



# UL 1951

## STANDARD FOR SAFETY

### Electric Plumbing Accessories

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UL Standard for Safety for Electric Plumbing Accessories, UL 1951

Second Edition, Dated July 22, 2011

### **SUMMARY OF TOPICS**

***This revision to ANSI/UL 1951 dated June 27, 2020 include the following changes:***

***Addition of reference to UL 61800-5-1 as a replacement to UL 508C; [5.5.4.1](#), [5.5.4.2](#)***

***Addition of reference to UL 62368-1 as an alternative to UL 60950-1; [5.3.4](#), [5.3.5](#), [5.12.1](#), [5.12.2](#)***

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 April 10, 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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## PART 1 – ALL EQUIPMENT

### INTRODUCTION

#### 1 Scope

1.1 These requirements cover equipment connected to or used with plumbing in commercial or household locations. Examples of equipment covered by these requirements are irrigation equipment, sprinkler controls, pedicure spas, water controls located in kitchens and bathrooms, electric faucets, toilets and toilet flushing systems. All equipment is intended for installation and use in accordance with the National Electrical Code, NFPA 70, and is rated 600 volts or less.

1.2 These requirements do not cover pumps, dishwashers, washing machines, or other equipment connected to plumbing that is covered by individual requirements.

1.3 These requirements do not cover refrigeration systems or controls that regulate water temperature, or equipment for use in hazardous locations as defined in the National Electrical Code, NFPA 70.

#### 2 Units of Measurement

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

2.2 Unless indicated otherwise, all voltage and current values are rms and wattage values are average power.

#### 3 Undated References

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

#### 4 Glossary

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

4.2 FIELD-WIRING TERMINAL – A terminal to which power supply (including equipment grounding) or control connection will be made in the field when the product is installed as intended. If the wire, to be connected to the terminal, is provided as part of the unit and a pressure terminal, connector, soldering lug, soldered loop, crimped eyelet, or other means for making the connection is factory-assembled to the wire, it is not a field wiring terminal.

4.2.1 CAPACITOR, CLASS X – Capacitor or RC unit of a type suitable for use in situations where failure of the capacitor or RC unit would not lead to danger of electrical shock but could result in a risk of fire. Examples would be units connected phase to phase or phase to neutral.

4.2.2 CAPACITOR, CLASS Y – Capacitor or RC unit of a type suitable for use in situations where failure of the capacitor could lead to danger of electric shock. Examples would be capacitors connected across the primary and secondary circuits where electrical isolation is required to prevent an electric shock or between hazardous live parts and accessible parts.

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

4.4 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 control is a safety related control where other controls are being relied upon during testing for the safety function. The auxiliary control might more likely function in actual use but for test purposes, it is bypassed.

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

4.6 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 water to a user-determined level.

4.7 CONTROL, PROTECTIVE – A device or assembly of devices, the operation of which is intended to reduce the risk of fire, electric shock, or injury to persons during normal and reasonably anticipated abnormal operation of the appliance whereby during the evaluation of the protective control/circuit, the protective functions are verified under normal and single-fault conditions of the control. For example, a thermal cutout/limiter, or any other control/circuit relied upon for normal and abnormal conditions, is considered a protective control.

4.8 CONTROL, TYPE 2 ACTION – The actuation of an automatic control of 2.1.1 for which the manufacturing deviation and the drift of its operating value, operating time, or operating sequence have been declared and tested under this end product standard.

4.9 CONTROL, TYPE (2) D.H ACTION – This action is applicable to manual controls (described in 2.1.4 above). A Type D.H action shall be so designed that the contacts cannot be prevented from opening and which may automatically reset to the closed position if the reset means is held in the reset position. The control shall not reset automatically at any temperature above -35 °C with the reset mechanism in the normal position.

4.10 CONTROL, TYPE (2) D.J ACTION – This action is applicable to manual controls (described in 4.6 above). A Type D.J action shall be so designed that the contacts cannot be prevented from opening, and the control is not permitted to function as an automatic reset device if the reset means is held in the reset position. The control shall not reset automatically at any temperature above -35 °C.

4.10.1 DANGEROUS MALFUNCTION – Unintended operation of the appliance that may impair safety. Operating Control functions whose failure would result in a Dangerous Malfunction would be considered Safety Critical Functions.

Note – Control functions whose failure might result in a Dangerous Malfunction would include:

- a) Unexpected operation of the appliance where the operation would result in risk of electric shock, fire or mechanical hazard.
- b) Unattended energization of a heating appliance where the user has placed flammable materials near the appliance based on the assumption the appliance would remain off.

