

UL 1664

ISBN 1-55989-930-1

Immersion-Detection Circuit-Interrupters



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Underwriters Laboratories Inc.®

Standard

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October 26, 1995

Standard for

Immersion-Detection Circuit-Interrupters

UL 1664, Second Edition

Accompanying this transmittal notice is a copy of the Second edition of UL 1664.

THIS EDITION OF THE STANDARD IS NOW IN EFFECT.

As indicated on the title page, this UL Standard for Safety is an American National Standard. Attention is directed to the note on the title page of this standard outlining the procedures to be followed to retain the approved text of ANSI/UL 1664-1991.

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

OCTOBER 26, 1995



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UL 1664

Standard for

Immersion-Detection Circuit-Interrupters

First Edition – May, 1990

Second Edition

October 26, 1995

Approval as an American National Standard (ANSI) covers the numbered paragraphs on pages dated October 26, 1995. These pages should not be discarded when revised or additional pages are issued if it is desired to retain the ANSI approved text.

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

Approved as ANSI/UL 1664-1991, August 27, 1991

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

ISBN 1-55989-930-1

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CONTENTS

FOREWORD

INTRODUCTION

1 Scope	5
2 Glossary	5
3 Components	6
4 Units of Measurement	6
5 References	6

CONSTRUCTION

6 Mechanical Assembly	7
7 Enclosure	10
8 Accessibility of Uninsulated Live Parts and Film-Coated Wire	11
9 Electrical Insulation	12
10 Printed Wiring Boards	12
11 Attachment Plug	12
12 Flexible Cord	12
13 Terminations	13
14 Grounding	14
15 Spacings	15
16 Live Parts	16
17 Internal Wiring	16
18 Operating Mechanism	17
19 Supervisory Circuit	18

PROTECTION AGAINST INJURY TO PERSONS

20 Sharp Edges	18
----------------------	----

PERFORMANCE

21 General	18
22 Trip Threshold Measurement	20
23 Drop Test	21
24 Humidity Conditioning	21
25 Leakage Current Test	21
26 Voltage Surge Test	24
27 Calibration Test	27
28 Dielectric Voltage-Withstand Test	29
29 Shock Current Test	30
30 Temperature Test	30
31 Overload Test	33
32 Endurance Test	35

33	Abnormal Operation Test	37
34	Limited Short Circuit Test	37
35	Security of Blades Test	38
36	Crushing Resistance Test	38
37	Strain-Relief Test	39
38	Immersion Test	39
39	Sealant Test	39
40	Cord Flexing Test	42
41	Security of Terminals Test	44

MANUFACTURING AND PRODUCTION LINE TESTS

42	<i>Reserved For Future Use</i>	44
----	--------------------------------------	----

RATINGS

43	Details	44
----	---------------	----

MARKINGS

44	General	44
----	---------------	----

APPENDIX A

	Standards for Components	A1
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FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 These requirements cover immersion-detection circuit-interrupters that interrupt the electric circuit to an appliance in the event of an accidental immersion of the appliance. They are intended to interrupt the circuit at a predetermined current level that is less than that required to operate the overcurrent protective device of the supply circuit upon immersion of the connected appliance. The function is not to be dependent on the presence of a grounded object.

1.2 These requirements cover immersion-detection circuit-interrupters for use only in cord-connected appliances intended for connection to alternating-current circuits of 250 V or less. They are not to be provided with a general purpose outlet receptacle, cord connector body, or the like. Devices complying with these requirements are acceptable for use as components in an end product where the acceptability of the combination is to be determined.

1.3 The acceptability of an immersion-detection circuit-interrupter in any particular application depends upon its ability to be used continuously under the conditions that prevail in actual service. Accordingly, for a particular application, an immersion-detection circuit-interrupter may be affected by the requirements for the equipment it is used in, and it may be necessary to additionally evaluate features or performance characteristics that are not specified in this standard.

1.4 This Standard does not cover ground-fault circuit-interrupters, which are covered by the Standard for Ground-Fault Circuit-Interrupters, UL 943.

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

1.5 revised October 26, 1995

2 Glossary

2.1 For the purpose of this standard, the following definitions shall apply:

2.2 **ACCESSIBLE PART** – A part so located that it can be contacted by a person, either directly or by means of a probe or tool.

2.3 **CORD-CONNECTED** – Denotes connection to a supply circuit by way of a flexible cord terminating in an attachment plug.

2.4 **ENCLOSURE** – Any surface or surrounding structure that prevents access to a real or potential risk of electric shock or injury to persons.

