



UL 1795

STANDARD FOR SAFETY

Hydromassage Bathtubs

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UL Standard for Safety for Hydromassage Bathtubs, UL 1795

Fourth Edition, Dated August 5, 2009

Summary of Topics

This revision of UL 1795 is being issued to add requirements for ozone generators.

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. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

The new requirements are substantially in accordance with Proposal(s) on this subject dated November 4, 2011.

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The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

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AUGUST 5, 2009

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1

UL 1795

Standard for Hydromassage Bathtubs

First Edition – February, 1988

Second Edition – November, 1993

Third Edition – March, 1999

Fourth Edition

August 5, 2009

This UL Standard for Safety consists of the Fourth Edition including revisions through January 13, 2012.

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 <http://csds.ul.com>.

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CONTENTS

INTRODUCTION

1 Scope	7
2 Components	7
3 Units of measurement	7
4 Undated references	8
5 Glossary	8
6 Accessories	8D

CONSTRUCTION

7 General	8D
7A Component Specifications	8D
7A.1 General	8D
7A.2 Quick-connect wire connectors	8E
7A.3 Terminal blocks	8E
7A.4 Wire connectors	8F
8 Frame and Enclosure	8F
8.1 General	8F
8.2 Barriers	11
8.3 Moving parts	14
9 Mechanical Assembly	14
9.1 General	14
9.2 Adhesive used to secure parts	15
10 Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving Parts	16
11 Provisions for Servicing	21
12 Resistance to Corrosion	22
13 Power Supply Connections	23
13.1 General	23
13.2 Permanently connected units	24
13.3 Cord- and plug-connected units	27
14 Live Parts	27
15 Internal Wiring	28
15.1 General	28
15.2 Splices and connections	29
16 Separation of Circuits	30
17 Grounding	31
18 Equipotential Bonding	32
19 Circuits	33
19.1 General	33
19.2 Secondary circuits	34
19.3 Circuits accessible to a bathtub occupant	34
19.4 Safety circuits	34
20 Insulation	34
20.1 Electrical insulation	34
20.2 Thermal insulation	35
21 Printed-Wiring Boards	35
22 Spacings	36
22.1 General	36
22.2 Class 2 circuits	36

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22.3	Field-wiring terminals	36
22.4	Other than field-wiring terminals	36
22.5	Safety circuits	36
22.6	Printed-wiring boards	36
22.7	Spacings within motors	36A
23	Ground-Fault Circuit-Interrupters	36A
24	Electric Heaters	36A
25	Hydromassage Bathtubs Configured for Field-Installed Heaters	36A
26	Field-Installed Heaters	36B
27	Heater Protection	36B
28	Motors	37
28A	Motor Overload Protection	38
29	Air Blowers	39
30	Overload Protection	39
31	Leakage Current Collectors	42
32	Gaskets	42A
33	Luminaires	42A
34	Capacitors	42A
35	Transformers	42B
36	Switches, Receptacles, and Controls	44
36.1	General	44
36.2	Manually-operated switches	44A
36.3	Reduction of risk of injury to persons	44B
37	Sharp Edges	44B
38	Temperature-Regulating Controls	44B
38.1	General	44B
38.2	Temperature-regulating controls with a marked or implied "off" position	45
39	Temperature-Limiting Controls	46
39.1	General	46
39.2	Temperature-sensitive controls	46
39.3	Pressure-sensitive controls	48
39A	Temperature sensing, thermistor devices	48B
40	Parts Subject to Pressure	49
41	Protection Against Entrapment	49
42	Direct Plug-In Controls	50
42A	Ozone Generators	50A

PERFORMANCE

43	General	51
44	Insulation Resistance Test	51
45	Starting Current Test	51
46	Power Input Test	52
47	Temperature Test	52
48	Dielectric Voltage-Withstand Test	56
48.1	General	56
48.2	Class 2 circuits	57
48.3	Printed-wiring boards	57
49	Switch Overload Test	57
50	Water Temperature Tests	58
50.1	General	58
50.2	Normal operation	58
50.3	Abnormal operation	59

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51	Water Exposure Test	60
51.1	General	60
51.2	Splashing	61
51.3	Flooding	61
52	Available Current Test	61
53	Test for Leakage Current After Heating Element Failure	62
54	Grounding Impedance Test	63
55	Flow Rate Test	63
56	Gaskets and Seals – Accelerated Aging Test	64
56A	Ozone Offgas Test	64
57	Abnormal Operation Tests	64A
57.1	Water back flow	64A
57.2	Electrolytic capacitor	65
57.3	Rotating parts test	65
57.4	Transformer test	65
57.5	Dry-fire control operation	65
58	Tests for Parts Subject to Pressure	66
58.1	Hydrostatic pressure test	66
58.2	Reverse hydrostatic pressure test	66
58.3	Check valves	66
59	Metallic Coating Thickness Test	66
60	Strain Relief Test	68
61	Leakage Current Test	68
62	Tests for Field-Installed Heaters	71
63	Direct Plug-In Controls	71

MANUFACTURING AND PRODUCTION-LINE TEST

64	Dielectric Voltage-Withstand Test	72
----	---	----

RATINGS

65	General	73
----	---------------	----

MARKINGS

66	General	73
67	Cord Tags	76
68	Hydromassage Bathtubs Configured for Field-Installed Heaters	77
69	Field-Installed Heaters	77
70	Direct Plug-In Controls	78

INSTRUCTIONS

71	General	79
72	Instructions Pertaining to a Risk of Fire, Electric Shock, or Injury to Persons	80
73	Operating Instructions	81
74	Installation Instructions	82
75	User-Maintenance Instructions	83

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APPENDIX A**APPENDIX B****REQUIREMENTS FOR ELECTRONIC CONTROLS EVALUATED TO THE STANDARD FOR
TEMPERATURE-INDICATING AND -REGULATING EQUIPMENT, UL 873**

B1 General	B1
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INTRODUCTION

1 Scope

1.1 These requirements cover indoor hydromassage bathtubs, rated 250 volts or less, for household and commercial use, for permanent connection to the plumbing of the building. They are intended for either permanent connection to the electrical supply or are factory-provided with a cord terminating in an attachment plug, and are intended for installation and use in accordance with the National Electrical Code, NFPA 70.