4.11 LINE-VOLTAGE CIRCUIT – A circuit involving a potential of not more than 600 volts and having circuit characteristics in excess of those of a low-voltage circuit.

4.12 LOW-VOLTAGE CIRCUIT – A circuit involving a peak open-circuit potential of not more than 42.4 volts supplied by a battery, by a Class 2 transformer, or by a combination of a transformer and a fixed impedance that as a unit, complies with all performance requirements for a Class 2 transformer. A circuit derived from a line-voltage circuit by connecting a resistance in series with the supply circuit as a means of limiting the voltage and current is not a low-voltage circuit.

4.13 OPPOSITE POLARITY – A difference of potential between two points, where shorting of these two points would result in a condition involving overload, rupturing of printed wiring-board tracks, components or fuses, and the like.

4.13.1 PEDICURE SPA – An appliance intended for water immersion of feet, usually (but not necessarily) associated with professional pedicure services. A pedicure spa usually has a water circulation/foot massage function and a water heater, and may additionally have heat and massage functions in an integral chair. A pedicure spa may be portable, stationary or be intended to be permanently fixed in place.

4.14 PRIMARY CIRCUITS – The wiring and components that are conductively connected to the supply circuit.

4.14.1 RISK OF ELECTRIC SHOCK – A risk of electric shock is considered to exist within a circuit unless the circuit meets one of the following criteria. The circuit shall be supplied by an isolating source such that:

- a) The voltage does not exceed 30 V rms;
- b) The voltage does not exceed 42.4 V peak;
- c) The voltage does not exceed 60 V dc continuous; or
- d) The voltage does not exceed 24.8 V peak for DC interrupted at a rate of 200 Hz or less with approximately 50 percent duty cycle.
- e) When protective impedance is used, the current available through a 1500 ohm resistor between the part or parts and either pole of the supply source does not exceed 0.7 mA peak or 2 mA DC;
  - 1) For frequencies exceeding 1 kHz, the limit of 0.7 mA (peak value) is multiplied by the value of the frequency in kHz but shall not exceed 70 mA peak;
  - 2) For voltages over 42.4 V peak and up to and including 450 V (peak value) the capacitance shall not exceed 0.1  $\mu$ F.

4.15 SAFETY CIRCUIT – A primary or secondary circuit that contains a control relied upon to reduce a risk of fire, electric shock, or injury to persons.

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

4.16 SECONDARY CIRCUIT – A circuit supplied from a secondary winding of an isolation transformer.

4.17 USER SERVICING – Any form of servicing that can be performed by personnel other than those who are trained to maintain the particular equipment is considered user servicing. Some examples of user servicing are:

- a) Attaching accessories by means of attachment plugs and receptacles or by means of other separable connectors.
- b) Replacing lamps and fuses and resetting circuit breakers located in an operator-access area unless the lamps, fuses, or circuit breakers are marked to indicate replacement or resetting only by qualified service personnel.
- c) Making routine operating adjustments necessary to adapt the unit for its different intended functions.

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

4.18 VOLTAGE FOLDBACK – A circuit design feature intended to protect the power supply output transistors. When overcurrent is drawn by the load, the supply reduces the output voltage and current to within the safe power dissipation limit of the output transistors.

4.19 WORKING VOLTAGE – The highest voltage to which the insulation or the component under consideration is, or can be, subjected when the equipment is operating under conditions of normal use. Overvoltages that originate outside the equipment are not taken into account.

## CONSTRUCTION

### 5 Components

#### 5.1 General

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

- a) Comply with the requirements for that component as indicated in [5.2](#) – [5.21](#);
- b) Be used in accordance with its rating(s) established for the intended conditions of use;
- c) Be used within its established use limitations or conditions of acceptability; and
- d) Additionally comply with the applicable requirements of this end product standard.

