



UL 20

STANDARD FOR SAFETY

General-Use Snap Switches

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UL Standard for Safety for General-Use Snap Switches, UL 20

Fourteenth Edition, Dated July 20, 2018

Summary of Topics

This revision of ANSI/UL 20 dated May 31, 2023 includes the following changes in requirements:

- Field Replacement Actuator; Clause [4.9A](#), [5.2.10](#), Clause [5.32](#), [7.1.15](#), [7.1.16](#), [Figure 10](#)**
- Revised Marking for Products with USB Type Outlets; [SA12.1](#)**
- Spring Action Clamp Terminal; [2.19A](#), Clause [4.7A](#), Clause [5.20A](#), [Table 14A](#), [7.2.2A](#)**
- Separable Terminal Assembly Construction; [1.1](#), [1.8A](#), [2.6A](#), [2.13](#), [4.5.3.19A](#), [4.5.3.19B](#), [Annex C](#)**

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

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated August 12, 2022 and February 24, 2023.

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Fourteenth Edition

General-Use Snap Switches

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ANSI/UL 20-2023



Commitment for Amendments

This standard is issued jointly by the Association of Standardization and Certification (ANCE), the Canadian Standards Association (operating as "CSA Group"), and ULSE Inc. (ULSE). Comments or proposals for revisions on any part of the standard may be submitted to ANCE, CSA Group, or ULSE at anytime. Revisions to this standard will be made only after processing according to the standards development procedures of ANCE, CSA Group, and ULSE. CSA Group and ULSE will issue revisions to this standard by means of a new edition or revised or additional pages bearing their date of issue. ANCE will incorporate the same revisions into a new edition of the standard bearing the same date of issue as the CSA Group and ULSE pages.

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This Standard is subject to review within five years from the date of publication, and suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to inquiries@csagroup.org and include "Proposal for change" in the subject line: Standard designation (number); relevant clause, table, and/or figure number; wording of the proposed change; and rationale for the change.

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This ANSI/UL Standard for Safety consists of the Fourteenth Edition including revisions through May 31, 2023. The most recent designation of ANSI/UL 20 as an American National Standard (ANSI) occurred on May 31, 2023. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

The Department of Defense (DoD) has adopted UL 20 on December 4, 1981. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

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

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CONTENTS

Preface	7
----------------------	----------

1	Scope	9
2	Definitions	10
3	General	11
3.1	Components	11
3.2	Units of Measurement	12
3.3	Reference Publications	12
4	Construction	15
4.1	Enclosure	15
4.2	Lining	16
4.3	Bushings and Strain Relief	17
4.4	Bases and Bodies	17
4.5	Current-Carrying Parts	19
4.6	Separable Jumper Connector for Separable Terminals	23
4.7	Separable Terminal Assembly	24
4.7A	Spring Action Clamp Terminals	24
4.8	Insulating Material	24
4.9	Actuating Members	25
4.9A	Field Replacement Actuator	25
4.10	Creepage Distances, Clearances, and Distances Through Sealing Compounds	25
4.11	Assembly	27
4.12	Provision for Grounding	28
5	Testing	29
5.1	General	29
5.2	Test Sequence	30
5.3	Tungsten-Filament-Lamp Load Characteristics	37
5.4	Assembly Test	38
5.5	Test Conditions	39
5.6	Overload Test	40
5.7	Endurance Test	42
5.8	Temperature Test	43
5.9	Dielectric Voltage-Withstand Test	44
5.10	Security of Switch Leads Test	45
5.11	Push-In Terminal Tests	45
5.12	Effect of Heat on Actuating Members Test	46
5.13	Switching Mechanism Test	46
5.14	Strain-Relief Test	48
5.15	Fault Current Test	48
5.16	Crushing Test	49
5.17	Resistance to Heat Test	49
5.18	Door Switch Assembly Test	49
5.19	Retention of Tab Connection Test	49
5.20	Separable Connector Pull Test	49
5.20A	Spring Action Clamp Terminal Pull Test	50
5.21	Mold Stress Relief Test	51
5.22	Separable Terminal Assembly Humidity Conditioning Followed By Dielectric Test	51
5.23	Short Circuit Withstand Test	51
5.24	Latching Mechanism Test	52
5.25	Abnormal Overload Test	52
5.26	Temperature Test	53
5.27	Continuity Impedance Test	54
5.28	Bonding (Fault Current) Test	54

5.29	Mounting Yoke Resistance Test	55
5.30	Combination Wire Binding/Pressure-Type Terminal Assembly Test	55
5.31	Inrush Current	56
5.32	Field Replacement Actuator	57
6	Ratings	58
7	Markings	59
7.1	General	59
7.2	Supplementary Markings	61
7.3	Location	63
7.4	Tungsten	64
7.5	AC-Only Identification	64
7.6	Switch Termination Restrictions	64
7.7	For Use with Electronic Ballasts	66
8	Self-Contained Switches for Use Without a Separate Outlet Box	67
8.1	General	67
8.2	Construction	67
8.3	Performance Testing	69
8.4	Markings and Instructions	74

SUPPLEMENT SA – AC ONLY FLUSH SWITCH WITH INTEGRAL POWER SUPPLY WITH CLASS 2 OUTPUT CONNECTORS

INTRODUCTION

SA1	Scope	83
SA2	Glossary	83

CONSTRUCTION

SA3	General	83
SA4	Polymeric Enclosure	84
SA5	Spacings	84
SA6	Terminals and Leads	84

PERFORMANCE

SA7	Temperature Test	84
SA8	Class 2 Output Power Supply	88
SA9	Assembly Test	88
SA10	Installation Instructions	89
SA11	User Instructions	89
SA12	Markings	89

ANNEX A (Normative) Standards for Components

A1	Component Standards	90
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Annex B (Informative) Canadian Requirements for CO/ALR Switches

B1	General	92
B2	Heat Cycling with Wire Disturbance	93
B3	Heat Cycling with Vibration	94
B4	Environmental	95
B5	Stripping Torque	96

Annex C (Informative) French Translations and Markings

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Preface

This is the harmonized ANCE, CSA Group, and ULSE standard for General-Use Snap Switches. It is the first edition of NMX-J-005-ANCE, fifth edition of CAN/CSA-C22.2 No. 111, and the fourteenth edition of UL 20. This edition of CAN/CSA-C22.2 No. 111 supersedes the previous edition(s) published on May 10, 2010. This edition of UL 20 supersedes the previous edition(s) published on May 10, 2010. This harmonized standard has been jointly revised on May 31, 2023. For this purpose, CSA Group and ULSE are issuing revision pages dated May 31, 2023, and ANCE is issuing a new edition dated May 31, 2023.

This harmonized standard was prepared by the Association of Standardization and Certification, (ANCE), CSA Group and ULSE Inc. (ULSE). The efforts and support of the NEMA (National Electrical Manufacturers Association), EFC (Electro-Federation of Canada), and the CANENA Technical Harmonization Committee for Snap Switches, THSC 23-B, are gratefully acknowledged.

This standard is considered suitable for use for conformity assessment within the stated scope of the standard.

The present Mexican standard was developed by the CT 23 Electrical Accessories (Wiring Devices) from the Comité de Normalización de la Asociación de Normalización y Certificación, A.C., CONANCE, with the collaboration of the Wiring Devices manufacturers and users.