- 2.5 **ENERGIZED PART** – A part at some potential with respect to another part, or to earth.
- 2.6 **INDOOR USE** – Use in an indoor location or where exposure to rain is not likely to occur.
- 2.7 **LEAKAGE CURRENT** – Denotes all currents including capacitively coupled currents which may be conveyed between energized parts of a circuit and either ground or other parts.
- 2.8 **ORDINARY TOOLS** – Pliers, and flat-bladed and cross recessed-head (Phillips type) screwdrivers.
- 2.9 **TRIP** – Denotes automatic interruption by the immersion-detection circuit-interrupter of the electric circuit to the load.

3 Components

3.1 Except as indicated in 3.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

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

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

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

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

4 Units of Measurement

4.1 If a value of measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement.

5 References

5.1 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.

CONSTRUCTION

6 Mechanical Assembly

6.1 An immersion-detection circuit-interrupter shall be formed and assembled so that it will have the strength and rigidity necessary to resist abuses to which it is likely to be subjected, without producing or increasing 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.

6.2 An immersion-detection circuit-interrupter shall have all parts reliably secured in place.

6.3 An immersion-detection circuit-interrupter shall be constructed so that it will not be necessary to open or remove the enclosure when used as intended.

6.4 Lampholders, switches, and other similar components shall be mounted securely and shall be prevented from turning by more than friction between surfaces. For example the use of a lockwasher is acceptable to prevent the turning of a device having a single hole mounting means.

Exception No. 1: A lampholder of a type in which the lamp cannot be replaced, (such as a neon pilot or indicator light in which the lamp is sealed-in by a nonremovable jewel), need not be prevented from turning if rotation cannot reduce spacings below the minimum acceptable values or produce stress on a connector.

Exception No. 2: A switch or other similar component shall be securely mounted and prevented from turning, unless the turning of such a component is part of the design of the unit and introduces no additional risk of fire or electrical shock, such as reduced spacings below the minimum acceptable values or stress on a connection.

6.5 An indicator light shall be one in which the lamp is sealed-in, such as by a nonremovable jewel.

6.6 A switch shall be located within the unit enclosure in such a manner as not to be accessible or exposed to tampering, nor subject to damage during normal use. This requirement does not apply to the actuating means of a switch.

6.7 The maximum acceptable moment, center of gravity, dimensions, and weight of a direct plug-in unit shall comply with the requirements specified in (a), (b), (c) and (d). See Figure 6.1 and 6.8 and 6.9:

- a) The quotient of WY/Z shall not exceed 48 ounces (1361 g);
- b) The quotient of WY/S shall not exceed 48 ounces (1361 g);
- c) The product of WX shall not exceed 80 ounce-inches (0.56 N · m); and
- d) The weight of a unit shall not exceed 28 ounces (794 g).

6.8 Definitions for the symbols used in 6.7 are as follows:

- a) W is the weight of the unit in ounces (g);
- b) Y is the distance illustrated in Figure 6.1 in inches (mm);
- c) Z is the lesser of the two distances, Z_1 or Z_2 , as illustrated in Figure 6.1. in inches (mm);
- d) S is the lesser of the two distances, S, or S_2 , as illustrated in Figure 6.1 in inches (mm); and
- e) X is the greater of the two distances, X_1 or X_2 , as illustrated in Figure 6.1 in inches (mm).

6.9 The moment and weight specified in 6.7 are to be determined as follows:

- a) For units with an output cord, the cord is to be cut off at the enclosure, or at the strain-relief means if the strain-relief means is outside the enclosure.
- b) For units with directly mounted accessories, the values are to be measured with the accessories in place.

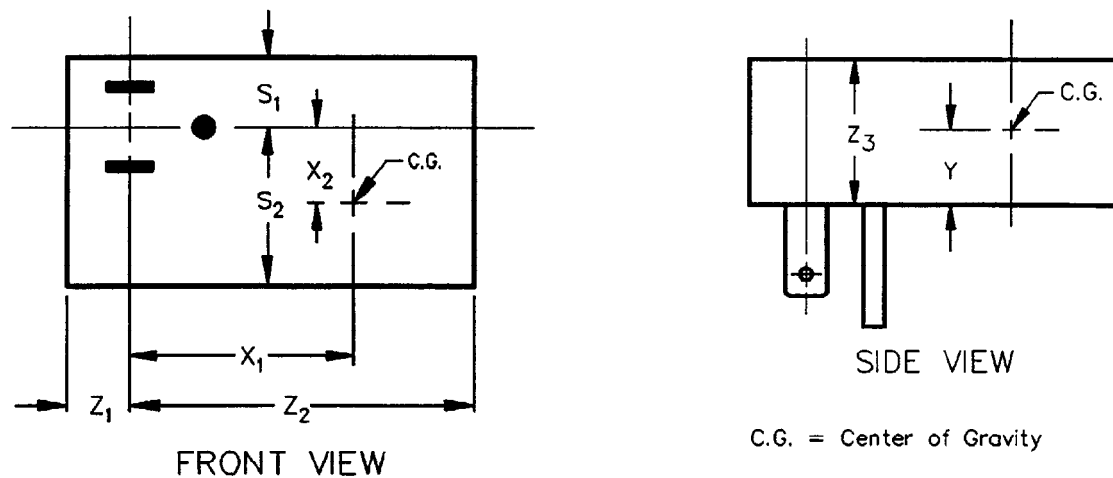
6.10 When inserted in a parallel-blade duplex receptacle, any part of a unit, including output wiring, shall not interfere with full insertion of an attachment plug into the adjacent receptacle. See Figure 6.2.