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

- a) Involves a feature or characteristic not required in the application of the component in the product;*
- b) Is superseded by a requirement in this end product standard; or*
- c) Is separately investigated when forming part of another component, provided the component is used within its established ratings and limitations.*

*Exception No. 2: A component complying with a UL component standard other than those cited in [5.2](#) – [5.21](#) is acceptable if:*

- a) The component also complies with the applicable component standard of [5.2](#) – [5.21](#); or*
- b) The component standard:*
  - 1) Is compatible with the ampacity and overcurrent protection requirements National Electrical Code, ANSI/NFPA 70, where appropriate;*
  - 2) Considers long-term thermal properties of polymeric insulating materials in accordance with the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B; and*
  - 3) Any use limitations of the other component UL standard is identified and appropriately accommodated in the end use application. For example, a component used in a household application, but intended for industrial use and complying with the relevant component standard may assume user expertise not common in household applications.*

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

5.1.3 A component that is also intended to perform other functions, such as overcurrent protection, ground-fault circuit-interruption, surge suppression, any other similar functions, or any combination thereof, shall comply additionally with the requirements of the applicable UL standard(s) that cover devices that provide those functions.

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

5.1.4 A component not anticipated by the requirements of this end product standard, not specifically covered by the component standards of [5.2](#) – [5.21](#), and that involves a potential risk of electric shock, fire, or personal injury, shall be additionally investigated in accordance with the applicable UL standard, and shall comply with [5.1.1](#) (b) – (d).

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

## 5.2 Attachment plugs and receptacles

5.2.1 Attachment plugs and receptacles shall comply with the Standard for Attachment Plugs and Receptacles, UL 498.

*Exception No. 1: Attachment plugs integral to cord sets or power supply cords are covered under the requirements of the Standard for Cord Sets and Power-Supply Cords, UL 817 and are not required to comply with UL 498.*

*Exception No. 2: A fabricated pin terminal assembly (ies) is not required to comply with UL 498 if it complies with requirements in Current-Carrying Parts, Section [13](#), Insulating Material, Section [14](#), and Spacings, Section [25](#) of this end product standard.*

5.2.2 Single and multipole connectors for use in data, signal, control and power applications within and between electrical equipment, and that are intended for factory assembly to copper or copper alloy conductors, or for factory assembly to printed wiring boards, shall comply with the Standard for Component Connectors for Data, Signal, Control and Power Applications, UL 1977.

5.2.3 Female devices (such as receptacles and connectors) that are intended, or that may be used, to interrupt current in the end product, shall be suitably rated for current interruption of the specific type of load, when evaluated with its mating plug or connector.

## 5.3 Batteries and battery chargers

5.3.1 A lithium ion (Li-On) single cell battery shall comply with the requirements for secondary lithium cells in the Standard for Lithium Batteries, UL 1642. A lithium ion multiple cell battery, and a lithium ion battery pack, shall comply with the applicable requirements for secondary lithium cells or battery packs in the Standard for Household and Commercial Batteries, UL 2054. The unit shall also be marked in accordance with [58.6](#).

5.3.2 Rechargeable nickel metal-hydride (Ni-MH) battery cells and packs shall comply with construction and performance requirements of this end product standard, or the applicable requirements for secondary cells or battery packs in the Standard for Household and Commercial Batteries, UL 2054.

5.3.3 Primary batteries (non-rechargeable) that comply with the relevant UL standard and [5.1](#) are considered to comply with the requirements of this end product standard.

5.3.4 A Class 2 battery charger shall comply with one of the following:

- a) The Standard for Class 2 Power Units, UL 1310;
- b) The Standard for Information Technology Equipment, Part 1: General Requirements, UL 60950-1, with an output marked "Class 2", or that complies with the limited power source (LPS) requirements and is marked "LPS"; or
- c) The Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1, marked "Class 2" that complies with the limited power source (LPS) requirements and is marked "LPS".

5.3.5 A non-Class 2 battery charger shall comply with one of the following:

- a) The Standard for Power Units Other Than Class 2, UL 1012;
- b) The Standard for Information Technology Equipment, Part 1: General Requirements, UL 60950-1; or
- c) The Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1.

### 5.3A Button or coin cell batteries of lithium technologies

Section 5.3A deleted

## 5.4 Capacitors and filters

5.4.1 The component requirements for a capacitor are not specified. A capacitor complying with the Standard for Capacitors, UL 810, is considered to comply with the requirements of [21.1](#).

5.4.2 Electromagnetic interference filters with integral enclosures that comply with the Standard for Electromagnetic Interference Filters, UL 1283, are considered to comply with the requirements of [21.1](#).

5.4.3 A capacitor connected across the line or between line and ground (such as a capacitor for radio-interference elimination) shall be suitable for the voltage involved and comply with the Standard for Fixed Capacitors for Use in Electronic Equipment – Part 14: Sectional Specification: Fixed Capacitors for Electromagnetic Interference Suppression and Connection to the Supply Mains, UL 60384-14. They shall be rated for the intended application, including operating voltage, subclass, Upper and Lower Temperature rating. The duration of the damp-heat test shall be 21 days for indoor use appliances and 56 days for appliances permanently installed outdoors.

