),

b) Means of mounting the switch make it unlikely that operation of the switch will loosen it,

c) The spacings are not reduced below the minimum required values if the switch rotates, and

d) Operation of the switch is to be by mechanical means rather than contact by persons.

Exception No. 2: A lampholder of a type in which the lamp cannot be replaced (such as a neon pilot or indicator lamp in which the lamp is sealed in a nonremovable jewel) need not be prevented from turning if rotation cannot reduce spacings below the minimum acceptable values or adversely affect water resistance of outdoor units.

9.3 The means for preventing the turning mentioned in 9.2 is to consist of more than friction between surfaces – for example, a lock washer may be used as means for preventing a small stem-mounted switch or other device having a single-hole mounting means from turning.

9.4 Each uninsulated live part shall be secured to the base or mounting surface so that it will not turn or shift in position if such motion may result in a reduction of spacings below the minimum values indicated in Spacings, Section 25.

9.5 Tin-lead solder shall not be used for the fastening of seams or the assembly of parts.

9.6 Screws that attach a cover, door, or other part that is removed to operate the unit or to install field wiring shall be retained by at least two full threads into metal.