This standard was reviewed by the CSA Integrated Committee on Wiring Devices for Household and General Use, under the jurisdiction of the CSA Technical Committee on Wiring Products and the CSA Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee. This standard has been developed in compliance with Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

Application of Standard

Where reference is made to a specific number of samples to be tested, the specified number is to be considered a minimum quantity.

Note: Although the intended primary application of this standard is stated in its scope, it is important to note that it remains the responsibility of the users of the standard to judge its suitability for their particular purpose.

Level of Harmonization

This standard is published as an equivalent standard for ANCE, CSA Group and ULSE.

An equivalent standard is a standard that is substantially the same in technical content, except as follows: Technical national differences are allowed for codes and governmental regulations as well as those recognized as being in accordance with NAFTA Article 905, for example, because of fundamental climatic, geographical, technological, or infrastructural factors, scientific justification, or the level of protection that the country considers appropriate. Presentation is word for word except for editorial changes.

Interpretations

The interpretation by the standards development organization of an identical or equivalent standard is based on the literal text to determine compliance with the standard in accordance with the procedural rules of the standards development organization. If more than one interpretation of the literal text has been identified, a revision is to be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

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1 Scope

1.1 The requirements of this Standard apply to manually operated, general-use snap switches and modular switch assembly for connection to copper (Cu) or copper-clad conductors used in accordance with the National Electrical Code (NEC), ANSI/NFPA 70, or the Canadian Electrical Code (CE Code), Part I, and intended to be permanently connected in accordance with the NEC and the CE Code, Part I. In Canada, requirements for switches for connection to aluminum (Al) conductors used in accordance with the CE Code, Part I, and intended for connection to wiring systems recognized by the CE Code, Part I, are covered in Annex B.

1.2 This Standard applies to ac/dc rated switches for which the load ratings do not exceed 60 A at 250 V or less, 30 A at 251 V – 600 V, and 2 hp at 125 V – 600 V or less. This Standard also covers ac-only rated switches for which the load ratings do not exceed 30 A at 347 VAC or less.

1.3 This Standard applies to switches constructed to be installed readily in a flush device box or on an outlet-box cover and intended for connection to branch-circuit wiring.

1.4 This Standard applies to pendant and through-cord switches intended for field installation on flexible cord and provided with one "on" and one "off" position.

1.5 This Standard applies to switches intended for surface mounting and provided with a separable base and cover for connection to exposed wiring consisting of nonmetallic sheathed cable or open wiring on insulators (knob and tube).

1.6 This Standard applies to self-contained switches intended for flush mounting without a separate outlet box and for connection to branch-circuit wiring consisting of one or more non-metallic sheathed cables containing copper conductors.

1.7 This Standard applies to ac/dc fixture switches intended to be installed in fixtures to control incandescent lighting or fans for connection to branch-circuit wiring.

1.8 This Standard also applies to single-pole, momentary-contact door switches constructed to be installed readily in a special-purpose device box or on an outlet-box cover for connection to branch-circuit wiring.

1.8A A modular switch assembly is considered to be a general-use AC only flush switch.

1.9 This Standard does not apply to:

a) Clock operated switches specified in the Standard for Clock-Operated Switches, UL 917, and CSA Standard C22.2 No. 177;

b) Dimmer switches specified in the Standard for Solid-State Dimming Controls, UL 1472, and CSA Standard C22.2 No. 184.1;

c) Industrial control equipment specified in the Standard for Industrial Control Equipment, UL 508, and CSA Standard C22.2 No. 14;

d) Solid-state, single-phase motor speed controls specified in the Standard for Solid-State Fan Speed Controls, UL 1917, and CSA Standard C22.2 No. 156;

e) Special-use and ac-only fixture switches specified in the Standard for Switches for Appliances – Part 1: General Requirements, UL 61058-1, and CSA Standard C22.2 No. 55; and

f) Switches for use in hazardous locations specified in the Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations, UL 1203, and CSA Standard C22.2 No. 159.

1.10 For switches intended for connection to branch-circuit wiring containing aluminum conductors, refer to the Standard for Receptacles and Switches Intended for Use with Aluminum Wire, UL 1567, or to Annex B.

In Mexico, this Clause is not applicable. The use of aluminum conductors from 0.824 mm² (18 AWG) to 8.37 mm² (8 AWG) is prohibited.

2 Definitions

2.1 The following definitions apply in this Standard:

2.2 CLEARANCES – Through-air spacing.

2.3 CREEPAGE DISTANCES (CREEPAGE) – Over-surface spacings.

2.4 DOOR SWITCH – A single-pole, momentary contact switch with a push-button actuator, provided with an outlet-box and cover. It is intended for installation in door jambs to control lighting fixtures, typically in a closet.

2.5 FIXTURE SWITCH – A switch installed in the enclosure of a fixture such as a luminaire, a fan, or the like.

2.6 FLUSH SWITCH – A switch provided with a mounting yoke or integral flush device cover plate and intended for installation in or on an outlet box intended to control a branch circuit.

2.6A MODULAR SWITCH ASSEMBLY – A device consisting of a separable terminal assembly and switch.

2.7 PENDANT SWITCH – A switch intended to be installed at the end of a flexible cord for use in branch-circuit pendant applications.

2.8 SELF-CONTAINED SWITCH – A switch intended for flush mounting without a separate outlet box for connection to one or more nonmetallic sheathed cables containing copper conductors.

2.9 SEPARABLE JUMPER CONNECTOR – Consists of shorted pins or tabs located within the body of the connector. It is intended to mate with a special purpose connector during an electrical installation to simulate an installed switch on a separable terminal assembly for the purpose of verifying circuit integrity.

2.10 SINGLE POLE, 3-WAY, 4-WAY, OR 2 POLE SWITCHES – Is intended to be supplied by a single branch circuit and to control a single set of loads. The circuit and loads can be connected line-to-neutral (e.g., 120V ac, 277V ac) or line-to-line (e.g., 208V ac, 240V ac). See [Figure 9](#) for details.

2.11 SURFACE SWITCH – A switch provided with a separable base and cover primarily intended for branch-circuit installation on exposed wiring consisting of open wiring on insulators or nonmetallic sheathed cable.

2.12 SYNTHETIC LOAD – The use of a combination of resistances and capacitances instead of tungsten-filament-lamps as a load.

2.13 TERMINAL ASSEMBLY, SEPARABLE – A two-piece terminal assembly provided with an integral mechanical latching mechanism(s). Consists of permanently attached pins or tabs located on the body of the switch which are capable of receiving a special purpose connector or back plate connector with leads or wiring terminals for connection to the branch circuit conductors. May be one of the constructions described below:

- a) A back plate connector that is secured to the device box; or
- b) A special-purpose connector that is installed into a device box.

2.14 TERMINAL, COMBINATION WIRE BINDING/PRESSURE-TYPE – A wire binding screw with an integrally machined pressure ring. Pressure ring terminals accept both single and multiple conductors that are captured under the machine formed pressure ring. These terminals may be wired with a single conductor using the conventional 3/4 loop around the wire-binding screw.

2.15 TERMINAL, INSULATION DISPLACEMENT – A terminal having a contacting member that forces the conductor insulation aside and presses against the side of the conductor to make contact.

2.16 TERMINAL, PIN-TYPE – A terminal having a contact pin that punctures the conductor insulation to contact the current-carrying conductor.

2.17 TERMINAL, PRESSURE-WIRE – A terminal where the conductor is clamped under a pressure plate or saddle by one or more screws or nuts.

2.18 TERMINAL, PUSH-IN – A terminal where the stripped end of a conductor is pushed into the terminal and the clamping pressure is maintained by a spring mechanism, without the use of screws.

2.19 TERMINAL, SET-SCREW – A terminal where the clamping pressure is applied by the end of the screw bearing directly on the conductor.

2.19A TERMINAL, SPRING ACTION CLAMP – A terminal where the stripped end of a conductor is inserted into the terminal and a manually operated integral lever enables clamping pressure to a spring mechanism, without the use of screws.

2.20 TERMINAL, WIRE-BINDING SCREW – A terminal in which the conductor is bent around the screw and is clamped directly under the head of the screw when it is tightened.

2.21 THROUGH-CORD SWITCH – A switch intended to be installed along the length of flexible cord such as for use in power-supply cords or cord sets.

2.22 TWO- OR THREE-CIRCUIT SWITCHES – Consists of a two- or three-pole switch, respectively, intended to be supplied by multiple single-phase branch circuits and to control multiple sets of single-phase loads, each of no more than 120 V ac line-to-neutral or 240 V ac line to line, and no more than 240 V ac between circuits; see [7.2.4](#). See [Figure 9](#) for details.

3 General

3.1 Components

In Mexico, Clauses [3.1.1](#) – [3.1.4](#) are not applicable.

3.1.1 Except as indicated in Clause [3.1.2](#), a component of a product covered by this Standard shall comply with the requirements for that component. See Annex [A](#) for a list of Standards covering

components generally used in the products covered by this Standard. A component shall comply with the CSA Group or the Underwriters Laboratories Inc., standards as appropriate for the country where the product is to be used.

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

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

3.1.3 A component shall be used in accordance with its ratings for the intended conditions of use.

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

3.2 Units of Measurement

3.2.1 The values given in SI (metric) units shall be normative, except for AWG conductor sizes. Any other values given are for information purposes only.

3.3 Reference Publications

3.3.1 Where reference is made to any Standards, such reference shall be considered to refer to the latest editions and revisions thereto available at the time of printing, unless otherwise specified.

ANCE Standards

NOM-001-SEDE

Standard for Electrical Installations

NMX-J-023/1-ANCE

Metallic Outlet Boxes Part 1: Specifications and Test Methods

NMX-J-235/1-ANCE

Enclosures for Electrical Equipment, Non-environmental Considerations

NMX-J-235/2-ANCE

Enclosures for Electrical Equipment, Environmental Considerations

NMX-J-574-ANCE

Method for the Determination of the Proof and the Comparative Tracking Indices of Solid Insulating Materials

ANSI Standards

ANSI C82.11

Lamp Ballasts – High Frequency Fluorescent Lamp Ballasts

ANSI C82.14

Lamp Ballasts – Low-Frequency Square Wave Electronic Ballasts for Metal Halide Lamps

CSA Standards

C22.1

Canadian Electrical Code, Part I

CAN/CSA C22.2 No. 0

General Requirements – Canadian Electrical Code, Part II

CAN/CSA C22.2 No. 0.17

Evaluation of Properties of Polymeric Materials

C22.2 No. 14

Industrial Control Equipment

C22.2 No. 18.1

Metallic Outlet Boxes

C22.2 No. 18.2

Outlet Boxes, Conduit Boxes, and Fittings

C22.2 No. 42

General Use Receptacles, Attachment Plugs, and Similar Wiring Devices

C22.2 No. 42.1

Cover Plates for Flush-Mounted Wiring Devices

C22.2 No. 55

Special Use Switches

C22.2 No. 65

Wire Connectors

C22.2 No. 94.1

Enclosures for Electrical Equipment, Non-environmental Considerations

C22.2 No. 94.2

Enclosures for Electrical Equipment, Environmental Considerations

C22.2 No. 156

Solid-State Speed Controls

C22.2 No. 159

Attachment Plugs, Receptacles, and Similar Wiring Devices for Use in Hazardous Locations: Class I, Groups A, B, C, and D; Class II, Group G, in Coal or Coke Dust, and in Gaseous Mines

CAN/CSA C22.2 No. 177

Clock-Operated Switches

C22.2 No. 184.1

Solid State Dimming Controls

NEMA Standards

ANSI/NEMA WD6

Wiring Devices – Dimensional Specifications

NEMA 410

*Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts***UL Standards**

UL 50

Enclosures for Electrical Equipment, Non-Environmental Considerations

UL 50E

Enclosures for Electrical Equipment, Environmental Considerations

UL 94

Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

UL 486E

Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

UL 498

Attachment Plugs and Receptacles

UL 508

Industrial Control Equipment

UL 514A

Metallic Outlet Boxes

UL 514C

Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers

UL 514D

Cover Plates for Flush-Mounted Wiring Devices

UL 746A

Polymeric Materials – Short Term Property Evaluations

UL 746C

Polymeric Materials – Use in Electrical Equipment Evaluations

UL 917

Clock-Operated Switches

UL 1203

Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations

UL 1310

Class 2 Power Units

UL 1472

Solid-State Dimming Controls (Bi-National CSA C22.2 No. 184.1-96)

UL 1567

Receptacles and Switches Intended for Use with Aluminum Wire

UL 1917

Solid-State Fan Speed Controls

UL 61058-1

Switches for Appliances – Part 1: General Requirements

3.3.2 Where reference is made to the following publications not under the jurisdiction of UL or of the CSA Steering Committee on the Canadian Electrical Code, Part II, such reference shall be considered to refer to the edition listed below:

ASTM Standard (American Society for Testing and Materials)

E28-99

Test Methods for Softening Point of Resins Derived from Naval Stores by Ring-and-Ball Apparatus

National Fire Protection Association (NFPA)

NFPA 70

National Electrical Code

3.3.3 In Canada, general requirements applicable to these products are provided in CAN/CSA C22.2 No. 0.

4 Construction

4.1 Enclosure

4.1.1 Switches shall be provided with complete enclosures that house all live parts, except that switches designed to be installed in device boxes or cut-out boxes or intended specifically for use in devices where they will be so enclosed as to prevent the exposure of live parts to accidental contact, need not be provided with such enclosures.

4.1.2 A key-operated switch shall be constructed so that a 0.5 mm (0.02 inch) diameter rigid steel wire cannot be inserted into the key slot so as to contact live electrical parts.

4.1.3 A metal enclosure of a switch (such as the cover of a surface-type switch or the shell of a fixture or pendant-type switch) shall be not less than 0.33 mm (0.013 inch) thick. Heavier metal shall be employed to provide strength and rigidity if the switch is rated more than 5 A, 250 V; 10 A, 125 V; or if the size or shape of the enclosure warrants such increased metal thickness.

In Mexico, the following applies: A metal enclosure of a switch (such as a cover of a surface-type switch or the shell of a fixture or pendant-type switch) shall have the mechanical strength to enable it to comply with the specifications and test methods listed in this Standard.