5.4.3.1 X1 capacitors are generally used in circuits of permanently connected appliances. However, if the appliance is provided with a separate surge protective device that limits the impulse voltage to  $\leq 2.5\text{KV}$ , an X2 capacitor is permitted.

5.4.3.2 Y1 capacitors are used in circuits where the prevention of electric shock is afforded solely by the isolation provided by the capacitor. Two Y2 capacitors connected in series is considered to provide the same level of protection as one Y1 capacitor.

5.4.3.3 Y2 capacitors are used where the prevention of electric shock is provided by the combination of the capacitor and earth ground for circuits operating at voltages  $\geq 150\text{V}$  and  $\leq 300\text{V}$ .

5.4.3.4 Y4 capacitors are used where the prevention of electric shock is provided by the combination of the capacitor and earth ground for circuits operating at voltages  $\leq 150\text{V}$ .

## 5.5 Controls

### 5.5.1 General

5.5.1.1 Auxiliary controls shall be evaluated using the applicable requirements of this end product standard and the parameters in Controls – End Product Test Parameters, Section [23](#).

5.5.1.2 Operating (regulating) controls shall be evaluated using the applicable component standard requirements specified in [5.5.2](#) – [5.5.7](#), and if applicable, the test parameters in Controls – End Product Test Parameters, Section [23](#), unless otherwise specified in this end product standard.

5.5.1.3 Protective (limiting) controls shall be evaluated using the applicable component standard requirements specified in [5.5.2](#) – [5.5.7](#), and if applicable, the test parameters in Controls – End Product Test Parameters, Section [23](#), unless otherwise specified in this end product standard.

5.5.1.4 Solid-state protective controls shall comply with one of the following:

- a) The Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991;
- b) The Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements UL 60730-1, except Clause H 11.12 (Controls using software).

5.5.1.5 An electronic, non-protective control that is simple in design need only be subjected to the applicable requirements of this end-product standard. A control that does not include an integrated circuit or microprocessor, but does consist of a discrete switching device, capacitors, transistors, and resistors, is considered simple in design. Such controls shall comply with the Abnormal Operation Test, Section [53](#).

### 5.5.2 Controls, electromechanical and electronic

5.5.2.1 A control, other than as specified in [5.5.3](#) – [5.5.7](#), shall comply with one of the following:

- a) The Standard for Solid-State Controls for Appliances, UL 244A;
- b) The Standard for Temperature-Indicating and -Regulating Equipment, UL 873;
- c) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1.

### 5.5.3 Controls, liquid level

5.5.3.1 A liquid level control shall comply with one of the following:

- a) The Standard for Solid-State Controls for Appliances, UL 244A;

- b) The Standard for Temperature-Indicating and -Regulating Equipment, UL 873;
- c) The Standard for Industrial Control Equipment, UL 508;
- d) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; and one of the following:
  - 1) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Automatic Electrical Water Level Controls of the Float Type for Household and Similar Applications, UL 60730-2-16A;
  - 2) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Automatic Electrical Water and Air Flow Sensing Controls, Including Mechanical Requirements, UL 60730-2-18.

#### 5.5.4 Controls, motor and speed

5.5.4.1 A control used to start, stop, regulate or control the speed of a motor shall comply with one of the following:

- a) The Standard for Solid-State Controls for Appliances, UL 244A;
- b) The Standard for Temperature-Indicating and -Regulating Equipment, UL 873;
- c) The Standard for Industrial Control Equipment, UL 508;
- d) The Standard for Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal, and Energy, UL 61800-5-1;
- e) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1.

5.5.4.2 A motor speed control evaluated to the Standard for Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal, and Energy, UL 61800-5-1 shall not be utilized to provide motor overload protection specified in [19.2](#) – [19.3](#) unless the electronic protection features have additionally been determined to comply with Standard for Electronically Protected Motors, UL 1004-7.

#### 5.5.5 Controls, pressure

5.5.5.1 A pressure control shall comply with one of the following:

- a) The Standard for Temperature-Indicating and -Regulating Equipment, UL 873;
- b) The Standard for Industrial Control Equipment, UL 508, if an operating control;
- c) The Standard for Limit Controls, UL 353, if a protective control;
- d) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements, UL 60730-2-6.

#### 5.5.6 Controls, temperature

5.5.6.1 A temperature control shall comply with one of the following: