UL 1054

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Special-Use Switches

Underwriters Laboratories Inc. (UL)
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UL Standard for Safety for Special-Use Switches, UL 1054

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Revisions: This Standard contains revisions through and including February 29, 2000.

Text that has been changed in any manner 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.

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The new and revised requirements are substantially in accordance with UL's Bulletin(s) on this subject dated October 22, 1999. The bulletin(s) is now obsolete and may be discarded.

The revisions dated February 29, 2000 include a reprinted title page (page1) for this Standard.

As indicated on the title page (page 1), 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 this ANSI/UL Standard.

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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that have been revised and that have a future effective date are located after the Standard, and are preceded by a ″SUPERSEDED REQUIREMENTS″ notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Recognition and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

This Standard consists of pages dated as shown in the following checklist:

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1	February 29, 2000
2	February 12, 1999
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Standard for Special-Use Switches

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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 set of revised requirements.

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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 which conflict with specific requirements of the Standard cannot be judged to comply with the Standard. A product employing materials or having forms of construction not addressed by this Standard may be examined and tested according to the intent of the requirements and, if found to meet the intent of this Standard, 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 manually operable and mechanically operable special-use switches:

a) That are for use on direct current as well as on alternating current or on alternating current only, and

b) For which the load ratings do not exceed 60 amperes at 250 volts or a lower potential and 30 amperes or 2 horsepower at 600 volts or a lower potential.

1.2 A special-use switch is intended for use in a device or appliance. A special-use switch is intended for factory installation in equipment and is not intended for field wiring other than replacement in original equipment. A vacuum-cleaner-handle switch, a heater switch, a radio or television switch, and a through-cord switch that has more than one on or one off position are examples of special-use switches.

1.2 revised January 26, 1996

1.3 These requirements do not cover through-cord switches with one on and one off position, special-use dimmer switches, or switches constructed so that they can be installed readily in a flush-device box or an outlet-box cover or can otherwise be used in a wiring system that complies with the National Electrical Code, NFPA 70.

1.3 revised January 26, 1996

1.4 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 to determine that the level of safety as originally anticipated by the intent of this Standard is maintained. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this Standard shall not be judged to comply with this Standard. Where appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this Standard.

1.4 revised February 29, 2000

2 Glossary

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

2.2 ACTUATING MEMBER – The part of the operating mechanism that extends outside the body of the switch and is intended to be exposed to contact by the operator.

2.3 CURRENT-INRUSH FACTOR – The number by which the normal (steady-state) peak current through a tungsten-filament-lamp load is multiplied to obtain the peak value of the inrush current through the load.

2.4 PUSH-IN (SCREWLESS) TERMINAL – A wire terminal that automatically locks a stripped conductor when it is inserted in the terminal.

2.5 TELEVISION SWITCH – A switch intended for use as a supply-circuit control switch in a radio or television-receiving appliance.

3 Components

3.1 A component of a product covered by this standard shall comply with the requirements for that component, and shall be used in accordance with its recognized rating and other limitations of use. 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 switches covered by this standard, or

b) Is superseded by a requirement in this standard.

3.2 If a value for 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.

3.3 In the following text, a requirement that applies only to a switch for a specific use, such as in a heating appliance or in a radio or television-receiving appliance, is so identified by a specific reference in that requirement to the use involved. Absence of such specific reference or use of the term switch indicates that the requirement applies to all switches covered by this standard unless the context indicates otherwise.

4 General Requirements for All Switches

4.1 Requirements under this heading apply to all switches covered by this standard. They are supplemented in subsequent sections with requirements applying exclusively to heater switches, television switches, and special-use dimmer switches.

4.2 A switch shall employ materials that are acceptable for the intended use.

CONSTRUCTION

5 Enclosure

5.1 General

5.1.1 A metal enclosure of a switch shall not be less than 0.013 inch (0.33 mm) thick. Heavier metal shall be employed to provide strength and rigidity if the switch is rated more than 5 amperes-250 volts, 10 amperes-125 volts, or if the size or shape of the enclosure requires an increased metal thickness.

5.1.2 A switch intended to be exposed to a specific environment shall comply with the applicable requirements in the Standard for Enclosures for Electrical Equipment, UL 50.

5.1.2 added January 26, 1996

5.2 Lining

5.2.1 All conductive material on the inside surface of a part of the enclosure that is removable for wiring shall be lined completely with insulation not less than 1/32 inch (0.8 mm) thick. The thickness of the insulation is to be measured by means of a machinist's micrometer caliper having a flat-ended spindle and a rounded anvil.

Exception: The lining of a switch may be less than 1/32 inch (0.8 mm) thick if of a material – other than paper or fiber – that has been shown to be acceptable for the application, and may be omitted if there is a spacing of not less than 1/4 inch (6.4 mm) between any uninsulated live part and the metal enclosure.

5.2.2 An insulating lining shall be secured so that it will remain in place under conditions of ordinary service and prevent the enclosure from becoming a live part even if a wire inside the switch should become loose or detached from its position.

6 Thermoplastic Materials

6.1 A thermoplastic material used in a switch shall comply with the requirements in Table 6.1.

Exception: A thermoplastic material with a flammability Class of less than V-2 as required in Table 6.1 used in a switch with material that complies with the applicable 3/4-inch flame test specified in the Standard for Polymeric Materials - Use in Electrical Equipment Evaluations, UL 746C, complies with the requirement.

6.1 revised February 12, 1999

Table 6.1
Minimum flammability class for a thermoplastic material

Table 6.1 revised February 12, 1999

Function	Minimum flammability class[a]
Enclosure or support of current-carrying parts	V-2[b]
A functional part other than an enclosure or support of current-carrying parts	HB[b]

[a] The flammability Class is determined at a minimum thickness of 0.8 mm (0.031 inch) or the minimum thickness employed in the construction, whichever is greater.

[b] In accordance with the applicable requirements in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

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6A Nonmetallic Parts

Section 6A added June 20, 1996

6A.1 A nonmetallic material employed either in the actuation mechanism or for the sole support of a current–carrying part of a switch shall have a Relative Thermal Index (RTI) – electrical, or mechanical without impact acceptable for its intended use. The RTI for a material is to be determined in accordance with the Standard for Poymeric Materials – Long Term Property Evaluations, UL 746B, at the minimum thickness employed in the construction. Also, the switch shall comply with Mold Stress Section 14.1.

Exception: A mold stress test need not be conducted for a material that is intended to be used at a temperature below 50°C (122°F) or below the generic RTI for the material specified in the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B.

6A.1 added June 20, 1996

7 Sealing Compound

7.1 Live screwheads or nuts on the underside of a base constructed for surface mounting shall be:

a) Countersunk not less than 1/8 inch (3.2 mm) in the clear, and covered with a waterproof, insulating sealing compound that has a softening point of 65°C (149°F) or higher; or

b) Spaced not less than 1/2 inch (12.7 mm) through air from the mounting surface and staked, upset, or otherwise reliably prevented from loosening.