4.1.4 A nipple (male or female) through which wires can pass shall have not less than five full, clean-cut threads of standard pitch as indicated in [Table 1](#). The wireway provided by the nipple shall be free from burrs, fins, sharp edges, and the like that can damage wiring.

Table 1
Threading for nipples

(see Clause 4.1.4)

Pipe trade size, inch	Threading per inch
1/8	27 threads
1/4	18
3/8	18
1/2	14
3/4	14

4.1.5 A nipple that is not integral with the body of a switch shall be secured to prevent turning relative to the enclosure, and to provide mechanical strength equivalent to that of a unit piece.

4.1.6 A female nipple in a fixture-type switch shall be provided with a No. 8 – 40 setscrew.

Note: The setscrew may be omitted in the nipple of a fixture-type switch if the nipple is of the 1/2 inch or larger pipe size, has a tapered thread, and is intended to be tightened with a wrench.

4.1.7 A threaded nipple for attachment to rigid metal conduit of the 1/2 inch or larger trade size shall be provided with a positive end stop for the conduit and a bushing, or an equivalent smooth, well-rounded surface, to prevent damage to wiring that enters the switch enclosure from the conduit.

Note: Providing a positive end stop and bushing shall not be required for a hole tapped for rigid metal conduit in the wall of an outlet box or equivalent enclosure that is provided with a switch.

4.1.8 A switch intended to be exposed to a specific environment shall comply with the requirements of the Standards for Enclosures for Electrical Equipment, Non-Environmental Considerations, UL 50, Enclosures for Electrical Equipment, Environmental Considerations, UL 50E, CSA C22.2. No. 94.1, Enclosures for Electrical Equipment, Non-environmental Considerations, C22.2. No. 94.2, Enclosures for Electrical Equipment, Environmental Considerations, or NMX-J-235/1 ANCE, Enclosures for Electrical Equipment, Non-Environmental Considerations and NMX-J-235/2-ANCE, Enclosures for Electrical Equipment, Environmental Considerations.

4.1.9 A through-cord switch shall be provided with two distinct holes to accept and pass through the intended flexible cord. If a through-cord type switch is provided with one hole and provisions such as a knock out, the device is considered to be a pendant switch.

4.1.10 A door switch shall be provided with an outlet box and cover plate. The outlet box and cover plate shall comply with the performance requirements of either the Standard for Metallic Outlet Boxes, UL 514A or NMX-J-023/1-ANCE, or the Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C, as appropriate, or Metallic Outlet Boxes, C22.2 No. 18.1 and Outlet Boxes, Conduit Boxes, and Fittings, C22.2 No. 18.2.

4.2 Lining

4.2.1 If a part of the enclosure of a switch is removable for wiring and is wholly or partly of conductive material, the inside surface of all such conductive material shall be lined completely with insulation not less than 0.71 mm (0.028 inch) thick.

Note: The lining of a fixture switch may be less than 0.71 mm (0.028 inch) thick but not less than 0.33 mm (0.013 inch) thick.

4.2.2 An insulating lining shall be secured so that it will remain in place under conditions of intended service, and shall prevent the enclosure from becoming a live part even if a wire inside the switch should become loose or detached from its termination. The lining of the cover of a surface-type switch shall extend beyond the edge of the cover.

4.2.3 In switches having molded covers protected by a metal armor, the armor may be flush with the cover if the construction of the switch is such that the armor is not likely to make contact with any live parts when the cover is being put in place on the switch.

4.3 Bushings and Strain Relief

4.3.1 The cord-inlet hole in a pendant or through-cord switch that has a metal enclosure shall be provided with an insulating bushing or the equivalent. The material of the bushing shall be of porcelain, phenolic, or cold-molded composition, or other insulating material determined to be acceptable for the purpose.

4.3.2 Hard fiber may be provided as the insulating material if the bushing is not less than 1.19 mm (0.047 inch) thick and if it is formed and secured in place so that it will not be affected by conditions of ordinary moisture.

4.3.3 A threaded insulating bushing shall not be used in a threaded nipple to form a pendant switch if the pipe size of the nipple is smaller than 3/8 inch.

4.3.4 A pendant or through-cord switch shall have provision for strain relief so that a pull exerted on the flexible cord cannot be transmitted directly to wiring terminals. If space is provided within the switch enclosure for a strain-relief knot, all parts of the enclosure on which the cord can touch shall be smooth and well-insulated.

4.3.5 A metal cord grip may be provided on a pendant switch intended particularly for use with jacketed flexible cord, such as Type S or SJ, if the diameter of the cord-inlet hole is not less than 7.9 mm (0.31 inch).

4.4 Bases and Bodies

4.4.1 General

4.4.1.1 A base or body in or on which live parts are mounted shall be of insulating material determined to be acceptable for the particular application. See Clauses [4.8.2](#) and [4.8.3](#).

4.4.1.2 A hole for the entrance of wire in a base intended for surface mounting shall be as indicated in [Table 2](#).

Table 2
Holes for entrance of wire

(see Clause [4.4.1.2](#))

Switch rating A	Diameter of smallest hole that may be provided mm (inch)
0 – 15	5.6 (0.219)
16 – 25	6.4 (0.250)
26 – 35	7.1 (0.281)

4.4.1.3 A sub-base for a surface-type switch for use with open wiring shall be constructed so that it will separate the wires leading to the switch not less than 13 mm (1/2 inch) from the surface wired over. A sub-base shall be of insulating material determined to be acceptable for the purpose.

4.4.1.4 The body of a switch employing a combination wire binding/pressure-type terminal shall employ integrally formed channels/guides within the body to:

- a) Properly position the individual conductor; and
- b) Provide a means to reduce the likelihood of the conductor(s) being displaced from under the terminal ring when conductor(s) are installed.

Compliance is determined by the Compliance Wire Binding/Pressure-Type Terminal Assembly Test described in Clause [5.30](#).

4.4.2 Means for Mounting

4.4.2.1 A base intended for surface mounting shall have two or more holes for mounting screws, and a base with an area of more than 0.016 m² (25 inch²) shall have three or more holes for mounting screws. A mounting-screw hole shall be countersunk not less than 3 mm (1/8 inch) in the material of the base; and there shall be a spacing over the surface of insulating material, between the head of the screw or washer, and the nearest uninsulated live part, in accordance with [4.10.1](#).

4.4.2.2 A flush switch shall be provided with means for mounting in a standard flush-device box or on a standard outlet-box cover in accordance with Clause [4.11](#), Provisions for Grounding. Flush-type switches rated 347 V shall be provided with means for mounting in a specific-use box having tapped holes, spaced on 89.69 mm (3-17/32 inch) centers, that are intended for the mounting of the switch. The mounting screws for a switch that is intended for mounting in a standard flush-device box shall be #6 - 32 and shall be spaced 83.34 mm (3-9/32 inch) apart.

In Mexico, the mounting screws for a switch may be a size other than #6-32.

4.4.2.3 A metal yoke, strap, or mounting ears shall not be less than 1.02 mm (0.040 inch) or more than 2.3 mm (0.09 inch) thick. If a nonferrous metal is used, it shall be of sufficient thickness to provide mechanical strength and rigidity not less than that of 1.02 mm (0.040 inch) thick steel. The yoke, strap, or mounting ears may be provided with extension plaster ears, which may be scored so that they can be broken off if not needed.