Exception: A unit that renders the adjacent receptacle completely unusable in any one mounting position is acceptable.

6.11 A mounting tab shall not be provided with the unit.

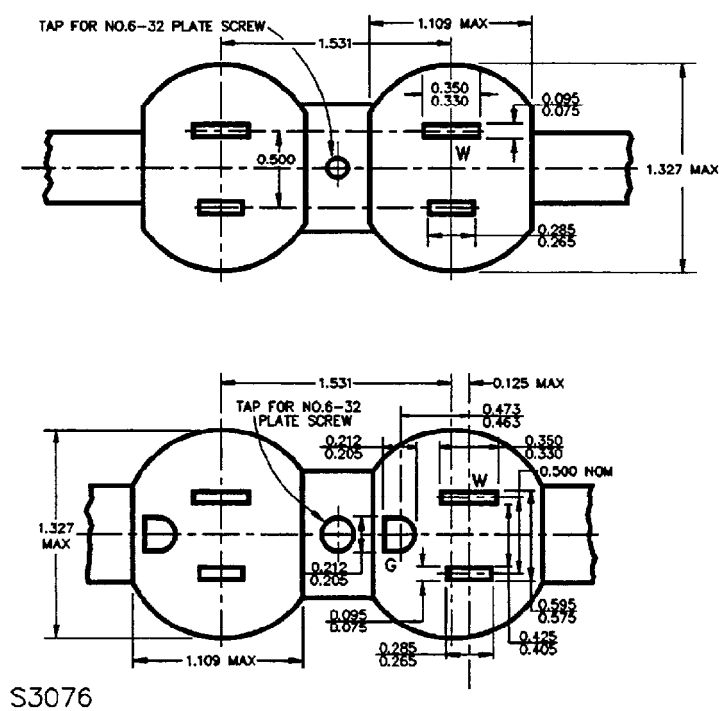
6.12 The enclosure of a unit shall be capable of being gripped for removal from the receptacle to which it is connected. The perimeter of the face section from which the blades project shall not be less than 5/16 inch (7.9 mm) from any point on either blade.

Figure 6.1
Dimensions of a direct plug-in unit



CP100

Figure 6.2
Parallel receptacle duplex



7 Enclosure

7.1 General

7.1.1 An immersion-detection circuit-interrupter shall be provided with an enclosure that shall house all current-carrying parts other than primary blades and output leads. The enclosure shall have the strength and properties necessary to reduce the risk of mechanical damage to the various parts.

7.1.2 If access to the interior of a unit can present a risk of fire, electric shock, or injury to persons, seams and joints of the enclosure shall be assembled by welding, riveting, the use of screws or fasteners that are not removable by the use of an ordinary tool, (see 2.8), or the equivalent. For enclosure parts secured together by adhesive, see 7.3.2.

Exception: A unit containing components that may require factory assembly may have the enclosure assembled by screws or other fasteners removable by an ordinary tool, provided there is means to discourage user-tampering such as sealing of one or more of the assembly fasteners. Potting compound, encapsulation, or equivalent means provided to comply with this requirement shall be in place when the units are subjected to the Enclosure Tests outlined in 7.3.1 and the Crushing Resistance Test, Section 36.

7.1.3 Cross recessed-head screws (Phillips type), spring clips, and the like are considered to be defeatable by an ordinary tool.

7.2 Metal enclosures

7.2.1 An enclosure constructed of sheet metal shall be formed from stock having a thickness not less than that specified in Table 7.1. The thickness of enclosure sheet metal, other than steel or aluminum, shall not be less than that specified in Table 7.1 for uncoated steel, and shall have the necessary strength and rigidity.

Table 7.1
Thickness of sheet metal enclosures

	Minimum acceptable thickness	
	Inch	(mm)
Uncoated steel	0.026	(0.66)
Zinc-coated steel	0.029	(0.74)
Aluminum	0.040	(1.02)

7.2.2 A lanced tab provided for internal component mounting may have a small opening caused by die clearance if:

- The opening caused by the tab is substantially closed by the mounted component; and
- The tab is located on the surface of the enclosure with the supply-connector pins.