7.2 The depth or thickness of sealing compound covering a nut or screwhead shall not be less than 1/16 inch (1.6 mm) or 1/8 inch (3.2 mm) if the underside of the base is not recessed and may contact the surface upon which the switch is mounted.

7.3 Sulfur is not an acceptable sealing material.

7.4 Determination of the softening point of a sealing compound is to be made in accordance with the Test for Softening Point by Ball-and-Ring Apparatus, ASTM E28-92.

8 Live Parts

8.1 General

8.1.1 A current-carrying part and a wire-binding nut and a screw shall be of metal and shall have the necessary strength, rigidity, and ampacity to comply with the performance requirements.

8.1.2 A current-carrying part shall be:

a) Copper or a copper alloy, or

b) Stainless steel that is resistant to corrosion except for quick-connect terminations, push-in terminals, solder terminals, and parts that are subjected to arcing as shown by the applicable overload and endurance tests.

Exception No. 1: Hermetically sealed switching contacts may be made of corrosion resistant steel alloy.

Exception No. 2: Steel that is protected against corrosion by either zinc plating or the equivalent, may be used for the external buttons or contacts on a mercury-contact switch chamber.

Exception No. 3: Unplated steel may be used for parts wholly within a mercury-contact switch chamber.

Exception No. 4: Sheet steel that is clad on both surfaces with copper if the thickness of copper on each side is at least 10 percent of the total thickness, and all cut edges are coated with zinc or the equivalent.

Exception No. 5: Sheet steel may be used for terminals of a television-rated switch provided that:

a) All surfaces including cut edges are coated with zinc, tin, or the equivalent;

b) The applicable overload and endurance tests show that the part is not subjected to arcing;

c) The results of the test described in 18.4.1 and 18.4.2 are acceptable; and

d) The terminals are constructed for solder connections only.

8.1.2 revised January 26, 1996

8.2 Terminals and leads

8.2.1 A switch shall be provided with wire leads, terminals, or other acceptable means for the connection of conductors.

8.2.2 Means for connection of a switch employing positive screw pressure on a stripped conductor shall be provided with upturned lugs or the equivalent that will retain the wire under the binding-screwhead. Connection by means of soldering, welding, riveting, crimping, or other forms of construction may be used if shown to be acceptable for the purpose by tests. Consideration is to be given to the current involved and the mechanical features of the connecting means.

8.2.3 A wire-binding screw shall thread into metal.

8.2.4 Wire leads used on a switch shall be of a size, type, and length that is acceptable for the intended end use.

8.3 Push-in terminals

8.3.1 A push-in (screwless) terminal shall be:

a) For use with copper conductors only; and

b) For the connection of current-carrying conductors only – not for connection of an equipment-grounding conductor.

8.4 Quick-connect terminals

8.4.1 A quick-connect terminal employed on a switch shall comply with the Standard for Quick-Connect Terminals, UL 310, as applicable, and Table 8.1, or the requirements in 18.3.1 – 18.3.5 and 21.2.1 – 21.2.3.

Table 8.1
Quick-connect terminal dimensions

Nominal tab dimensions, inch		
Width	**Thickness**	**Length**
0.250	0.032	0.307
0.205	0.032	0.245
0.205	0.020	0.245
0.187	0.032	0.245
0.187	0.020	0.245
0.125	0.032	0.275
0.125	0.020	0.275
0.110	0.032	0.275
0.110	0.020	0.275

9 Insulating Material

9.1 Fiber, mica, molded composition, or other insulating material shall be judged with reference to the form, size, and purpose of the parts for which it is used, the manner of its assembly, and its location and security in the switch.

9.2 Vulcanized fiber may be used for insulating washers, separators, and barriers, but not as the sole support of live parts.

9.3 Hard rubber shall not be used as insulating material.

9.4 A base or body in or on which live parts are mounted shall be of porcelain, phenolic, cold-molded composition, or other insulating material acceptable for the application.

10 Assembly

10.1 General

10.1.1 A switch shall be capable of being readily wired as intended.

10.1.2 Uninsulated live parts shall be secured in place so that they will be prevented from turning or shifting in position if such displacement can adversely affect performance or result in a reduction of spacings below the minimum acceptable values specified in Spacings, Section 11.

10.1.3 A screw used for the general assembly of a switch shall, if possible, be prevented from loosening or backing by sealing, staking, or equivalent means.

10.1.4 When an assembly screw that must be loosened or removed in order to wire or install a switch is tightened with a torque of 6 pound-inches (0.68 N·m), the serviceability of the assembly means shall not be impaired.

10.1.5 The chain of a pull-type mechanism shall not become energized nor shall it cause the mechanism to jam when suddenly and completely released after having been pulled to the full on position or the full off position.

10.2 Actuating members

10.2.1 An actuating member shall have the strength necessary to resist the abuse to which it may be subjected and shall be securely, but not necessarily rigidly, attached to the operating mechanism that it is intended to control, and, if of insulating material, shall comply with the requirements for Effect of Heat on Actuating Members, Section 22.

10.2.2 An actuating member of conductive material shall be insulated from live parts.

11 Spacings

11.1 Spacings through air and over surface between uninsulated live parts of opposite polarity and between an uninsulated live part and a dead metal part that may be grounded or exposed to contact by persons when the device is installed in the intended manner shall not be less than the minimum values specified in Table 11.1.

Exception: This requirement does not apply to a switch that complies with the dielectric voltage-withstand test described in 19.2

Table 11.1
Spacings

Potential involved,volts	Minimum spacings	
	inch	(mm)
0 – 250	3/64	(1.2)
251 – 600	1/8	(3.2)

11.2 A dead metal part as mentioned in 11.1 includes a metal surface on which the switch is mounted in the intended manner. A dead metal screwhead, rivet, or the like is not to be considered exposed to contact by persons after the switch is installed in the intended manner, if the dead metal is located in a hole not more than 9/32 inch (7.1 mm) in diameter and recessed not less than 3/16 inch (4.8 mm) in the clear.

11.3 In measuring a spacing, an isolated dead metal part interposed between uninsulated live parts of opposite polarity, or between an uninsulated live part and a grounded or exposed dead metal part, is to be considered as reducing the spacing by an amount equal to the dimension of the isolated dead metal part in the direction of the measurement.

PERFORMANCE

12 General

12.1 Unless otherwise specified:

a) Six representative samples of a switch in commercial form shall be tested as described in 12.3 – 22.2.

b) One set of samples shall be used throughout all the tests.

12.2 An additional set of six samples of a switch having a solid-state circuit used for varying power to a load, such as a speed control switch, shall be subjected to the overload, endurance, temperature and dielectric voltage-withstand tests with the solid-state circuit short-circuited.

Exception: This requirement does not apply to a dimmer switch.