In Mexico, the following applies: A metal yoke, strap, or mounting ears shall provide the mechanical strength to enable it to comply with the specifications and test methods in this Standard. The yoke, strap, or mounting ears may be provided with extension plaster ears, which may be scored so that they can be broken off if not needed.

4.4.2.4 If a yoke, mounting ears, or strap as described in Clause [4.4.2.3](#) is made of steel, the corrosion protection for a switch for use in a flush-device box or on an outlet-box cover shall be a zinc or equivalent coating not less than 0.0038 mm (0.00015 inch) thick in accordance with the method for determining protection against corrosion in the Standard for Metallic Outlet Boxes, UL 514A, or NMX-J-023/1-ANCE, or CAN/CSA C22.2 No. 0, General Requirements – Canadian Electrical Code, Part II, or other coatings determined to be acceptable for the particular application.

4.4.2.5 A nonmetallic yoke, strap, or mounting ears shall be of a material and construction determined to be acceptable for the intended use.

4.4.2.6 A screw provided for use in mounting the switch to an outlet box or other enclosure shall project not more than 22 mm (7/8 inch) beyond the strap or cover and shall have a flat or blunt end. The end of the screw shall have no burrs, fins, or sharp edges that can damage wiring. This does not preclude thread-cleaning slots or grooves in the end of a screw.

4.4.2.7 A flush switch that is provided with an adjustable screw, or screws if more than one is provided, or any other adjustment hardware shall not project more than 22.2 mm (7/8 in) beyond the plane of the mounting yoke where secured to the outlet box. The end of the adjustable hardware shall have a flat or blunt end. If an adjustment screw is provided, it may have thread-cleaning slots or grooves but shall not have any burrs, fins, or other sharp edges that could damage wiring.

4.4.2.8 The adjustment means of an adjustable flush switch shall not permit installation in an application where the front edge of the installed outlet box, plaster ring, extension ring or outlet box extender is set back from the finished surface (for example, drywall) more than 6.4 mm (1/4 in). Compliance shall be checked by measurement.

4.4.3 Sealing

4.4.3.1 Live screw heads or nuts on the underside of a base intended for surface mounting shall be covered with a waterproof, insulating sealing compound with a softening point of 65°C (149°F) or higher. If such parts are spaced not less than 6.4 mm (1/4 inch) through-air from the mounting surface and are staked, upset, or otherwise reliably prevented from loosening, sealing compound need not be provided.

4.4.3.2 Sulphur shall not be used as a sealing material.

4.4.3.3 Determination of the softening point of a sealing compound shall be made in accordance with the test method specified in ASTM E28-99, Standard Test Methods for Softening Point of Resins Derived from Naval Stores by Ring-and-Ball Apparatus.

4.5 Current-Carrying Parts

4.5.1 General

4.5.1.1 Current-carrying parts and wire-binding nuts and screws shall be of metal and shall have the strength, rigidity, and ampacity to comply with the requirements outlined in Clause [4.5](#).

Note 1: A switching contact in a general-use ac switch shall not be of copper, copper alloy, steel, or other material that is likely to corrode in service so as to adversely affect the switch performance, particularly the heating.

Note 2: A corrosion-resistant (stainless) steel alloy may be used for hermetically sealed switching contacts and for other current-carrying parts not subject to arcing.

4.5.1.2 Current-carrying parts shall not be permitted to be iron or steel, plain or plated.

Note 1: Current-carrying parts may be made of sheet steel clad on both surfaces with copper in the thickness ratio of 10 percent copper, 80 percent steel, and 10 percent copper, and with all cut edges coated with zinc, or an equivalent coating if the applicable overload and endurance tests show that the parts are not subject to arcing.

Note 2: Steel that is corrosion-resistant (stainless) or steel that is protected against corrosion by zinc plating, or an equivalent coating, may be used for grounding terminals, wire-binding nuts, clamps, and screws.

4.5.2 Live Parts

4.5.2.1 Uninsulated live parts shall be secured in place so that turning will not adversely affect performance and so that there is no likelihood of a reduction in spacings to values less than the minimum

required spacings specified in [Table 6](#). Contact jaws shall be prevented from turning or shifting in position by means other than friction between surfaces.

4.5.2.2 Except for a wiring terminal, an uninsulated live part mounted on insulating material that wiring can touch shall be recessed into the insulating material so that the wiring cannot touch the live part.

4.5.3 Terminals and Leads

4.5.3.1 Switches shall be provided with wire leads or wiring terminals for the connection of conductors that have an ampacity not less than the maximum current rating of the switch. Wire-binding screws shall be as specified in [Clause 4.5.3.9](#).

4.5.3.2 The means for connection of conductors shall be one of the following:

- a) Positive binding-screw pressure on a bared conductor plus upturned lugs or the equivalent to retain the wire under the screw head;
- b) Soldering, welding, riveting, or crimping; or
- c) Other means if shown to be acceptable for the purpose by tests to determine the adequacy of the current-carrying ability and mechanical features of the connecting means. See [Clause 4.5.3.3](#).

4.5.3.3 A push-in (screwless) terminal shall comply with the performance requirements in Push-In Terminal Tests, [Clause 5.11](#), and shall be:

- a) For use only with a solid copper conductor;
- b) For a current-carrying connection only, not for grounding; and
- c) Marked as indicated in [Clause 7.2.2](#).

4.5.3.4 Push-in terminals intended for use on branch circuit wiring shall be designed so that they will permit the use of a solid 14 AWG (2.1 mm²) conductor but will reject a 12 AWG (3.3 mm²) or larger solid conductor. The opening provided for the conductor shall reject a No. 48 drill rod, 1.981 ± 0.0076 mm (0.076 ± 0.0003 inch) in diameter. The rod shall be applied with 22 N (5 lbf). Openings, other than those intended for wire termination, such as wire release openings, shall not permit electrical contact to be made with a 14 AWG (2.1 mm²) conductor.

4.5.3.5 A switch employing "push-in" terminations may be provided with a means to release the conductors. Where an opening in the insulating body is provided for such purpose behind the plane of the mounting means, it shall not permit entry of a 14 AWG (2.1 mm²) solid conductor. The wire release means, if provided, shall be subject to the Push-In Terminal Tests, [Clause 5.11](#).

4.5.3.6 A release mechanism shall be located or guarded so that it cannot be unintentionally actuated during installation. The release mechanism may be guarded by recessing, ribs, barriers, or the like.

4.5.3.7 Switches having terminals of a set screw type shall meet the performance requirements for copper conductors AWG sizes 14, 12, and 10 (2.1 mm², 3.3 mm², and 5.3 mm²) as specified in UL 486E or CSA C22.2 No. 65.

4.5.3.8 Switches employing a combination wire binding/pressure-type terminal shall be limited to 10, 12 or 14 AWG conductors. The terminals shall comply with the applicable performance requirements as specified in UL 486E. See also [Clause 1.10](#) for terminals intended for use with aluminum conductors.

4.5.3.9 The minimum sizes of wire-binding screws used in making electrical connections shall conform to [Table 3](#).

Table 3
Minimum sizes of wire binding screws

(see Clauses [4.5.3.9](#), [4.12.6](#))

Rating of switch A	Minimum size of screw	Minimum head diameter	Maximum number of threads per inch
20 or less	#6	0.275 inch	36
20 or less	M3.5	7.0 mm	–
30	#8	0.315 inch	32
30	M4	8.0 mm	–

4.5.3.10 A terminal plate for a soldering lug or pressure wire connector shall not be less than 0.76 mm (0.030 inch) thick, and the tapped hole shall not have less than two full threads in the metal for a terminal screw.

4.5.3.11 A terminal plate for a wire-binding screw shall be of metal not less than 0.76 mm (0.030 inch) thick, and the tapped hole shall not have less than two full threads in the metal.

4.5.3.12 In a terminal plate formed from stock which has the minimum required thickness, as given in Clauses [4.5.3.10](#) and [4.5.3.11](#), the metal may be extruded at the tapped hole for the binding screw to provide two full threads.

4.5.3.13 With reference to the requirements in Clauses [4.5.3.10](#) and [4.5.3.11](#), metal not less than 1.52 mm (0.060 inch) thick may be used for a tapped hole for a screw having 32 threads per inch.

4.5.3.14 A wire-binding screw shall thread into metal.

4.5.3.15 Switches intended for mounting in outlet boxes shall have their terminals located or protected so that they will not be pressed, in normal assembly, against the wiring in the box when the switches are installed.

4.5.3.16 Exposed-back wiring terminals shall not be used on a general-use switch intended for installation in a flush-device box, but may be used on a switch intended specifically for mounting in a box that is to be supported by rigid metal conduit, or on a surface-type switch mounted in or on (integral with) an outlet-box cover.

4.5.3.17 Copper or copper alloy terminal parts that come into contact with branch-circuit conductors, other than the grounding conductor, shall not have a coating of zinc or cadmium.

4.5.3.18 Wire leads provided on a switch shall be insulated conductors of a type suitable for the purpose and not less than 100 mm (4 inch) in length. The ampacity of the leads shall be not less than the maximum current rating of the switch.

Note 1: If provided, a grounding conductor may be a bare solid copper wire, or if insulated, the insulation shall be green with or without one or more yellow stripes. The length of a grounding lead shall not be less than 152 mm (6 inches).

Note 2: The length of the leads is not specified for a fixture switch intended to be incorporated in a wiring harness provided the harness and fixture switch are assembled at the same factory.

4.5.3.19 A switch employing a separable terminal assembly shall have solid or stranded copper conductors 12 AWG (3.3 mm²) or larger.

4.5.3.19A A modular switch assembly with a special-purpose connector type may be rated either 15 or 20 A only and shall have solid or stranded 14 AWG (2.1 mm²) copper conductors for 15 A, or 12 AWG (3.3 mm²) for 20 A. The special-purpose connector shall be keyed to prevent interchangeability of differently rated devices.

4.5.3.19B A modular switch assembly with a back plate connector type shall be rated 15 A only. The back plate shall have solid or stranded 14 AWG (2.1 mm²) copper conductors or larger or provided with field wiring terminals.

4.5.3.20 The wire leads of a general-use switch shall be made of copper and not be smaller in size than indicated in [Table 4](#).

Note: Leads provided for external connection of a pilot light or other signal or sensing circuits in a switch may be 18 AWG (0.82 mm²) or larger, regardless of the switch rating.

Table 4
Minimum sizes of switch leads

(see Clauses [4.5.3.20](#), [4.12.7](#))

Current rating of switch A	Copper supply leads AWG	Copper grounding leads AWG
0 – 6	18	18
6.1 – 10	16	16
10.1 – 15	14	14
15.1 – 20	12	12
20.1 – 30	10	10
30.1 – 40	8	10
40.1 – 50	6	10
50.1 – 60	4	10

4.5.3.21 Pressure cable connectors included in the package of an individually packaged general-use snap switch employing wire leads shall be rated for the intended wire connections of the switch as identified by the switch manufacturer and rated for the size(s) and the number of wires expected to be joined. Switches shall comply with Clause [7.6.8](#).

4.5.3.22 In a general-use switch rated less than 30 A and having provision for the connection of two or more conductors of the circuit (including an identified (grounded) conductor), one set of wiring terminals or leads shall be identified for the identified (grounded) conductor, unless the electrical connection between a pair of terminals intended to be connected to the identified (grounded) conductor is clearly evident, or unless (as in the case of a straight 2-pole switch) it does not make any difference to which set of terminals the identified (grounded) conductor is connected.

4.5.3.23 If identification of wiring terminals is necessary, a terminal for the connection of an identified (grounded) conductor shall be identified by one of the following means:

- a) Being covered with a white metallic coating;
- b) Being made of metal substantially white in color; or

c) Having the word "white" or "W" marked on or directly adjacently to the terminal.

In Mexico, "B" may be used as an acceptable marking.

Other terminals shall be readily distinguishable. See also Clause [4.5.3.25](#).

4.5.3.24 The white-colored head of a wire-binding screw that is not readily removable from its terminal plate, and that does not appear to relate to other parts, may serve as the terminal identification specified in Clause [4.5.3.23](#).

4.5.3.25 If the terminal that is plated white to comply with Clause [4.5.3.23](#) is not visible, the wire-entrance hole for connection to that terminal shall be marked with the word "white" or the letter "W", or colored white directly adjacent to the hole.

In Mexico, "B" may be used as an acceptable marking.

4.5.3.26 The identification of leads shall be in accordance with [Table 5](#).

Table 5
Polarity identification of leads

(see Clause [4.5.3.26](#))

Identification obtained by	Acceptable combinations ^a	
	Identified (Grounded) conductor (unswitched leads)	All other conductors (switched leads)
Color of braid ^b	Solid white or gray (without tracer) Color other than white, gray, or green, with tracer in braid	White or gray with tracer in braid or Solid color other than white, gray, or green (without tracer)
Color of insulation ^b	Solid white or gray, stripe, white or gray, on contrasting color other than green	Solid color other than white, gray, or green
Color of separator ^b	Solid white or gray	Solid color other than white, gray, or green
Conductor tinning ^c	Tin or other acceptable metal on all strands of the conductor	No tin or other white metal on the strands of the conductor
^a A bare solid copper wire, or green wire, with or without one or more yellow stripes, shall be used only as an equipment grounding conductor.		
^b If color of braid, insulation, or separator is used for identification, all conductors shall either be tinned or not tinned.		
^c If conductor tinning is used for identification, all braids and/or insulation shall have the same color and shape.		

4.6 Separable Jumper Connector for Separable Terminals

4.6.1 A separable jumper connector shall consist of permanently attached shorted pins or tabs located within the insulated enclosure to simulate an installed switch. It shall be reliably keyed by a physical or mechanical means to maintain correct polarity consistent with the intended use.

4.6.2 A separable jumper connector shall not provide any means of connecting the grounding conductor.

4.7 Separable Terminal Assembly

4.7.1 A separable terminal assembly shall consist of permanently attached pins or tabs located on the switch body and shall be capable of receiving a special purpose connector with leads for connection to the branch circuit.

4.7.2 A separable terminal assembly shall:

- a) Be provided with a mechanical means such as a lock, latch or similar means which prohibits unintentional separation when in the mated condition, and shall comply with the Latching Mechanism Test described in [5.24](#);
- b) Be reliably keyed by a physical or mechanical means to maintain correct polarity consistent with the intended use. The terminals shall be marked identifying the terminals for connection of the ungrounded circuit conductor, the grounded circuit conductor, and the grounding conductor. Color-coding of integral wire leads is an acceptable means of terminal identification; and
- c) Be constructed such that the grounding terminal makes first and breaks last when connecting and disconnecting the terminal assembly.

4.7.3 When disconnected, the contacts of the special purpose connector shall not be accessible to contact by the probe in [Figure 2](#).

4.7A Spring Action Clamp Terminals

4.7A.1 In addition to the requirements contained in this standard, a switch employing a spring action clamp terminal shall also comply with the applicable requirements, as specified in the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E. All tests shall be investigated with minimum and maximum conductor AWG size and for each type of conductor (solid and stranded), for each device construction.

4.7A.2 A switch employing spring action clamp terminals are intended for either stranded or solid or both, copper wire only.

4.7A.3 A switch employing spring action clamp terminals are intended for the connection of a single conductor only.

4.7A.4 A switch that is provided with spring action clamp terminal shall be provided with a positive means to prevent unintentional separation of the conductor from the terminal and shall comply with the Spring Action Clamp Terminal Pull Test described in Clause [5.20A](#).

4.8 Insulating Material

4.8.1 Insulating materials shall be judged with reference to the particular form, size, and purpose of the parts for which they are used, the manner of their assembly, and their location and security in the switch.

4.8.2 Insulating material in contact with current-carrying members shall be recognized as suitable for the particular application, and may include certain ceramic, thermoset, thermoplastic, and elastomeric materials.

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

4.8.4 A switch intended for use in a flush-device box or on an outlet-box cover shall employ insulating materials described in Clause 4.8.5 that have been investigated and determined to have a comparative tracking index of at least 175 V in accordance with the method for determining the comparative tracking index of solid insulating material under moist conditions, in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A (Performance Level Category of 3 or better), Evaluation of Properties of Polymeric Materials CAN/CSA-C22.2 No. 0.17, or the Method for the Determination, the Proof and the Comparative Tracking Indices of Solid Insulating Materials, NMX-J-574-ANCE, with the test solution A.

4.8.5 The insulating materials referred to in Clause 4.8.4 are those used for the sole support of live parts, maintenance of electrical spacings, or the prevention of arcing between live parts.

4.8.6 In Canada, insulating materials in contact with current-carrying members of switches shall have a flammability classification of V-2 or better in accordance with CSA Standard CAN/CSA-C22.2 No. 0.17, in a thickness of 1.6 mm or in the minimum thickness in contact with that current-carrying member, whichever thickness is greater.

4.8.7 In Canada, as an alternative to the requirement of Clause 4.8.6, a thermosetting material, such as phenolic, melamine, or urea may be used as an insulating material in contact with current-carrying members of switches provided that material has the following characteristics:

- a) The flammability classification is HB or better in accordance with CSA Standard CAN/CSA-C22.2 No. 0.17; and
- b) The relative thermal index, mechanical without impact, is a minimum of 100°C in accordance with CSA Standard CAN/CSA-C22.2 No. 0.17.

4.9 Actuating Members

4.9.1 Actuating members may be made of insulating material. If of metal, they shall be either insulated from current-carrying parts or covered, where otherwise exposed to personal contact, with suitable insulating material. See also Clause 4.8.2 with regard to type of insulation required.

4.9.2 An actuating member of other than thermoset insulating material shall comply with Clause 5.12.

4.9A Field Replacement Actuator

4.9A.1 A flush switch provided with a field replacement actuator shall not permit contact to be made between the articulated probe shown in Figure 10 and any live part when the actuator is removed. Compliance is checked by inspection and if necessary, the field replacement actuator test, Clause 5.32.

4.10 Creepage Distances, Clearances, and Distances Through Sealing Compounds

4.10.1 Creepage distances, clearances, and distances through sealing compounds shall not be less than the values shown in Table 6.

4.10.2 For a flush switch, a barrier boss, shoulder, recessing, or similar means may be employed to provide the minimum creepage distances and clearances between any uninsulated live part and the wall of a flush-device box in which the switch may be mounted.

4.10.3 Compliance is checked by measurement.

4.10.4 A flush switch without integral wire leads shall be wired with the following solid copper wires connected to each terminal: 14, 12, and 10 AWG (2.1 mm², 3.3 mm², and 5.3 mm²) sizes for switches having 15 ampere (or less), 20 ampere, and 30 ampere ratings, respectively.

4.10.5 A flush switch shall be mounted in a metal gauge that simulates a flush-device box, as shown in [Figure 1](#).

4.10.6 External switch clearances to the box gauge's walls shall be checked with the switch mounted in any position permitted by the mounting screws and holes.

4.10.7 A dead metal screw head, rivet, or the like shall not 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 7.1 mm (9/32 inch) in diameter and recessed not less than 4.8 mm (3/16 inch) in the clear.

4.10.8 In measuring a creepage distance or clearance, an isolated dead metal part interposed between uninsulated live parts of different polarity, or between an uninsulated live part and an identified (grounded) or exposed dead metal part, reduces the creepage distance or clearance by an amount equal to the dimension of the isolated dead metal part in the direction of the measurement.

4.10.9 In measuring a creepage distance or clearance between non-arcing live parts of different polarity in a pilot or locator switch, the wire lead separation of a current-limited lamp-and-resistor assembly at points on the same side of the current-limiting resistor shall not be considered as reducing the creepage distance or clearance.

4.10.10 An indicating device, such as an ohmmeter, a battery-and-buzzer combination, or the like, shall be used to determine that continuity between the switch terminal(s) and the gauge does not exist with the switch mounted in any position permitted.

Table 6
Creepage distances, clearances, and distances through sealing compounds

(see Clause [4.5.2.1](#), [4.10.1](#))

Description	mm	inch
Creepage distances and clearances		
Between non-arcing live parts, with the exception of terminals, of different polarity		
Between non-arcing live parts, with the exception of terminals, and identified (grounded) material		
Between non-arcing live parts, with the exception of terminals, and accessible dead metal parts, with the exception of a recessed screw head, rivet, or the like (see Clause 4.10)		
Between terminals of different polarity		
Between terminals and identified (grounded) metal parts, or dead metal parts likely to be identified (grounded)		
Between terminals and accessible dead metal parts, with the exception of a recessed screw head, rivet, or the like (see Clause 4.10)		
ac/dc switches rated 250 V or less	1.2	3/64
ac/dc switches rated greater than 250 V to 600 V	3.2	1/8
ac-only switches rated 300 V ac or less	1.2	3/64
ac-only switches rated greater than 300 V ac	3.2	1/8
self-contained switches	1.6	1/16
Clearances		
Between non-arcing live parts and metal flush-device cover plates		

Table 6 Continued on Next Page

Table 6 Continued

Description	mm	inch
ac/dc switches	3.2	1/8
ac-only switches rated 300 V ac or less	3.2	1/8
ac-only switches rated greater than 300 V ac	6.4	1/4
Self contained switches		
Between non-arcing live parts and the surface on which the base of a surface switch mounts	3.2	1/8
Distances through insulating sealing compound		
Between non-arcing live parts covered with at least 1.6 mm (1/16 inch) of sealing compound and the surface on which the base of a surface switch mounts	3.0	0.118

4.11 Assembly

4.11.1 General

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

4.11.1.2 Sealing, staking, or an equivalent means shall be employed so that screws upon which the general assembly of a switch depends cannot loosen or back out.