1.2 These requirements do not cover portable cord-connected hydromassage equipment, which is covered by the Standard for Personal Hygiene and Health Care Appliances, UL 1431, or hydrotherapy tubs, which are covered by the Standard for Medical Electrical Equipment, Part 1: General Requirements for Safety, UL 60601-1.

1.2 revised March 23, 2010

1.3 The majority of the requirements in this Standard address complete hydromassage bathtubs, including field-installed accessories. The following sections specify requirements for field-installed accessory heaters evaluated and certified for the hydromassage bathtub manufacturer.

- a) Hydromassage Bathtubs Configured for Field-Installed Heaters, (CONSTRUCTION) Section 25, and
- b) Field-Installed Heaters, Section 26.
- c) Test for Field-Installed Heaters, (PERFORMANCE) Section 62.
- d) Hydromassage Bathtubs Configured for Field-Installed Heaters, (MARKINGS) Section 68, and
- e) Field-Installed Heaters, Section 69.

2 Components

Section 2 revised and relocated as Section 7A.1 August 23, 2011

3 Units of measurement

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

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

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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, either directly or by means of a tool during user servicing, or that is not recessed the required distance behind an opening.

5.3 **ACCESSIBLE TO THE OCCUPANT** – Any surface or component within a 5-foot (1.52-m) reach path of the bathtub occupant.

5.4 **ACCESSORY** – An optional electrical component that is intended to be attached to the main equipment in the field or that may be shipped separately from the main equipment.

5.5 **CLASS 2 CIRCUIT** – A secondary circuit with an open circuit potential of no more than 30 volts rms (42.4 volts peak) supplied by either an inherently limited Class 2 transformer or by a transformer and fixed impedance that together comply with all performance requirements for inherently limited Class 2 transformers in the Standard for Low Voltage Transformers – Part 1: General Requirements, UL 5085-1, and the Standard for Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers, UL 5085-3.

5.6 **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.

5.6.1 **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.

5.6.1 added August 23, 2011

5.6.2 **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 bathtub lighting.

5.6.2 added August 23, 2011

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

5.6.3 added August 23, 2011

5.6.4 **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 bathtub water to a user-determined level.

5.6.4 added August 23, 2011

5.6.5 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.

5.6.5 added August 23, 2011

5.6.6 CONTROL, TYPE 2 ACTION – The actuation of an automatic control (see 5.6.1) 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.

5.6.6 added August 23, 2011

5.6.7 CONTROL, TYPE 2.D.H ACTION – This action is applicable to manual controls (see 5.6.3). 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.

5.6.7 added August 23, 2011

5.6.8 CONTROL, TYPE 2.D.J ACTION – This action is applicable to manual controls (see 5.6.3). 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.

5.6.8 added August 23, 2011

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

5.8 DEAD METAL – A metal part not connected to electrical circuitry and not intended to conduct current. Does not include an isolated metal name plate, cabinet trim, screws, or small metal hardware fastened to a nonconductive enclosure.

5.9 DOUBLE INSULATION – An insulation system comprised of basic insulation and supplementary insulation, with the two insulations physically separated and arranged so that they are not simultaneously subjected to the same deteriorating influences (temperature, contaminants, or the like) to the same degree.

5.10 DRY-FIRE PROTECTION – A device or circuit that de-energizes the heater whenever water circulation through the heater is interrupted.

5.11 ENCLOSURE – That part of a unit that:

- a) Renders inaccessible any part that may present a risk of electric shock;
- b) Prevents emission of flame or molten material; or

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- c) Prevents unintentional contact with internal parts that may involve a risk of injury.

Some examples are tub materials, skirting materials, service access covers, electrical boxes, and barriers.

5.12 FIELD-WIRING TERMINAL – A terminal or terminals to which the electrical supply is to be connected during installation of the unit.

5.13 HYDROMASSAGE BATHTUB – A permanently installed bathtub equipped with a recirculating piping system, a pump, and associated plumbing constructed to accept, circulate, and discharge water upon each use. Optional equipment such as control switches, timers, blowers, heaters, temperature controls, air bubblers, and luminaires may be provided. A hydromassage bathtub may be provided with an air blower and no recirculating pump.

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

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

5.16 LEAKAGE CURRENT COLLECTOR – Conductive metal in the circulating water system of a hydromassage bathtub that provides a path for leakage current to ground.

5.17 LIVE PART – A part at some potential with respect to another part, or to earth ground.

5.18 MAXIMUM NORMAL LOAD – A load that closely approximates the most severe conditions of normal use.

5.19 PRIMARY CIRCUIT – An input circuit that supplies energy to a product.

5.20 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 52. 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

5.20 revised August 23, 2011

Table 5.1
Risk of electric shock limits

Table 5.1 added August 23, 2011

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
Bathtub water and ground	0.5	2.0
Any point accessible to the bathtub occupant and ground	0.5	2.0
Any point on the bathtub control and ground ^a	0.5	2.0
Any two points on the bathtub 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.		

5.21 RISK OF FIRE – A risk of fire is considered to exist if the available power at any point exceeds Class 2 levels as defined in 5.5.

5.22 SAFETY CIRCUIT – Any circuit that is relied upon to reduce the risk of fire, electric shock, or unintentional contact with moving parts. An interlock circuit, a temperature-limiting control, a temperature-regulating control, an open neutral circuit, or a dry-fire control is considered to be a safety circuit.

5.23 SECONDARY CIRCUIT – A circuit derived from the secondary of an isolating transformer.

5.24 TRIP-FREE TEMPERATURE-LIMITING CONTROL – A control device constructed so that, regardless of the position of the actuating handle, button, or lever, the contacts cannot be held in the closed position when the water has attained a temperature hotter than specified.

5.25 UNIT – A term meaning a hydromassage bathtub.

5.26 USER SERVICING – Any form of servicing that may be performed by anyone other than qualified service personnel.

6 Accessories

6.1 An accessory for optional use shall comply with the applicable requirements of this standard and shall be constructed such that it can be used without alteration of wiring, enclosure, or other features of the main equipment depended upon to reduce the risk of fire, electric shock, or injury to persons. If the main equipment has provisions for electrical or mechanical connections to field applied accessories, such accessories shall be investigated with the main equipment and accompanied by installation instructions. An accessory that is made available or recommended by the manufacturer shall be investigated with the unit.

6.2 Each accessory connector shall be marked to indicate that the accessory is to be connected as specified in 66.13.

CONSTRUCTION

7 General

7.1 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 introducing a 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.

7.2 A hydromassage bathtub is not prohibited from:

- a) Being provided as a completely enclosed unit;
- b) Having only one finished side for built-in installations; or
- c) Being without finished sides for custom installations.

7.3 A completely enclosed unit shall provide access for splice inspection and routine maintenance after final installation. A unit intended for built-in or custom installation shall include instructions that detail the access for splice inspection and routine maintenance after final installation. See 74.5.

7A Component Specifications

7A added August 23, 2011

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) Pollution Degree III installations.

Exception: Components installed so they reside entirely in the user (bathroom) side of the tub installation.

- 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.

8 Frame and Enclosure

8.1 General

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

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

8.1.3 An enclosure containing an electrical component, other than a motor having a sealed housing, shall have provision for drainage if there is a knockout or unthreaded opening in the enclosure or if there is a risk of condensation accumulating.

8.1.4 The material of a part, such as an enclosure, a frame, or a guard, the breakage of which may result in a risk of injury to persons, shall have such properties as to meet the demand of expected loading conditions.

8.1.5 The requirement in 8.1.4 applies to those portions of a part adjacent to moving parts considered to involve a risk of injury to persons.

8.1.6 An enclosure shall be judged with respect to its size, shape, and thickness, considering the intended use. Sheet steel shall be not less than 0.026 inch (0.66 mm) thick if uncoated or 0.029 inch (0.74 mm) thick if galvanized. Nonferrous sheet metal shall be not less than 0.036 inch (0.91 mm) thick.

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.

8.1.7 For unreinforced, flat surfaces in general, cast metal shall be no less than 1/8 inch (3.2 mm) thick, malleable iron shall be not less than 3/32 inch (2.4 mm) thick, and die-cast metal shall be not less than 5/64 inch (2.0 mm) thick.

Exception: Corresponding thicknesses of not less than 3/32, 1/16 (1.6 mm), and 3/64 inch (1.2 mm), respectively, are not prohibited from being used when the surface under consideration is curved, ribbed, or otherwise reinforced, or when the shape or size of the surface, or both, is such that the required physical strength is provided.

8.1.8 Among the factors taken into consideration when investigating a material used as an enclosure are its:

- a) Physical strength;
- b) Resistance to impact;
- c) Moisture-absorptive properties;
- d) Combustibility;
- e) Resistance to corrosion; and

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- f) Resistance to distortion at temperatures to which the enclosure may be subjected under conditions of normal or abnormal use.

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

8.1.9 All electrical parts shall be located or enclosed so as to reduce the risk of unintentional contact with any uninsulated live part or internal wiring.

8.1.10 Live parts shall be located at least 1-1/2 inches (38.1 mm) above the intended mounting surface.

8.1.11 Polymeric materials shall comply with the applicable requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

Exception: A polymeric tub material of a hydromassage bathtub within which each electrical component is provided with a suitable electrical enclosure, as specified in Frame and Enclosure, Section 8, and Internal Wiring, Section 15, are not required to comply with the requirements in UL 746C.

8.1.12 The polymeric materials specified in 8.1.11, when molded or fabricated by a source other than the manufacturer, shall be identified according to the Standard for Polymeric Materials – Fabricated Parts, UL 746D.

8.2 Barriers

8.2.1 An opening in the bottom of the enclosure is not acceptable if the opening is located directly below field- or factory-made splices or overload or overcurrent protective devices.

8.2.2 A barrier of material that is resistant to combustion shall be provided:

a) Under a motor unless:

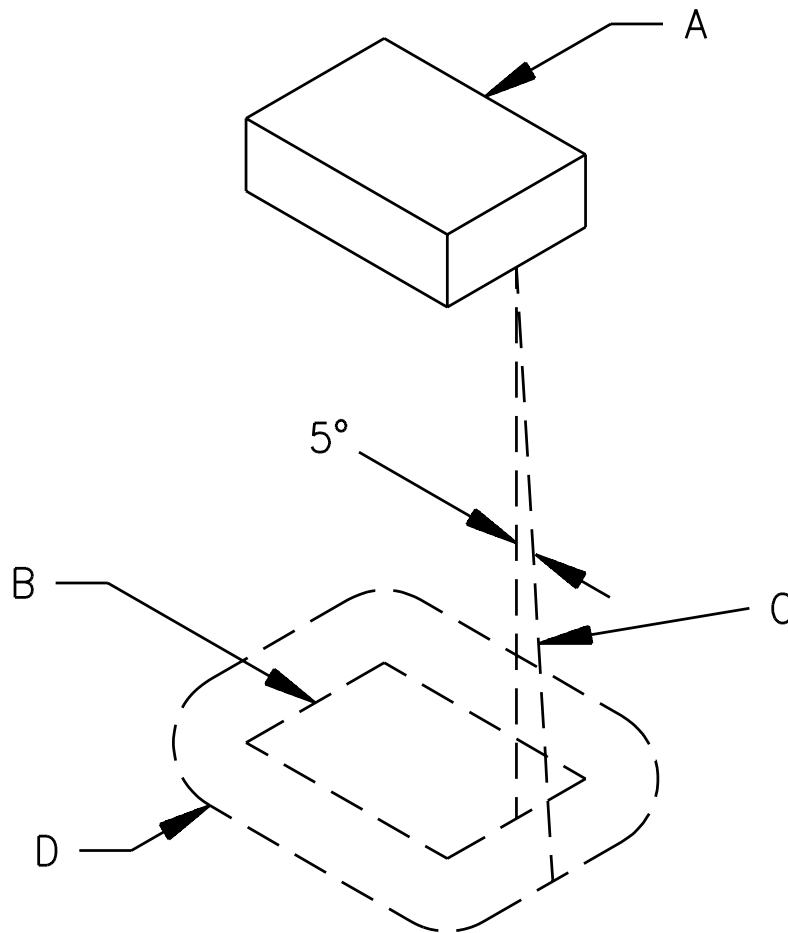
- 1) The structural parts of the motor or of the overall unit provide the equivalent of such a barrier; or
- 2) The protection provided with the motor is such that no burning insulation or molten material falls to the surface that supports the unit when the motor is energized under each of the following 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 prevent 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.