12.3 A switch having higher alternating-current ampere ratings than direct-current ratings is to be tested for both ratings with separate samples used for each set of tests. A switch having the same alternating- and direct-current ampere ratings is to be tested on direct current if the direct-current voltage is equal to or greater than the alternating-current voltage rating.

12.4 Other than as noted in 18.1.5, the test sequence is to be:

a) Mold stress – if required,

b) Overload,

c) Endurance,

d) Tungsten-filament-lamp load endurance – if required,

e) Temperature, and

f) Dielectric-voltage withstand.

12.5 Overload and endurance tests at the highest rated voltage may represent tests at a lower voltage of the same frequency if the volt-amperes at the highest voltage is the same or higher than the volt-amperes at the lower voltage. The temperature test is to be conducted at the highest ampere rating that the test represents.

12.6 In addition to the tests mentioned in 11.3, a switch with mercury contacts shall be subjected to the Limited Short-Circuit Test, Section 20.

12.7 A switch having two or more on and off positions of the switch mechanism, such as a 2-circuit, 3-circuit, 3-pole, or series-parallel switch, is to be tested under conditions representing those of actual service, including each position that involves the making and breaking of the maximum current.

12.8 During the testing of a switch, all metal parts of the frame and the enclosure that may be grounded when installed under conditions of actual service or that are exposed to contact by the user are to be connected to ground or to a conductor of the test circuit. See 12.9.

12.9 For the overload and endurance tests, dead metal parts are to be connected through a 15-ampere or less fuse. The potential rating of the fuse is to be equal to, or greater than, the potential to ground or to the conductor of the test circuit to which dead metal parts of the equipment are to be connected. The circuit is to be connected so that:

a) On direct current, the dead metal parts will be positive with respect to the nearest arcing point in the switch, and

b) The potential between live parts and conductive dead metal parts is the full test potential.

Exception: A switch, other than a television switch, rated 240 or 250 volts that is not marked as described in 24.4 may be tested with one-half the test potential between live parts and conductive dead metal parts.

12.10 During the overload and endurance tests, a switch is to be mounted and wired so that conditions of actual service will be represented. The switch is to be connected to a load and, other than as noted in 16.5, to a supply circuit having a voltage that is within 5 percent of the rated voltage of the switch. The test circuit is to have such capacity that the potential across the load, measured at or adjacent to the switch, will have the required value when the switch under test is closed in the circuit with the required test current flowing.

12.11 With reference to the requirement in 12.10, it is impracticable to describe the details of connections that are to be made to obtain operating conditions identical with those in actual service because of the different arrangements of terminals. The switch is to be connected in the test circuit so that it will have the same position, relative to the load controlled and the supply mains, that it will have in actual service.

12.12 As a rule, the switch is to be connected in the test circuit between the mains and the load.

12.13 A lower power factor, a lower frequency, and a greater rate of operation than those specified in the performance sections of these requirements may be employed if agreeable to those concerned and if it is not a less severe condition of the test.

12.14 Whenever tests are conducted with alternating current, the circuit frequency is to be the same as the rated frequency of the switch. Other than as noted in 12.15 or, if no frequency is specified, 60-hertz alternating current is to be used.

12.15 A switch rated 50 hertz may, if agreeable to those concerned, be tested on a 60-hertz circuit, except that the currents used for the overload and endurance tests are to be 120 percent of the current that would be used if the switch were tested on a 50-hertz circuit.

12.16 In testing a switch, a cycle of operation includes operation of the switch from the off position through every electrical position of the switch, back to the off position.

12.17 A switching mechanism is not to be adjusted, lubricated, or otherwise conditioned either before or during any of the tests. Switches may be lubricated as a regular practice when they are assembled by the manufacturer.

13 Testing Circuits

13.1 General

13.1.1 An ampere-rated switch shall be subjected to overload and endurance tests with direct current and with a noninductive resistance load. A switch with an ampere rating for use in alternating-current circuits only is to be tested with alternating current and with an inductive load that has a power factor of 0.75 – 0.80.

13.1.2 The noninductive load referred to in 13.1.1 may consist of any convenient combination of carbon-filament lamps or resistors or both that will cause the required current to flow through the test circuit with a power factor of 0.98 – 1.0 on 60-hertz alternating current.

13.1.3 The reactive components of an inductive load for testing a switch for either an ampere or horsepower alternating-current rating are not to be in parallel with other reactances or resistances, except that an air-core reactor in any phase may be shunted by resistance in which the power loss is approximately 1 percent of the total power consumption in that phase. Parallel individual loads made up of resistance and inductive-reactance components connected in series may be used if the power factors of the paralleled loads are equivalent.

13.2 Tungsten-filament-lamp load

13.2.1 The test circuit, including the generator or other source of supply for testing a switch for tungsten-filament-lamp load rating is to have sufficient capacity to permit a current inrush through the switch and load as follows:

a) For direct current – not less than eight times the normal current, when the circuit is closed on a 20-ampere load. If a synthetic load is employed, its characteristics are also to be such that the current-inrush factor will not be less than 9 with a 15-ampere load, 10 with a 10-ampere load, and 11 with a 5-ampere load.

b) For alternating current – not less than the value specified in Table 13.1, when the circuit is closed on a load corresponding to a rating equal to or greater than the rating of the switch.

Exception: A direct-current tungsten-filament-lamp load and the supply circuit need not be sufficient for a 20-ampere load test if a ten-times inrush is available for a 10-ampere load and testing is limited to ratings that do not exceed 10 amperes.

Table 13.1
Test currents for tungsten-filament-lamp loads

Switch rating, amperes	Overload test		Endurance tests	
	Steady-state current (rms), amperes	Minimum inrush current (peak), amperes	Steady-state current (rms), amperes	Minimum in rush current (peak), amperes
1	1.5	27	1	18
2	3.0	51	2	35
3	4.5	71	3	51
4	6.0	91	4	65
5	7.5	111	5	78
6	9.0	130	6	92
7	10.5	147	7	105
8	12.0	163	8	117
9	13.5	178	9	130
10	15.0	191	10	141
11	13.75	180	11	153
12	15.0	191	12	163
13	16.25	201	13	173
14	17.5	211	14	183
15	18.75	215	15	191
16	20.0	226	16	199
17	21.25	230	17	207
18	22.5	239	18	214
19	23.75	243	19	220
20	25.0	247	20	226

13.2.2 With reference to the requirements in 13.2.1, the circuit shall be such that the peak value of the inrush current will be reached within 1/240 of a second after the circuit is closed.

13.2.3 A synthetic load to simulate a tungsten-filament-lamp load for testing on alternating current shall be investigated as described in 13.2.4 and 13.3.2, and also with respect to conditions that are introduced by use on alternating current.

13.2.4 The acceptability of a test circuit, including the generator or other source of supply, for testing with tungsten-filament lamps is to be determined by means of oscillograph studies. The current-inrush factor of eight mentioned in 13.2.1 is to be based on a normal current flow of 20 amperes, and testing equipment that has adequate capacity at 20 amperes is acceptable for testing switches rated at more than 20 amperes. With reference to a 60-hertz timing wave, the peak value of the inrush current as shown by the oscillograms are to be attained within 1/4 cycle.

13.2.5 The characteristics of a direct-current test circuit are to be judged from 12 or more oscillograms, and testing equipment is acceptable if not less than half the oscillograms show a current-inrush factor equal to, or greater than the minimum acceptable current-inrush factor.

13.2.6 The characteristics of an alternating-current test circuit are to be judged from 12 or more oscillograms. Those that indicate that the absolute value of the current is decreasing – the value in question is approaching the zero point – are to be disregarded. The observed peak values of twelve or more oscillograms taken when the absolute value of the current is increasing should be sufficient to show whether the capacity of the test circuit is adequate to produce the required current-inrush factor.

13.2.7 A tungsten-filament-lamp load used as the load for a switch is to be made up of the smallest possible number of lamps having standard ratings of not more than 500 watts. Fewer lamps, each rated more than 500 watts, may be used if desired. The operating cycle is to be such that the lamps are off for at least 55 seconds of each test cycle. If a switch is operated at the rate of 10 cycles per minute, see 12.15, at least ten banks of lamps controlled by a commutator are necessary for each switch under test.

13.3 Synthetic load

13.3.1 The acceptability of a test circuit – including the generator or other source of supply – for testing with a synthetic load shall be determined in a manner similar to that described in 13.2.6, consideration being given to the provision of higher current-inrush factors with the lower current loads, as required by 13.2.1.

13.3.2 A synthetic load may be used instead of tungsten-filament lamps and may consist of noninductive resistors that are connected and controlled so that a portion of the resistance is shunted during the closing of the switch under test or if a portion of the load is cut out prior to opening the switch. A synthetic load may also consist of a noninductive resistor or resistors and a capacitor in parallel, in which case the load is to be calibrated immediately after the capacitor has been charged and discharged in the normal manner. A combination load consisting of tungsten-filament lamps and resistors or capacitors, or both, is considered to be a synthetic load.

13.3.3 A synthetic load used instead of tungsten-filament lamps is to be calibrated against and is to be equivalent to a tungsten-filament-lamp load in the test circuit. The calibration of a synthetic load is to be checked at appropriate intervals to determine that none of the constants of the circuit or load change with time or use.

13.3.4 The characteristics of a synthetic load are to be such that the inrush current will be as specified in 13.2.1 – 13.2.3. The current in the capacitor/resistance load is not to be less than half the required inrush current at 1/60 second and not less than twice the steady-state current at 7/120 second after the circuit is closed. The current in a straight resistance load is to be the full inrush value for a minimum of 15 milliseconds after the circuit is closed.

14 Tests on Nonmetallic Parts

14.1 Mold stress

14.1.1 With reference to Nonmetallic Parts, Section 6A, a nonmetallic parts is to be subjected to the test as specified in 14.1.2. There shall be no distortion of a nonmetallic part employed either in the actuation mechanism or for the sole support of a current-carrying part of the switch or switch parts that would adversely affect the performance of the switch.

14.1.1 revised June 20, 1996

14.1.2 The switch is to be conditioned in an air-circulating oven for 300 hours. The temperature of the oven is to be the temperature that the switch is intended to attain in the end-use application as specified by the manufacturer. The maximum temperature shall not exceed the temperature index rating of the material – electrical or mechanical, generally without impact.

14.1.3 The samples subjected to the mold-stress test are then to be used for the remaining electrical tests after being allowed to cool to room temperature.

14.2 Diaphragms

14.2.1 If the deterioration of a diaphragm, seal or similar part of a switch intended for use with laundry and dishwasher equipment or the like, would result in a risk of fire or electric shock, the part shall be resistant to deterioration from the vapors or liquids likely to come in contact with it as determined by investigation.

14.2.1 revised December 16, 1997

14.2.2 The test procedure to determine whether a part complies with the requirement in 14.2.1 depends upon such factors as the material of which it is made, its size, shape, and application in the appliance. Among the considerations the evaluation is to include, but need not be limited to, are:

a) Visual inspection for cracks, deformation, and the like after artificial aging, and

b) Comparison of hardness, tensile strength, and elongation before and after artificial aging.

14.2.3 With reference to the requirements in 14.2.1 and 14.2.2, a diaphragm made of a noncomposite material or materials is acceptable if its hardness, tensile strength and elongation, before and after aire oven aging tests, are in accordance with the requirements specified in the Standard for Gaskets and Seals, UL 157. The maximum service temperature specified in UL 157 corresponds to the temperature rating of the switch.

14.2.3 revised December 16, 1997

14.2.4 Materials exposed to powdered laundry detergents and bleach shall be subjected to the exposure test conditions of UL 157.

14.2.4 revised December 16, 1997

Table 14.1
Artificial-aging tests

Table 14.1 deleted December 16, 1997

15 Overload Test

15.1 A switch shall be subjected to the applicable overload test specified in Table 15.1. There shall be no electrical or mechanical malfunction of the switch, and the fuse that is connected to dead metal parts – see 12.9 – shall not open.

Table 15.1
Overload test

Switch rating	Test current	Load
0 – 10 amperes	150 percent of rating	
More than 10 amperes	125 percent of rating	
Horsepower:		
DC	See Table 15.2	Non-inductive
AC	See Table 15.3	Inductive, 0.4 – 0.5 power factor

15.2 For the overload tests, a switch is to be operated by means of its actuating member for 50 cycles of operation, making and breaking the specified current at a rate of 6 – 10 cycles per minute.

15.2 revised January 26, 1996

15.3 A switch rated in horsepower and intended for use on direct current as well as alternating current is to be tested with alternating current and direct current, with different samples used for the alternating- and direct-current tests.

15.4 A switch that has horsepower ratings at more than one voltage is to be tested at the overload current corresponding to the horsepower rating at the highest voltage. Also, a switch is to be tested at the highest overload-current value corresponding to a horsepower rating at any lower voltage if that current is more than 135 percent of the overload current involved at the maximum voltage rating. The higher current involved at a lower voltage may necessitate a separate heating test. If more than one test is conducted, three samples are to be used for each test. Refer to 12.3.

15.4 revised January 26, 1996

15.5 An overload test of a switch in a 3-phase circuit is representative of performance of the switch on a 2-phase circuit of the same voltage for the same horsepower rating.

15.6 A switch that has a horsepower rating and a current rating is to be tested for both horsepower and current ratings unless it is obvious that one overload test would represent the other. If both overload tests are conducted, each test for a horsepower rating is to be conducted on a separate set of samples.

15.7 Other than as noted in 15.8, each set of contacts of a switch is to be subjected to the required overload test.

15.8 For a switch that has multiple sets of identical contacts that are actuated in an identical manner, representative sets of contacts are to be selected for testing.

15.9 If a switch can be left in other than a full off or a full contact position, it shall perform acceptably in the overload test when operated so that the switching contacts are moved from the full contact to an intermediate position sufficient only to interrupt the circuit.

Table 15.2
Test current for d-c switches

Switch rating, horse-power	Full-load current, amperes			Overload current, amperes		
	125 v	250 v	600 v	125 v	250 v	600 v
1/10	2.0	1.0	–	20	10	–
1/8	2.2	1.1	–	22	11	–
1/6	2.4	1.2	–	24	12	–
1/4	3.0	1.5	–	30	15	–
1/3	3.8	1.8	–	38	19	–
1/2	5.4	2.7	–	54	27	–
3/4	7.4	3.7	1.6	74	37	16
1	9.6	4.8	2.0	96	48	20
1-1/2	13.2	6.6	2.7	132	66	27
2	17.0	8.5	3.6	170	85	36

Table 15.3
Overload-test current for a-c switches

Revised Table 15.3 effective March 1, 2001

Switch rating in horse-power	Test current, amperes									
	120 – 125 volts			240 – 250 volts			480 volts		600 volts	
	Single-phase	Two-phase four-wire	Three phase	Single-phase	Two-phase four-wire	Three phase	Two-phase four-wire	Three phase	Two-phase four-wire	Three phase
1/10	18	–	–	9.0	–	–	–	–	–	–
1/8	22.8	–	–	11.4	–	–	–	–	–	–
1/6	26.4	–	–	13.2	–	–	–	–	–	–
1/4	34.8	–	–	17.4	–	–	–	–	–	–
1/3	43.2	–	–	21.6	–	–	–	–	–	–
1/2	58.8	40.0	40.0	29.4	20.0	20.0	10.0	10.0	8.0	8.0
3/4	82.8	50.0	50.0	41.4	25.0	25.0	12.5	12.5	10.0	10.0
1	96.0	60.0	60.0	48.0	30.0	30.0	15.0	15.0	12.0	12.0
1-1/2	120.0	80.0	80.0	60.0	40.0	40.0	20.0	20.0	16.0	16.0
2	144.0	100.0	100.0	72.0	50.0	50.0	25.0	25.0	20.0	20.0

16 Endurance Test

16.1 A switch rated in amperes or horsepower shall be subjected to the tests described in 16.2 – 16.4. There shall be no electrical or mechanical malfunction of the switch and the fuse that is connected to dead metal parts – see 12.9 – shall not open. At the conclusion of the test, the switch shall be capable of performing its normal function and there shall be no loosening of parts or any other defect that will diminish appreciably the usefulness and reliability of the switch.

16.2 A switch is to be operated by means of its actuating member either manually or by an acceptable machine for 6000 cycles of making and breaking its rated current at a rate of 6 – 10 cycles per minute.

16.3 If an additional rating in horsepower is desired for an ampere-rated alternating-current switch, (such as a heater switch) that has been tested for overload and endurance at unity power factor, an additional endurance test with an inductive load may be waived if the current rating of the switch is not less than twice the full-load motor current corresponding to the horse-power rating. However, the switch is to be subjected to the horsepower overload test in accordance with Table 15.1.

16.4 For a switch rated in horsepower only, the endurance test-current is to be the applicable value of full-load current specified in Table 15.2 or Table 16.1.

16.5 A switch intended for the control of a tungsten-filament lamp is to be operated for an additional 6000 cycles, following the endurance test making and breaking a circuit with a load of tungsten-filament lamps or a load having equivalent current characteristics and adjusted so that the normal current flow is the rated current of the switch.

16.6 The open-circuit potential of the test circuit described in 16.5 is to be 120 ±5 volts, and the closed-circuit potential at the load with normal current flowing is to be within 5 percent of the open-circuit potential. A direct-current supply is to be used with a T-rated switch – see 23.3. An alternating-current supply is to be used with an L-rated switch – see 23.4.

Table 16.1
Full-load currents for a-c motors rated in horsepower

Revised Table 16.1 effective March 1, 2001

Horse-power	Full-load current, amperes									
	120 – 125 volts			240 – 250 volts			480 volts		600 volts	
	Single-phase	Two-phase four-wire	Three phase	Single-phase	Two-phase four-wire	Three phase	Two-phase four-wire	Three phase	Two-phase four wire	Three phase
1/10	3.0	–	–	1.5	–	–	–	–	–	–
1/8	3.8	–	–	1.9	–	–	–	–	–	–
1/6	4.4	–	–	2.2	–	–	–	–	–	–
1/4	5.8	–	–	2.9	–	–	–	–	–	–
1/3	7.2	–	–	3.6	–	–	–	–	–	–
1/2	9.8	4.0	4.4	4.9	2.0	2.2	1.0	1.1	0.8	0.9
3/4	13.8	4.8	6.4	6.9	2.4	3.2	1.2	1.6	1.0	1.3
1	16.0	6.4	8.4	8.0	3.2	4.2	1.6	2.1	1.3	1.7
1-1/2	20.0	9.0	12.0	10.0	4.5	6.0	2.3	3.0	1.8	2.4
2	24.0	11.8	13.6	12.0	5.9	6.8	3.0	3.4	2.4	2.7

17 Continuity Test

17.1 Immediately following the endurance test, one sample of a switch having contacts for separate circuits shall be subjected to a continuity test as described in 17.2. There shall be no electrical continuity between the contacts.

17.2 The actuating member of the switch is to be placed in any position that does not require an external retaining force to be maintained. The switch is then to be subjected for 1 minute to a 50 – 60 hertz essentially sinusoidal potential between the contacts for the separate circuits. The applied potential is to be equal to the maximum rated voltage of the switch.

18 Temperature Test

18.1 General

18.1.1 The temperature rise on the wiring terminals or on the wire leads used instead of wiring terminals shall not be more than 30°C (54°F) while a switch is continuously carrying the maximum rated current. The current for the temperature test of a switch rated in horsepower only shall be the same as that specified for the Endurance Test, Section 16.

18.1.2 The temperature test may be conducted at any ambient temperature within the range of 10 – 40°C (50 – 104°F).

18.1.3 During the temperature test, the switch is to be on a flat, horizontal nonconductive surface. Switches that are intended to be mounted immediately adjacent to each other are to be tested while mounted in that manner. If the test fixture used to hold the switch during the endurance test does not affect the temperature of the switch, the fixture may be used for the temperature test.

18.1.4 A switch that does not have a quick-make and -break mechanism and has two or more on contact positions shall comply with the requirement in 18.1.1 with the mechanism in any on position in which it can be left.

18.1.5 As indicated in 12.4, the temperature test is always required following the endurance test. If there is any question regarding the ability of a switch to pass the temperature test before the blades and contacts have been worked in, the test may be conducted following the overload test and prior to the endurance test.

18.1.6 The switch is to carry its maximum applicable current continuously (see 12.3) until constant temperatures are attained on the plates of wiring terminals or on wire leads used instead of wiring terminals. Connections to a switch not provided with attached leads are to be made with leads not less than 1 foot (300 mm) long having 1/32-inch (0.8-mm) thick thermoplastic insulation and of the size specified in Table 18.1. The temperature test may be conducted at any convenient voltage, using either alternating or direct current.

Table 18.1
Wire size for temperature test

Test current, amperes	Wire AWG	Size, (mm^2)
0.0 – 6	18	(0.82)
6.1 – 10	16	(1.3)
10.1 – 15	14	(2.1)
15.1 – 20	12	(3.3)
20.1 – 30	10	(5.3)
30.1 – 45	8	(8.4)
45.1 – 60	6	(13.3)

18.1.7 Temperatures are to be measured using thermocouples consisting of Nos. 28 – 32 AWG (0.08 – 0.03 mm^2) iron and constantan wires. Measurements are to be made on the terminals adjacent to the switch enclosure. If a switch has wire leads, the measurements are to be made on the copper conductors at the point of entrance of the lead to the switch. A temperature is considered to be constant when three successive readings, taken at 5-minute intervals, indicate no change.

18.2 Push-in terminals

18.2.1 A switch with push-in terminals shall be tested as described in 18.2.2. The temperature rise on the conductor attached to a push-in (screwless) terminal shall not exceed 30°C (54°F) based on an ambient temperature of 10 – 40°C (50 – 104°F) with the terminal connection carrying maximum rated current of the switch for 30 days without interruption.

18.2.2 Six previously unused samples are to be assembled with copper wire. The size and type of conductor and the method used to install it are to be in accordance with the manufacturer's instructions. Internal components of the switches, including the switching mechanism, may be short-circuited by means of a shunt. Temperatures are to be measured each working day.

18.3 Quick-connect terminals

18.3.1 A switch with quick-connect terminals shall be tested as described in 18.3.2. The temperature rise of a quick-connect tab and connector in combination shall not be more than 30°C (54°F). See 8.4.1.

18.3.2 The switch is to be tested as described in 18.2.2 except that the temperature of the tab is to be measured until constant temperatures are attained while connected to an appropriate female connector.

18.3.3 After the continuous heating test, a connector shall perform acceptably in a 500-cycle heating test as described in 18.3.4.

18.3.4 The switch is to be operated for 500 cycles – each cycle consisting of 45 minutes on and 15 minutes off. A current equal to twice the maximum rated current of the switch is to be passed through the terminal during each on period. The final on period may be longer than 45 minutes if necessary for the connector to attain thermal equilibrium – however, the on period is not to be prolonged longer than is necessary for temperatures to become constant. The temperature rise is to be determined at the end of the 24th on period and again at the end of the 500th on period. The temperature after the 500th on period shall not be more than 15°C (27°F) higher than the temperature reading after the 24th on period and the temperature rise is to not be more than 85°C (153°F).

18.3.5 For the tests described in 18.3.1 – 18.3.4, internal components of the switch, including the switching mechanism, may be short-circuited by means of a shunt.

18.4 Steel terminals

18.4.1 A switch having steel terminals shall be compared to a switch of the same construction having copper terminals. When tested as described in 18.4.2, the switch having steel terminals shall function in the intended manner, and comply with the requirements in 18.1.1 – 18.1.7 for at least as long as the switch having copper terminals functions in the intended manner or complies with the requirements in 18.1.1 – 18.1.7.

18.4.2 Samples of switches of the same construction having:

a) Steel terminals as mentioned in Exception No. 5 of 8.1.2, and

b) Copper terminals, are to be placed in a controlled atmosphere maintained at 60°C (140°F) at a relative humidity of 98 ±2 percent.

The switches are to be investigated to determine whether they comply with the requirements in 18.4.1 at intervals of approximately 168 hours. The test is to be continued until ultimate results are obtained, which will usually be within 2160 hours.

19 Dielectric Voltage-Withstand Test

19.1 A switch shall withstand for 1-minute, without breakdown, a 50 – 60 hertz essentially sinusoidal potential applied as described in 19.2 – 19.5. The potential is to be applied between live parts of opposite polarity and between live parts and dead metal parts, with the switch at the maximum operating temperature reached in normal use. The test potential is to be in accordance with Table 19.1.

Revised 19.1 effective February 11, 2000

Table 19.1
Test potentials for the dielectric voltage-withstand test

Added Table 19.1 effective February 11, 2000

Switch rating	Location of the test potential application	
	Between live parts of opposite polarity, volts	Between live parts and dead metal parts, volts
250 volts or less	1000	1000
More than 250 volts or 1/2 hp	1500	2 V[a] + 1000

[a] V is the voltage rating of the switch.

19.2 As an alternative to the test described in 19.1, a switch that does not have the minimum spacings required by 11.1 shall withstand without breakdown for 1 minute the application of a 50 – 60-hertz essentially sinusoidal potential of twice the rated voltage plus 1000 volts, with the switch mounted as described in 19.4. The test potential shall be applied between live parts of opposite polarity, and between live parts and dead metal parts.

19.3 The test specified in 19.2 is to be conducted immediately following conditioning of the switch for 48 hours in a moist-air chamber at a temperature of 32 ±1°C (90 ±2°F) and a relative humidity of 95 – 100 percent.

19.4 A switch that is to be tested as described in 19.2 is to be mounted in its intended manner on flat sheet metal not less than 1/16 inch (1.6 mm) thick, so that the most severe normal conditions of spacing exist. However, screws or other mounting means are to be the smallest that are commercially obtainable and that are adequate for securing the switch in place as in actual service.

19.5 The test specified in 19.1 or 19.2 is to be conducted using a testing transformer, the output voltage of which is essentially sinusoidal and can be varied. Starting at zero, the applied potential is to be increased gradually until the required test level is reached, and is to be held at that level for 1 minute. The increase in the applied potential is to be at a substantially uniform rate as rapid as is consistent with its value being correctly indicated by a voltmeter.

19.6 Other than as noted in 19.7, the transformer for dielectric voltage-withstand testing is to have a capacity of not less than 500 volt-amperes and an output or secondary potential of not less than the applicable value specified in 19.1 and 19.2.

19.7 The capacity of a transformer used for the test may be less than 500 volt-amperes if there is a meter of not more than 2 percent error connected across the secondary terminals to directly measure the applied potential.

20 Limited Short-Circuit Test

20.1 A switch having mercury contacts shall be tested in series with a standard, nonrenewable, cartridge fuse in a direct-current circuit of rated voltage. For an ampere rated switch, a 30-ampere fuse shall be used for a switch rated 30 amperes or less and a 60-ampere fuse shall be used for a switch rated 31 – 60 amperes. For a switch having a horsepower rating, the capacity of the fuse shall not be less than four times the full-load motor current corresponding to the switch rating, but shall not be less than 30 amperes. The test circuit shall be capable of delivering 3500 amperes when the system is short-circuited at the testing terminals.

Exception: Alternating current may be employed if the device is intended and marked for use on alternating current only. The power factor for the alternating-current test is to be 0.98 – 1.0.

20.2 There shall be no ignition of the cotton or the insulation on the circuit conductors or emission of flame or molten metal – mercury excepted – from the enclosure housing the switch. Wiring attached to the switch, except leads to the mercury contacts, shall not be damaged. Successive operations shall be conducted by alternately closing the short circuit on the switch by means of an acceptable switching device, and closing the switch on the short circuit.

20.3 Each of three sample switches that have not previously been tested is to be mounted in an enclosure of the material, dimensions, and other characteristics recommended by the manufacturer. Any exposed dead metal part including the enclosure and a metal surface on which the switch is mounted in the intended manner is to be grounded, and cotton is to be placed around each opening in the enclosure. Each switch is to be subjected to three operations with sufficient time between successive operations on any one sample to permit cooling to room temperature, unless the tube is damaged to the degree that it opens the circuit permanently before completion of the third operation. A switch need not be operable after the test.

21 Pull Test

21.1 Push-in terminals

21.1.1 A push-in terminal shall withstand without pull-out or breakage of the conductor or any strand of the conductor, the application of a straight pull as described in 21.1.2.

21.1.2 Conductors of the intended size, solid, stranded, or solder-dipped stranded, are to be connected to both terminals of one circuit in each of six samples in accordance with the manufacturer's instructions. The pull on each conductor is to be increased gradually until it reaches 5 pounds (22 N) and it is to be maintained at that value for 1 minute. Previously untested samples may be used for this test.

21.2 Quick-connect terminals

21.2.1 The force required to insert and withdraw the tab and connector of a quick-connect terminal shall comply with the values specified in Table 21.1 for the number of insertions and withdrawals specified in that table.

Table 21.1
Insertion and withdrawal forces

			Force	
			Pounds	(N)
First insertion:				
	Maximum individual		18	(80)
First withdrawal:				
	Maximum individual		20	(89)
	Minimum			
		Average	5	(22)
		Individual	3	(13)
Sixth withdrawal				
	Minimum:			
		Average	3	(13)
		Individual	2	(8.9)

21.2.2 Six unused tabs and connectors assembled in the intended manner to lengths of wire of the proper size are to be tested. See 8.4.1.

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21.2.3 Force measurements are to be made using a testing device capable of holding the reading and providing accurate alignment with slow and steady engagement and withdrawal of the tab and connector.

22 Effect of Heat on Actuating Members

22.1 An actuating member of insulating material shall be tested as specified in 22.2. The actuating member shall:

a) Not soften or be damaged by the exposure,

b) Operate the mechanism in the normal manner following such exposure, and

c) Not be adversely affected to the extent that it is appreciably deformed or fails to operate the mechanism.

22.2 The switch assembly is to be subjected to a temperature of 65°C (149°F) for a time long enough to determine that the insulating material under consideration is thoroughly heated – usually 1 hour in a constant-temperature oven will be sufficient. The actuating member is then to be operated manually – not controlling a load – as in actual service of 25 cycles of make and break. In conducting this test the actuating member is to be operated with no more force or greater impact than would be the case in normal service. The test is to be conducted immediately after removal of each individual sample from the oven.

RATING

23 General

23.1 The potential rating of a switch shall be any one or combination of the following values: A value, or values, less than 50 volts, 50, 75, 125, 250, or 600 volts.

Exception: An alternating-current potential rating may also be 120, 240, 277, or 480 volts.

23.2 A switch shall have a horsepower or a current rating, or both, for each voltage rating.

23.3 A switch that has been tested as required for a switch intended for the control of tungsten-filament lamps operating on direct current with acceptable results may have an additional T rating at 125 volts.

23.4 A switch that has been tested as required for a switch intended for the control of tungsten-filament lamps operating on alternating current with acceptable results may have an additional L rating at 120 or 125 volts.

23.5 For two- and three-circuit switches, including fan-motor and double-throw switches, the ampere rating applies to the maximum current carried using any combination of circuits.

23.6 The horsepower rating of a switch shall be 1/10, 1/8, 1/6, 1/4, 1/3, 1/2, 3/4, 1, 1-1/2, or 2 horsepower or an appropriate combination of such values at different voltages, except that the rating – not more than 2 horsepower – may be determined from the results of test performance at one or more of the established voltages mentioned in 23.1.

MARKING

ALL SWITCHES

24 General

24.1 A switch shall be plainly marked with

a) The manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product may be identified, and

b) The electrical rating, and if practicable, the catalog number, or

c) The catalog number, and if practicable, the electrical rating.

24.2 If a manufacturer produces switches at more than one factory, each switch shall have a distinctive marking by which it may be identified as the product of a particular factory.

24.3 The marked horsepower rating of a switch at any single voltage indicates that the switch is acceptable for that horsepower rating or less only at that voltage. If a switch is to be considered acceptable for any horsepower rating at another voltage, that horsepower and voltage rating shall also be marked on the switch.

24.4 A switch rated 240 or 250 volts that has been tested in accordance with 12.9 (b) shall be marked with the voltage rating 240 or 250.

24.5 The voltage rating of a switch rated 240 or 250 volts that has not been tested in accordance with 12.9 (b) shall not be underlined or otherwise marked to indicate that it has been so tested.

25 Supplementary Marking

25.1 Tungsten marking

25.1.1 A switch acceptable for the control of tungsten-filament lamps on direct as well as alternating current shall be marked with the letter T, located to indicate that it applies only to the rating at 125 volts.

25.1.2 A switch acceptable for the control of tungsten-filament lamps on alternating-current circuits only shall be marked with the letter L, located to indicate that it applies to the rating for 120 or 125 volts ac.

25.2 A-C only identification

25.2.1 A switch that is acceptable for use in alternating-current circuits only shall be marked ″AC ″ or with an acceptable frequency marking, such as 60 hertz, or a phase marking.

HEATER SWITCHES

26 General

26.1 In addition to the requirements in 26.2 – 26.6, switches for use in heating appliances shall comply with all applicable requirements in Sections 3 – 25.

26.2 With reference to the requirements in 7.1 and 7.2, the sealing compound may be omitted in a switch intended particularly for use with heating appliances if live parts on the underside of the base are countersunk not less than 1/4 inch (6.4 mm) and are staked, upset, or otherwise reliably prevented from loosening.

26.3 A cement or a sealing compound used to seal a live part in place on the underside of the base of a heater switch shall have a softening point of 150°C (302°F) or higher.