7.3 Polymeric enclosures

7.3.1 A polymeric enclosure or a polymeric part of an enclosure shall comply with the applicable requirements for enclosures as specified in the Standard For Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

Exception: The Drop Test of Section 23 of this standard shall be conducted in place of the tests described in Flammability — 3/4-inch Flame, Section 18, of the Standard for Polymeric Materials — Use in Electrical Equipment Evaluations, UL 746C.

7.3.2 An adhesive used in the assembly of an immersion-detection circuit-interrupter shall comply with the applicable requirements for adhesives as specified in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

Exception: Methods utilizing fusion techniques, such as solvent cementing, ultrasonic welding, electromagnetic induction, and thermal welding need not be investigated.

7.4 Corrosion resistance

7.4.1 Except as noted in 7.4.2, iron and steel parts shall be protected against corrosion by galvanizing, plating, enameling, or other equivalent means, if the corrosion of such unprotected parts would be likely to result in a risk of fire, electric shock, or injury to persons.

7.4.2 The requirement in 7.4.1 applies to all enclosing cases or to other parts upon which intended mechanical operation may depend. It does not apply to laminations and minor parts of iron or steel, such as washers, screws, and bolts, that are not current-carrying, if the corrosion of such unprotected parts would not be likely to result in a risk of fire, electrical shock or injury to persons, or result in the device not operating as intended. A part made of stainless steel does not require additional protection against corrosion.

8 Accessibility of Uninsulated Live Parts and Film-Coated Wire

8.1 An immersion-detection circuit-interrupter shall not have openings that allow a 1/16 inch (1.6 mm) diameter metal rod to be inserted and contact an uninsulated live part, film-coated wire, or internal wiring.

Exception: If the immersion-detection circuit-interrupter is intended to be enclosed in or constructed as an integral part of the end use product, the construction shall comply with the accessibility of live parts requirements of the end product standard.

8.2 With respect to the requirement in 8.1, a part of the outer enclosure that may be opened or removed by the user without using a tool, is to be opened or removed.

8.3 With respect to the application of the requirement in 8.1, the rod may be rotated or angled into any position before, during, or after insertion into the opening, and the penetration may be to any depth allowed by the opening size. The rod shall be applied with the minimum force necessary to determine accessibility and not as an instrument to judge the strength of a material.

9 Electrical Insulation

9.1 An insulating washer, bushing, and the like that is an integral part of an immersion-detection circuit-interrupter, and a base or support for the mounting of a current-carrying part, shall be of a moisture-resistant material that will not be adversely affected by the temperatures to which it will be subjected under conditions of intended use. Molded parts shall be so constructed that they will have strength and rigidity to withstand the stresses of intended service.

9.2 An insulating material used in an immersion-detection circuit-interrupter is to be judged with respect to its acceptability for the particular application. Materials such as mica, some molded compounds, and certain refractory materials are usually acceptable for use as the direct support of live parts. Other materials not acceptable for general use, such as magnesium oxide, may be acceptable if used in conjunction with other insulating materials, or so located and protected that the risk of mechanical damage and the absorption of moisture are reduced.

9.3 When it is necessary to investigate a material to determine its acceptability, consideration is to be given to its mechanical strength, insulation resistance, heat-resistant qualities, the degree to which it is enclosed or protected and any other features having a bearing on the risk of fire, electric shock, or injury to persons involved in conjunction with conditions of service. All these factors are to be considered with respect to thermal aging. For an appliance in which a polymeric material serves as an insulating material, or as the direct or indirect support for any live part, the polymeric material shall comply with the applicable requirements for the Direct or Indirect Support of Live Parts in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

10 Printed Wiring Boards

10.1 A printed-wiring board employed in a unit shall comply with the Standard for Printed-Wiring Boards, UL 796. For a unit with openings in the enclosure, the board shall be classed 94V-0 or 94V-1 in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94. The use of a board classed 94V-2 requires the use of an enclosure without ventilating openings.

10.2 A resistor, capacitor, inductor, or other part that is mounted on a printed-circuit board to form a printed-circuit assembly shall be secured so that it cannot be displaced to cause a risk of fire or electric shock by a force likely to be exerted on it during assembly or normal operation.

11 Attachment Plug

11.1 The attachment plug or integral blades, if provided, shall comply with the applicable requirements in the Standard for Attachment Plugs and Receptacles, UL 498.

12 Flexible Cord

12.1 A flexible cord, provided as an input power-supply cord or an output interconnecting cord, shall comply with the requirements of the Standard for Flexible Cord and Fixture Wire, UL 62, or the Standard for Cord Sets and Power-Supply Cords, UL 817, as applicable. The sense wire, if provided, shall be minimum No. 24 AWG (0.21 mm²).