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

8.2.3 The barrier specified in 8.2.2 shall be horizontal, located as indicated in Figure 8.1, and shall have an area no less than that described in Figure 8.1. Openings for drainage or ventilation may be provided in the barrier, provided that such openings will not permit molten metal or burning insulation to fall on combustible material.

Figure 8.1
Location and extent of barrier



EB120A

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) Oriented so that the area traced out on a horizontal plane is a 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.

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8.2.4 A switch, transformer, relay, or solenoid is to be individually and completely enclosed other than at terminals, unless it can be shown that malfunction of the component will not result in a risk of fire, or unless there are no openings in the bottom of the enclosure.

8.2.5 The barrier specified in 8.2.2, if plastic, shall have a minimum rating of 5VA in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

8.3 Moving parts

8.3.1 The rotor of a motor, a pulley, a belt, a gear, or other moving part that could cause injury to persons shall be enclosed or guarded to reduce the likelihood of unintentional contact.

9 Mechanical Assembly

9.1 General

9.1.1 A unit shall be assembled so that it will not be adversely affected by vibration. Motor brush caps shall be constructed so as not to loosen.

9.1.2 A unit shall be provided with an integral mounting means for the pump or air blower and shall be shipped from the factory with the pump or air blower mounted and plumbed in place.

Exception No. 1: The pump may be shipped with the bathtub but not secured or plumbed in place if the pump is provided:

- a) With provision to be plumbed to the bathtub with threaded unions and the pump and bathtub are factory assembled with all appropriate fittings and*
- b) In the same shipping container as the bathtub.*

Exception No. 2: The bathtub is not required to be provided with a pump mounting platform if the pump is provided with an integral mounting base that can be secured with the use of screws.

Exception No. 3: The pump may be shipped separately from the bathtub if:

- a) The pump is provided with provision to be plumbed to the bathtub with threaded unions and the pump and bathtub are factory assembled with all appropriate fittings and*
- b) The bathtub is marked with the following or the equivalent, "Pump shipped separately. Complete unit includes pump(s) ____, Model ____." The blanks shall be filled in with the name of the manufacturer and model number for the pump(s).*

Exception No. 4: Air blowers intended for field installation and that are part of optional kits may be mounted remote from the bathtub.

9.2 Adhesive used to secure parts

9.2.1 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.

9.2.2 The requirement in 9.2.1 applies to an adhesive used to secure a conductive part, including a nameplate, that may, if loosened or dislodged:

- a) Energize an accessible dead-metal part;
- b) Make a live part accessible;
- c) Reduce spacings below the minimum values described in Spacings, Section 22;
- d) Short circuit live parts; or
- e) Bridge live parts to ground, to dead metal, or to a Class 2 or safety circuit.

9.2.3 All electrical components shall be mounted securely and shall be prevented from turning.

Exception No. 1: An electric switch is not required to be prevented from turning when:

- 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 subject to forces that tend to turn the switch during intended operation of the switch);*
- b) The means of mounting the switch make it unlikely that operation of the switch will loosen it;*
- c) Electrical spacings are not reduced below the minimum required values if the switch rotates;*
- d) Strain is not transmitted to internal wiring; and*
- e) Intended operation of the switch is to be by mechanical means rather than by direct contact by persons.*

Exception No. 2: A lampholder with a nonreplaceable lamp need not be prevented from turning if:

- a) Rotation cannot reduce electrical spacings below the minimum required values,*
- b) Strain is not transmitted to internal wiring, and*
- c) The rotation does not affect the integrity of a watertight enclosure.*

9.2.4 An uninsulated live part shall be secured to its base or mounting surface so that it will be prevented from turning or shifting in position if such motion may result in a reduction of spacings below the minimum required values.

9.2.5 Friction between surfaces shall not be used as the sole means to prevent shifting or turning of live parts or shifting or turning of a device having a single-hole mounting means. A lock washer installed as intended may be used.

9.2.6 A unit is not prohibited from being shipped from the factory unassembled, or disassembled to the degree necessary to facilitate shipment, when:

- a) All of the parts are furnished by the manufacturer;
- b) Adequate electrical continuity is provided between the field-assembled components;
- c) The equipment is constructed so that the field assembly can be accomplished without drilling, cutting, threading, or any other alteration other than the attachment of field-installed electrical conduit or raceway;
- d) Detailed, step-by-step installation instructions are provided with the unit; and
- e) All safety features are factory installed.

10 Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving Parts

10.1 To reduce the risk of unintentional contact that may involve a risk of:

- a) Electric shock from an uninsulated live part or film-coated wire or
- b) Injury to persons from a moving part, an opening in an enclosure shall comply with either (1) or (2).
 - 1) For an opening that has a minor dimension as described in 10.5 of less than 1 inch (25.4 mm), an uninsulated live part, a moving part, or film-coated wire shall not be contacted by the probe illustrated in Figure 10.1.
 - 2) For an opening that has a minor dimension as described in 10.5 of 1 inch or more, an uninsulated part, a moving part, or film-coated wire shall be spaced from the opening as specified in Table 10.1.

Exception: An opening in a motor is not required to comply with these requirements when it complies with the requirements in 10.2.

10.2 With regard to a moving part or film-coated wire within the enclosure of a motor as specified in the Exception to 10.1:

- a) An opening that has a minor dimension, as described in 10.5, of less than 3/4 inch (19.1 mm) is not prohibited when:
 - 1) In an indirectly accessible motor, an uninsulated live part or a moving part cannot be contacted by the probe illustrated in Figure 10.2,
 - 2) Film-coated wire cannot be contacted by the probe illustrated in Figure 10.3, and
 - 3) In a directly accessible motor, an uninsulated live part or a moving part cannot be contacted by the probe illustrated in Figure 10.4.

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b) An opening that has a minor dimension of 3/4 inch or more is acceptable if an uninsulated live part, a moving part, or film-coated wire is spaced from the opening as specified in Table 10.1.