26.4 A noninductive resistance load is to be employed for the overload and endurance tests of a heater switch.

26.5 A heater switch having an alternating-current rating only is to be tested with alternating current.

26.6 A heater switch for the control of a three-wire element may have a single current rating at 125 – 250 volts.

TELEVISION SWITCHES

27 General

27.1 In addition to the requirements in Sections 28 – 31, a television switch shall comply with all applicable requirements in Sections 3 – 11.

28 Construction

28.1 Insulating material

28.1.1 Insulating material used as any part of an enclosure shall comply with the requirements for Class V-0 in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

28.1.1 revised February 12, 1999

28.1.2 Except as noted in 28.1.3, insulating material used as any part of an enclosure of a switch shall have arc-tracking characteristics with a minimum arcing time of 180 seconds when tested in accordance with the Standard Test Method for High-Voltage, Low-Current Dry Arc Resistance of Solid Electrical Insulation, ASTM D495-89.

28.1.3 An actuator made of an insulating material need not comply with the requirement in 28.1.2 if:

a) The area occupied by the actuator, where it passes through the plan of the enclosure plus the area of all other openings in the enclosure does not exceed 0.05 square inch (32 mm^2), and

b) The actuator complies with the requirement in 28.1.1.

28.1.4 Except as noted in 28.1.3, insulating material that projects into or through an opening in the enclosure shall be considered to be part of the enclosure and shall comply with the requirements in 28.1.2 and 28.1.5.

28.1.5 Insulating material used within an enclosure of a switch shall comply with the requirements for Class HB, V-0, V-1, or V-2 in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

28.1.5 revised February 12, 1999

28.2 Openings

28.2.1 The total unused area of all openings in a switch enclosure shall not exceed 0.05 square inch (32 mm^2). A part of the switch mechanism that is not in the plane of an opening shall be disregarded in making this measurement.

28.3 Wire leads

28.3.1 Wire leads, if provided, shall be acceptable for the purpose and shall have flame-resistant properties. Wire having flame-resistant properties is identified by the designation FR-1 (VW-1) surface-printed on the wire insulation or printed on an attached tag, or both.

29 Performance

29.1 General

29.1.1 Each of six representative samples of a television switch in commercial form shall be subjected to the tests described in 29.1.3 – 29.6.2; one set of samples being used throughout all the tests. There shall not be any warping, cracking, or blistering of the switch enclosure. Discoloration of the enclosure is acceptable.

29.1.2 A switch having more than one switch pole is to be tested with each pole controlling a separate load, with opposite polarity between poles.

29.1.3 The test sequence is to be overload, endurance, temperature, dielectric voltage withstand, continued endurance, and repeated dielectric voltage withstand.

29.2 Test conditions

29.2.1 The overload and endurance tests are to be conducted with alternating current and with a tungsten-filament-lamp load under the conditions described in 12.7 – 12.15 or a load as described in 13.2.3 and 13.3.1 – 13.3.4, and having the appropriate test current specified in Table 13.1, that is consistent with the switch rating.

29.2.2 Other than as noted in 29.2.3, the test circuit for the overload and endurance tests, is to be in accordance with 13.2.2, 13.2.4, and 13.2.6, and the load is to be as described in 13.2.7.

29.2.3 A tungsten-filament-lamp load and the supply circuit need only be sufficient to provide the test currents required for the switch rating or ratings to be tested in accordance with Table 13.1. A test circuit that provides one of the peak inrush currents specified for the overload test is considered to provide the peak inrush currents required for tests of a switch of a lower rating.

29.2.4 During the overload and endurance tests, the test conditions are to be as described in 12.7 – 12.15.

29.3 Overload

29.3.1 A switch shall be operated by means of its actuating member for 50 cycles of operation, making and breaking 150 percent of its rated current at a rate of not more than 10 cycles per minute. There shall be no electrical or mechanical malfunction of the switch. See 12.12.

29.3.1 revised January 26, 1996

29.4 Endurance

29.4.1 A television switch shall be subjected to 10,000 cycles of operation making and breaking its rated current. There shall be no electrical or mechanical malfunction of the switch.

29.4.2 The switch is to be operated by means of its actuating member, either manually or by a machine, at a rate of 6 – 10 cycles per minute. See 12.12.

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29.5 Temperature

29.5.1 A switch shall be tested as described in 18.1.6 and 18.1.7 while continuously carrying the maximum rated current. The temperature rise on the wiring terminals shall not exceed 30°C (54°F).

29.6 Dielectric voltage withstand

29.6.1 While in a heated condition representing normal operating temperature, a switch shall withstand without breakdown for 1 minute the application of a 60-hertz essentially sinusoidal potential of 1000 volts between:

a) Live parts and exposed dead metal parts.

b) Switch contacts with the switch in the open position.

c) Live parts of opposite polarity.

29.6.2 The dielectric voltage-withstand test is to be conducted as described in 19.5 using a transformer as described in 19.6.

29.7 Continued endurance

29.7.1 Upon completion of the overload, endurance, temperature, and dielectric voltage withstand tests described in 29.4.1 – 29.6.2, a switch shall be subjected to an additional 15,000 cycles of operation as described in 29.4.2. At the conclusion of this test, the switch shall be capable of making and breaking the test load.

29.8 Dielectric voltage withstand (repeated)

29.8.1 Following the continued endurance test described in 29.7.1, a switch shall comply with the requirements in 29.6.1 and 29.6.2 in a repeated dielectric voltage withstand test.

30 Rating

30.1 A television switch shall be rated in amperes and volts. The voltage rating shall be 120 or 240 volts ac. The ampere rating shall be any integer value from 1 – 20, inclusive.

31 Marking

31.1 A switch shall be plainly marked with the manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product may be identified, and the type designation ″TV-____″. The blank in the type designation shall be filled in with the ampere rating and voltage rating of the switch. Other electrical ratings may be marked on the switch if the switch, has been investigated and found acceptable for the additional ratings.

Exception: A television switch rated 120 volts ac only need not be marked with the voltage rating.

31.1 renumbered January 26, 1996

SPECIAL-USE DIMMER SWITCHES

32 Construction

Section 32 deleted January 26, 1996

33 Performance

Section 33 deleted January 26, 1996

34 Rating

Section 34 deleted January 26, 1996

Superseded requirements for

the Standard for

Special-Use Switches

UL 1054, Fifth Edition

The requirements shown are the current requirements that have been superseded by requirements in revisions issued for this Standard. To retain the current requirements, do not discard the following requirements until the future effective dates are reached.

19.1 A switch shall withstand for 1 minute without breakdown a 50 – 60-hertz essentially sinusoidal potential applied as described in 19.2 – 19.5 between live parts of opposite polarity and between live parts and dead metal parts, with the switch at the maximum operating temperature reached in normal use. The test potential shall be:

a) Fifteen-hundred volts for a switch rated more than 250 volts.

b) One-thousand volts for all other switches.

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