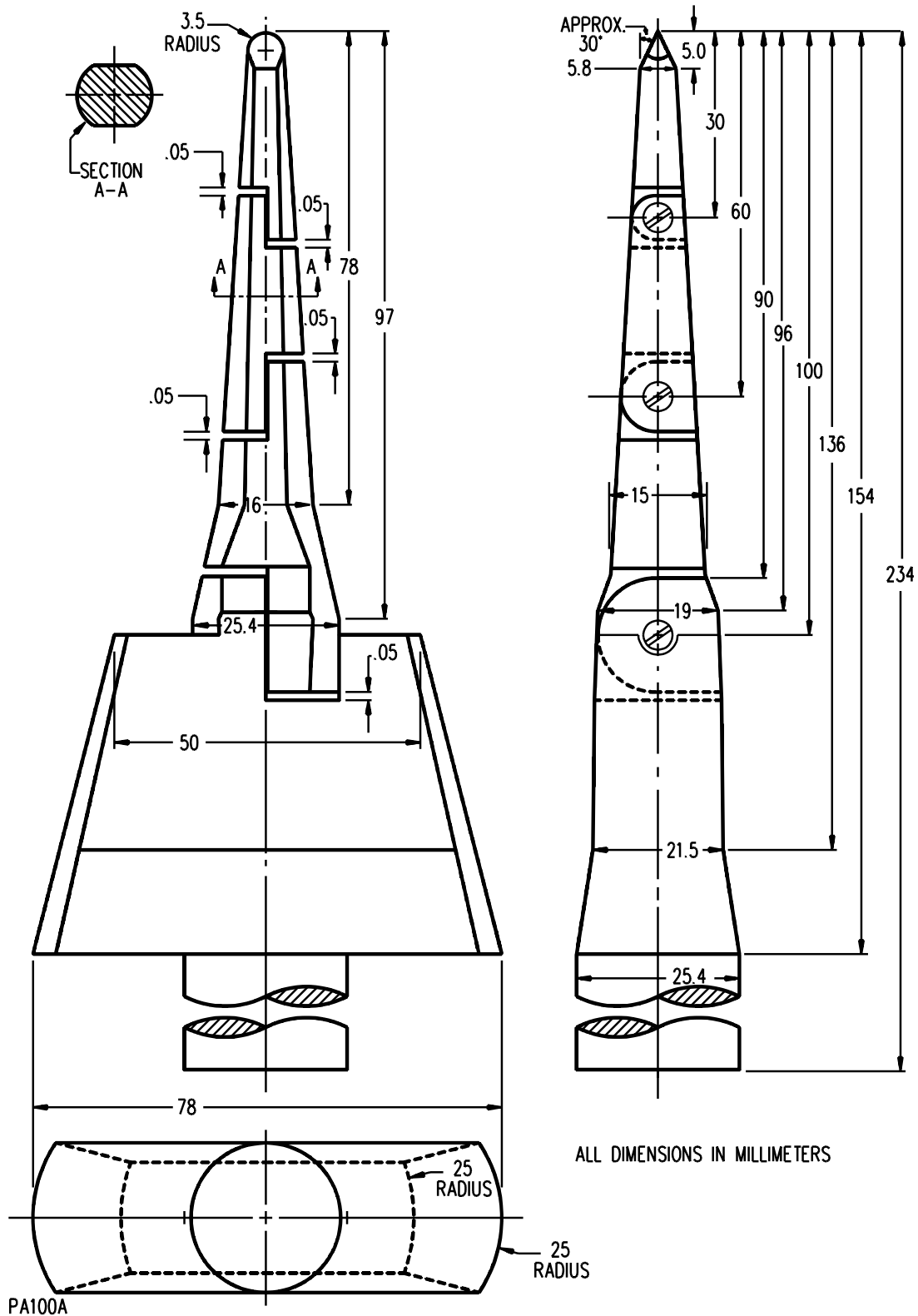
10.3 The probes specified in 10.1 and 10.2 and illustrated in Figures 10.1 – 10.4 shall be applied to any depth that the opening illustrated in Figure 10.5 will permit, and shall be rotated or angled before, during, and after insertion through the opening to any position that is necessary to examine the enclosure. The probes illustrated in Figures 10.1 and 10.4 shall be applied in any possible configuration; and, if necessary, the configuration shall be changed after insertion through the opening.

10.4 The probes illustrated in Figures 10.1 – 10.4 shall be used as measuring instruments to judge the accessibility provided by an opening, and not as instruments to judge the strength of a material; they shall be applied with the minimum force necessary to determine accessibility.

10.5 With reference to the requirements in 10.1 and 10.2, the minor dimension of an opening is the diameter of the largest cylindrical probe having a hemispherical tip that can be inserted through the opening.

10.6 During the examination of a unit to determine whether it complies with the requirements in 10.1 or 10.2, a part of the enclosure that may be opened or removed by the user without using a tool (to attach an accessory, to make an operating adjustment, or for other reasons) is to be opened or removed.

Figure 10.1
Accessibility probe



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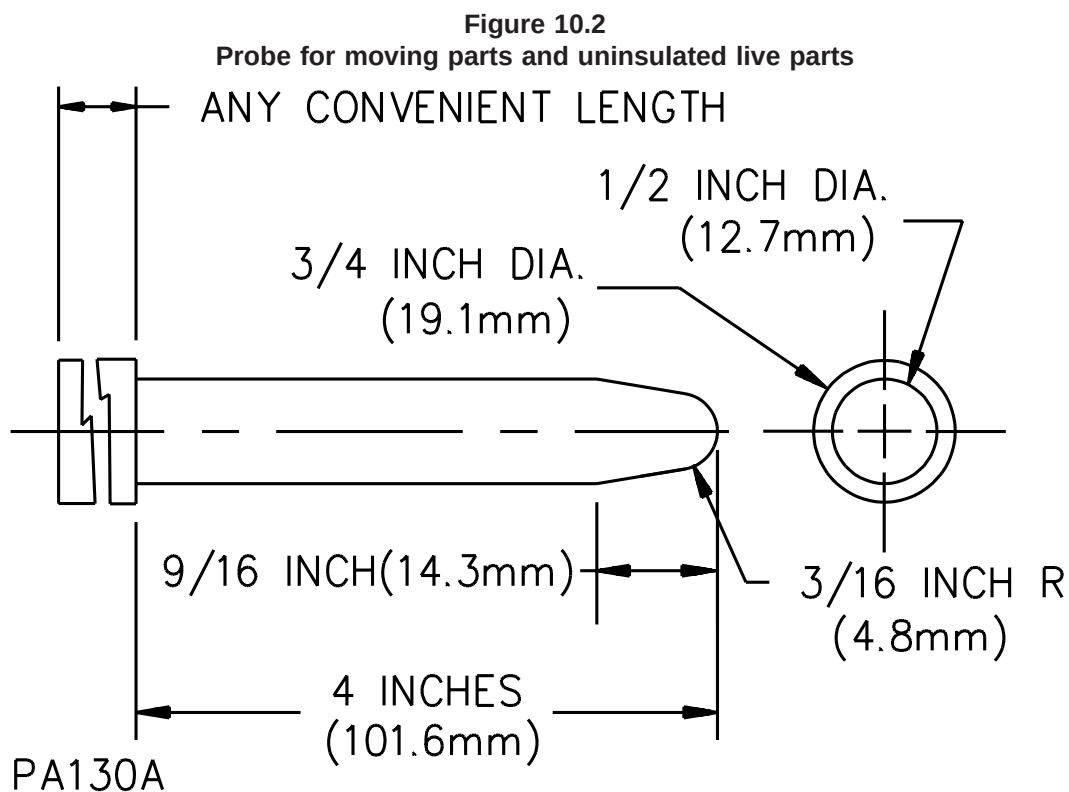
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Table 10.1
Minimum distance from an opening to a part that may involve a risk of electric shock or injury to persons

Minor dimension ^a of opening, inches ^b (mm) ^b		Minimum distance from opening to part, inches ^b (mm) ^b	
3/4 ^c	19.1	4-1/2	114.0
1 ^c	25.4	6-1/2	165.0
1-1/4	31.8	7-1/2	191.0
1-1/2	38.1	12-1/2	318.0
1-7/8	47.6	15-1/2	394.0
2-1/8	54.0	17-1/2	445.0
d	d	30	762.0

^a See 10.5 for a description of the minor dimension of an opening.
^b Between 3/4 inch and 2-1/8 inches, interpolation is to be used to determine a value between values specified in the table.
^c Any dimension less than 1 inch applies to a motor only.
^d More than 2-1/8 inches, but not more than 6 inches (152 mm).



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Figure 10.3
Probe for film-coated wire

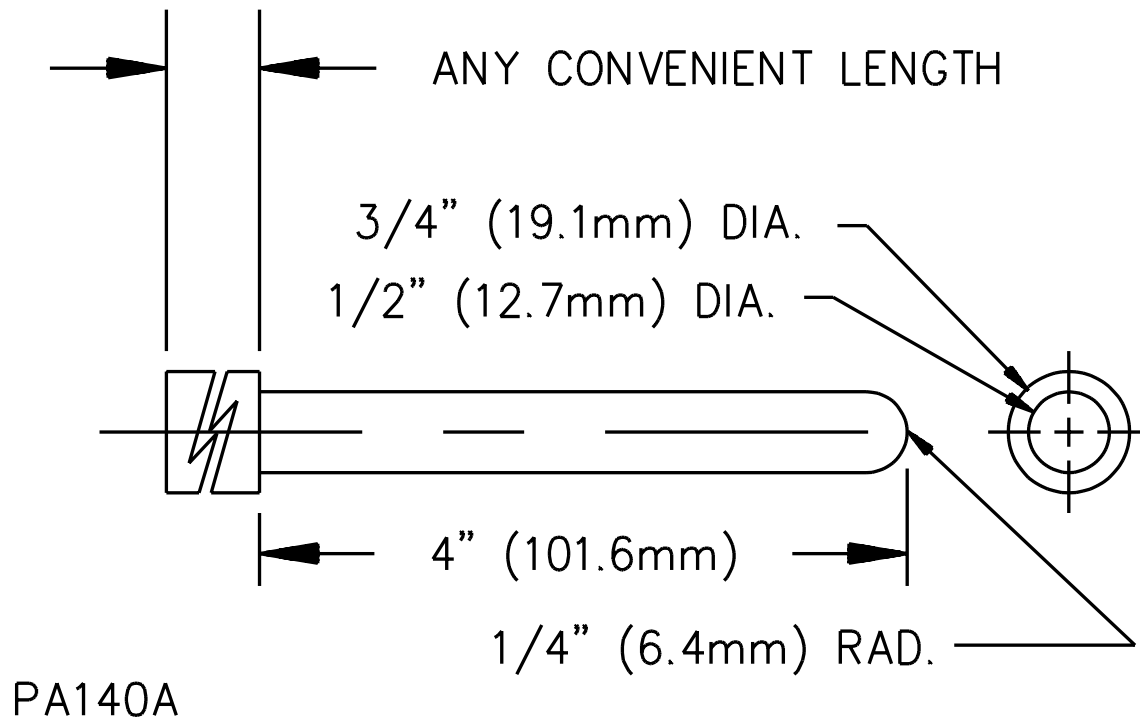
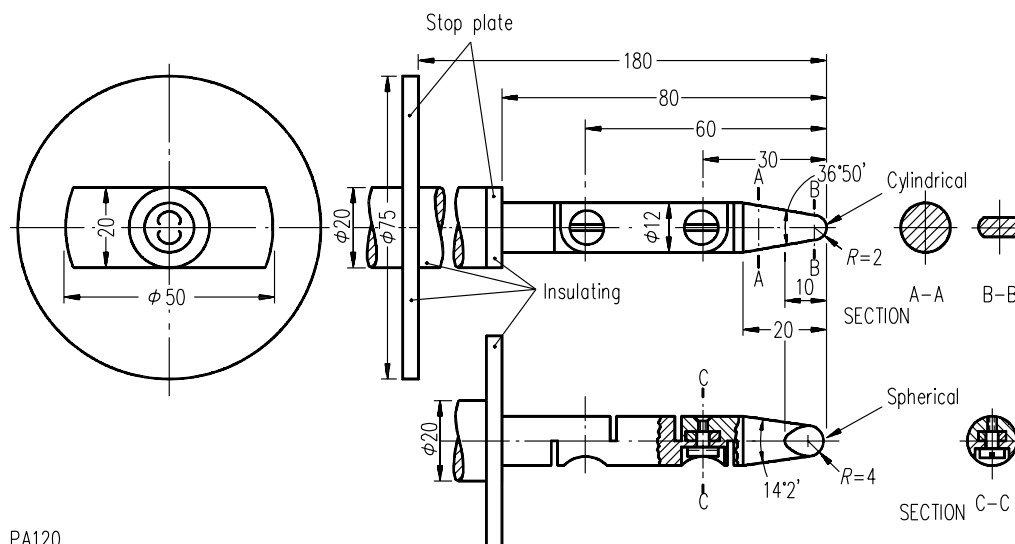
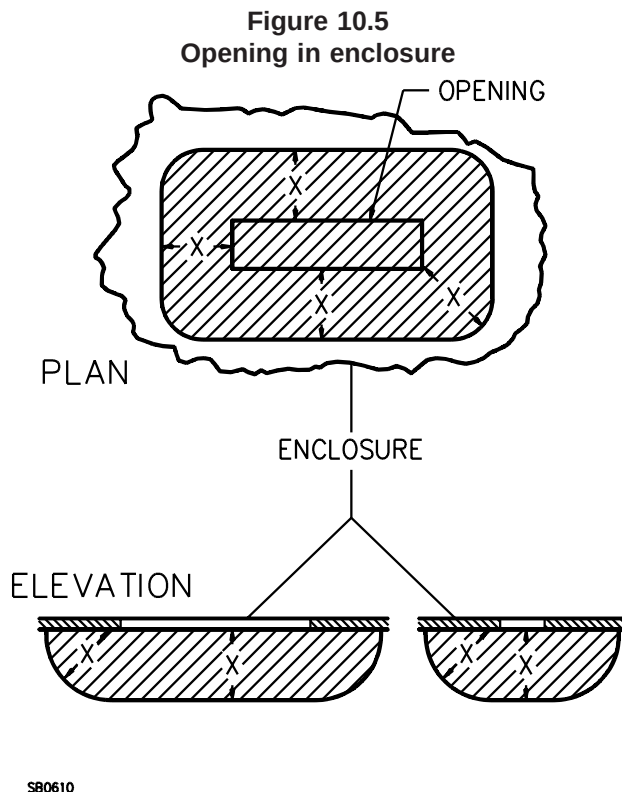


Figure 10.4
Articulate probe



Inches:	5/64	5/32	25/64	15/32	25/32	1-5/64	1-61/64	2-23/64	2-61/64	3-9/64	7-3/32
(mm):	2	4	10	12	20	30	50	60	75	80	180

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10.7 A directly accessible motor is a motor that may be contacted without opening or removing any part and that is located so as to be accessible to contact. An indirectly accessible motor is a motor that is accessible only by opening or removing a part of the outer enclosure, such as a panel or service door that can be removed without the use of tools, or a motor that is located in such a position or is otherwise guarded or enclosed so that it is unlikely to be contacted.

11 Provisions for Servicing

11.1 A hydromassage bathtub shall incorporate means for servicing internal components after installation as specified in 7.3.

11.2 An enclosure door or cover intended to give the user access to a fuseholder, a switch, or a circuit breaker shall be hinged, captive to the enclosure, and provided with a closing device. The door or cover shall be constructed such that no live part is accessible when the door is closed.

12 Resistance to Corrosion

12.1 An iron or steel part shall be made resistant to corrosion by enameling, galvanizing, plating, or other equivalent means when the corrosion of such a part is capable of resulting in a risk of fire, electric shock, or injury to persons.

Exception: Bearings, laminations, or minor parts of iron or steel, such as washers and screws, are not required to be corrosion resistant.

12.2 Aluminum, stainless steel, and copper or copper alloy with zinc content not in excess of 15 percent may be used without additional resistance to corrosion.

12.3 When, during use, aluminum comes into contact with water in the unit, it shall be an alloy of the 5000 series as given in the Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate, ASTM B209. Cast aluminum shall be one of the alloys shown in Table 12.1 or shall be an alloy that has been found to have equivalent resistance to corrosion.

Table 12.1
Aluminum alloys

Sand-cast	Permanent-mold cast	Die cast	Machined bar and rod stock
G4A	GM70B	G8A	5052
G10A	GS42A	S5C	5056
GM70B	S5A	S12A	5456
GS42A	S5B	S12B	6061
S5A	SG70A	SG100A	6063
S5B	SG70B	GS100B	
SG70A			
ZG61B			

12.4 Metals shall not be used in combinations to cause galvanic action.

12.5 A sheet steel enclosure and other parts of a unit, including hinges and other attachments, shall be made resistant to corrosion as specified in 12.1.

12.6 An enclosure that is entirely within the outer enclosure of a unit and that contains any live part other than a motor shall be made resistant to corrosion as described in 12.7(c)(1) and 12.7(c)(2) with or without the added epoxy, paint coating, or other means described in 12.7 and 12.8.

12.7 Sheet steel shall be made resistant to corrosion by one of the following:

a) Hot-dipped, mill-galvanized sheet steel designated G90 in the Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, ASTM A653/A653M.

b) A zinc coating, other than that provided on hot-dipped, mill-galvanized sheet steel, uniformly applied to an average thickness of not less than 0.00061 inch (0.015 mm) on each side, with a minimum thickness of 0.00054 inch (0.014 mm). The thickness of the coating shall be determined by the Metallic Coating Thickness Test, Section 59. An annealed coating shall also comply with 12.8.

c) A coating that complies with (1) or (2) and with one coat of an organic finish of the epoxy or alkyd-resin type paint on each surface applied after forming. The acceptability of the paint may be determined by consideration of its composition or by corrosion tests.

1) Hot-dipped, mill-galvanized sheet steel designated G60 or A60 in ASTM A653/A653M.

2) A zinc coating, other than that provided on hot-dipped, mill-galvanized sheet steel, uniformly applied to an average thickness of not less than 0.00041 inch (0.011 mm) on each surface with a minimum thickness of 0.00034 inch (0.009 mm). An annealed coating shall also comply with 12.8.

d) A cadmium coating not less than 0.0010 inch (0.025 mm) thick on both surfaces. The thickness of the coating shall be determined by the Metallic Coating Thickness Test, Section 59.

e) A cadmium coating not less than 0.00075 inch (0.019 mm) thick on both surfaces with one coat of paint on both surfaces, or not less than 0.00051 inch (0.013 mm) thick on both surfaces with two coats of paint on both surfaces. The paint shall be as described in (c).

f) Other finishes, including paints, special metallic finishes, and combinations of the two may be accepted if comparative tests with galvanized sheet steel (without annealing, wiping, or other surface treatment) complying with (a) indicate that such finishes provide equivalent resistance to corrosion. Among the factors that are to be taken into consideration when judging such finishes are exposure to salt spray, moist carbon dioxide-sulfur dioxide-air mixtures, moist hydrogen sulfide-air mixtures, ultraviolet light, and water. Organic coatings shall comply with the Standard for Organic Coatings for Steel Enclosures for Outdoor Use Electrical Equipment, UL 1332.

12.7 revised August 23, 2011

12.8 An annealed coating on sheet steel that is bent or similarly formed or extruded, or rolled at edges of holes after annealing shall be additionally painted in the affected areas if the process damages the zinc coating. If flaking or cracking of the zinc coating at the outside radius of the bent or formed section is visible at 25 power magnification, the zinc coating is considered to be damaged. Simple sheared or cut edges and punched holes are not required to be additionally treated.

13 Power Supply Connections

13.1 General

13.1.1 A unit shall have provision for termination of a permanent wiring system in accordance with 13.2.1 – 13.2.18 or shall be provided with a non-detachable power supply cord in accordance with 13.3.1 – 13.3.6.

13.1.2 A unit intended for connection to a grounded power supply conductor and using a lampholder of the Edison screwshell type or a single pole switch or control shall have one terminal or lead intended for connection of the grounded conductor supply circuit. The terminal or lead intended for such use shall be the one connected to screwshells of lampholders and shall not be the one connected to a single pole switch or control.

13.1.3 A terminal for connection of a grounded power supply conductor shall be of, or plated with, metal that is substantially white in color and shall be readily distinguishable from the other terminals; or 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.

13.1.4 A lead for connection of a grounded power supply conductor shall be finished to show a white or gray color and shall be readily distinguishable from the other leads.

13.1.5 A unit may have provision for a maximum of three supply sources. If the unit is cord-connected, all supply sources shall be through cord connection.

13.2 Permanently connected units

13.2.1 A unit shall be provided with a terminal compartment for the connection of power supply conductors.

Exception: A terminal compartment provided as an integral part of a motor that complies with the requirements for field wiring in the Standard for Rotating Electrical Machines – General Requirements, UL 1004-1, and is marked "Acceptable for Field Wiring" is considered to comply with the requirements for a terminal compartment specified in 13.2.

13.2.1 revised August 23, 2011

Table 13.1
Motor terminal compartments for wire-to-wire connections

Horsepower (kW output)	Minimum dimension,		Minimum usable volume,	
	inches	(mm)	cubic inches	(cm ³)
1 (0.7) or less ^a	2-1/4	57	10.5	172
1-1/2, 2, and 3 (1.2, 1.5, and 2.2) ^a	2-1/2	64	16.8	275
5 and 7-1/2 (3.7 and 5.6)	2-7/8	73	22.4	367
10 and 15 (7.5 and 11.2)	3-1/2	89	36.4	596
^a When the terminal compartment is partially or wholly integral with the frame or end shield, the minimum dimension of the cover opening is not specified, and the volume of the terminal compartment shall be not less than: 1) 1.1 cubic inch (18.1 cm³) per wire-to-wire connection for 1 horsepower or smaller motors. 2) 1.4 cubic inch (22.9 cm³) per wire-to-wire connection for 1-1/2, 2, and 3 horsepower motors.				

13.2.2 A terminal compartment shall be complete and shall enclose all field wiring terminals. No ventilation opening shall be located in the field wiring compartment.

Exception: A small hole provided for drainage is not considered a ventilation opening.

13.2.3 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.

13.2.4 A terminal compartment shall be attached to the unit in a manner to reduce the risk of the terminal compartment turning.

13.2.5 Electrical components shall not be mounted on the terminal compartment cover unless the internal wiring is provided with a method of quick disconnection.

13.2.6 Wire-bending space in a terminal compartment shall be as specified in Table 13.2.

Exception: A terminal compartment provided as an integral part of a motor that complies with the requirements for field wiring in the Standard for Rotating Electrical Machines – General Requirements, UL 1004-1, and is marked "Acceptable for Field Wiring" is considered to comply.

13.2.6 revised August 23, 2011

Table 13.2
Minimum wire-bending space

Wire size,		Minimum wire-bending space from terminal to wall,	
AWG	(mm ²)	inches	(mm)
14 – 10	2.1 – 5.3	Not specified	–
8	8.4	1-1/2	38.1
6	13.3	2	50.8
4	21.2	3	76.2

13.2.7 Sheet metal to which a wiring system is to be connected in the field shall be not less than 0.032 inch (0.81 mm) thick steel if uncoated, not less than 0.034 inch (0.86 mm) thick steel if galvanized, or not less than 0.045 inch (1.14 mm) thick if nonferrous.

13.2.8 A knockout for connection of a field wiring system to a field wiring compartment shall accommodate conduit of the trade size specified in Table 13.3.

Table 13.3
Trade size of conduit in inches

Wire size,		Number of wires				
AWG	(mm ²)	2	3	4	5	6
14	2.1	1/2	1/2	1/2	1/2	1/2
12	3.3	1/2	1/2	1/2	3/4	3/4
10	5.3	1/2	1/2	1/2	3/4	3/4
8	8.4	3/4	3/4	3/4	1	1
6	13.3	3/4	1	1	1-1/4	1-1/4
4	21.2	1	1	1-1/4	1-1/4	1-1/2
3	26.7	1	1-1/4	1-1/4	1-1/2	1-1/2
2	33.6	1	1-1/4	1-1/4	1-1/2	2
1	42.4	1-1/4	1-1/4	1-1/2	2	2
1/0	53.5	1-1/4	1-1/2	2	2	2-1/2

NOTE – This table is based on the assumption that all conductors will be of the same size and there will be not more than six conductors in the conduit. If more than six conductors will be involved or if all of them are not of the same size, the internal cross-sectional area of the smallest conduit that may be used is determined by multiplying by 2.5 the total cross-sectional area of the wires, based on the cross-sectional area of Type THW wire.