4.11.1.3 An assembly screw that must be loosened or removed in order to wire or install a switch shall be capable of being tightened with a torque of 0.68 N-m (6 lbf-in), without impairing the serviceability of the assembly means.

4.11.2 AC/DC Fixture Switch

4.11.2.1 The chain of an ac/dc fixture switch having a pull-type mechanism shall not become energized external to the enclosure, the external non-current-carrying parts of the fixture switch shall not become live, nor shall the chain cause the mechanism to jam when the chain is suddenly and completely released after having been pulled to the full "on" position and the full "off" position.

4.11.2.2 An AC/DC fixture switch having pull-type switch mechanisms shall have the operating means in the form of:

- a) A cord made of suitable insulating material;
- b) A chain with a link of suitable insulating material, connected to the metal chain as close as possible to where the chain emerges from the enclosure and that complies with the dielectric and mechanical strength test in Clauses [5.13.2.3](#) and [5.13.2.4](#); or
- c) A metal chain without an external insulating link, provided that the complete assembly complies with the dielectric voltage-withstand test outlined in Clause [5.9](#).

4.11.3 Insulating Links

4.11.3.1 An insulating link shall be designed for ready attachment to the conventional metal chain employed in pull-type fixture switch.

4.11.3.2 An insulating link shall be so constructed that there is a distance over the surface of the insulating material of not less than 12.7 mm (1/2 inch).

4.11.4 Pendant and Through-Cord Switch

4.11.4.1 A pendant or through-cord switch provided with pin terminals shall be capable of being assembled to the flexible cord types for which it is intended to be used. The switch shall physically exclude flexible cord types for which it is not intended. A switch intended for use with any group of flexible cords similar in appearance shall be capable of use with all such types unless the cords are distinguishable by marking or are physically excluded by the switch construction. See Clause [7.1.9](#).

4.11.5 Door Switch

4.11.5.1 A special switch box used to house a door switch shall have a volume sufficient to accommodate the electrical installation of the switch into the box. See Clause [5.18.1](#).

4.12 Provision for Grounding

4.12.1 A flush-type switch intended for mounting in a flush-device box shall be constructed so that a metal flush plate will be bonded to a grounded outlet box when installed in the intended manner.

In Mexico, this requirement does not apply for a switch intended to be installed with a non-metallic yoke in which the mounted metal flush plate is not in contact with live parts.

4.12.2 A flush-type switch that is provided with either a grounding terminal or lead shall comply with the requirements described in Clauses [4.5.3.1](#), [4.5.3.2](#), and [4.5.3.9](#) – [4.5.3.21](#). The construction shall also conductively connect a metal flush device cover plate to the grounding terminal or lead. See [7.1.14](#) for marking requirements.

4.12.3 Insulating material provided to separate the switch arcing chamber from the metal mounting yoke or metal flush plate shall be permanently secured to the flush switch. The flush plate mounting screws, when in place, shall not touch any part of the switch that is live. Switch assembly parts, such as assembly screws or flush plate screws, if of conductive material, shall not enter the switch arcing chamber or protrude into the outlet box, beyond the back of the switch.

4.12.4 If a device is provided with a grounding terminal, it shall be identified by one of the means identified in [Table 7](#).

4.12.5 A part relied upon to provide the terminal identification required in [Table 7](#) shall not be readily removable. A suitably staked terminal screw shall be considered to comply with this requirement.

4.12.6 The minimum size and the maximum number of threads per inch of a wire-binding screw shall comply with [Table 3](#).

4.12.7 If the device is provided with a grounding lead, it shall be made of copper and not be smaller in size than indicated in [Table 4](#).

Table 7
Identification of the grounding terminal

(see Clause [4.12.4](#), [4.12.5](#), [Figure 5](#))

Identification by	Grounding terminal	All other terminals
Wire-binding screw	Hexagonal, green-colored nut ^a or slotted screw head ^a	Other than white or green circular screw head
Pressure wire terminal visible	Green-colored connector, screw, or appendage ^a	Other than white- or green-colored connector
Pressure wire terminal concealed	Distinct green-colored area adjacent to wire entrance hole or the word "green" or "ground", the letters "G" or "GR" ^b or the grounding symbol distinctively marked adjacent to wire entrance hole ^d In Mexico, the use of a grounding symbol is not required.	Other than white or green area adjacent to wire entrance hole
Terminal plate		Other than white or green metal or plating
Insulating enclosure or terminal	The word "green" or "ground", the letters "G" or "GR" or the grounding symbol marked on or directly adjacent to terminal ^d or Green-colored terminal In Mexico, the use of a grounding symbol is not required.	Other than white- or green-colored terminal
Color of braid ^c	Solid color green (without tracer)	Solid color other than white, gray, or green (without tracer)
Color of insulation ^c	A bare solid copper wire, or green wire with or without one or more yellow stripes	Solid color other than white, gray, or green
Color of separator ^c	Solid color green	Solid color other than white, gray, or green
^a The screw should not be readily removable; see Clause 4.12.5 . ^b In letters minimum 1.6 mm (1/16 inch) high. ^c If color of braid, insulation, or separator is used for identification, all conductors shall be either tinned or not tinned. ^d See Figure 5 for the grounding symbol, which shall be permitted with or without the circle.		

5 Testing

5.1 General

5.1.1 A switch shall be investigated by subjecting it to the tests described in Clauses [5.2.1](#) – [5.2.13](#). Unless otherwise specified, one set of 6 devices shall be used during this test program.

5.1.2 A switch that has a horsepower rating or ratings in addition to a current rating shall be subjected to overload tests for both horsepower and current ratings, unless it is obvious that one would represent the other. If both overload tests are conducted, each test for a horsepower rating shall be conducted on a separate set of 6 devices.

5.1.3 A switch employing a separable terminal assembly shall also comply with the performance requirements in Clauses [5.19](#) – [5.27](#).

5.1.4 A separable jumper connector for a switch employing a separable terminal assembly shall comply with the performance requirements in Clause [5.2.13](#).

5.2 Test Sequence

5.2.1 The test sequence for a switch shall be as listed in Clauses [5.2.2](#) – [5.2.13](#).

5.2.2 AC/DC door switch testing

	Reference
a) Overload	5.6.1 , 5.6.2
b) Endurance No.1 (inductive)	5.7.1 , 5.7.2
c) Endurance No.2 (tungsten)	5.7.3
d) Temperature	5.8.1
e) Dielectric	5.9.1
f) Security of leads	5.10
g) Pull-out/push-in terminals	5.11.1 , 5.11.2
h) Temperature/push-in terminals	5.11.3 – 5.11.8
i) Resistance to heat (70°C)	5.17
j) Effect of heat on actuating members	5.12
k) Door Switch Assembly	5.18

5.2.3 AC-only door switch testing

	Reference
a) Overload	5.6.8 – 5.6.12
b) Endurance (inductive)	5.7.7
c) Endurance (tungsten)	5.7.8
d) Endurance (electronic ballast)	5.31.1
e) Temperature	5.8.1
f) Dielectric	5.9.1
g) Security of leads	5.10
h) Pull-out/push-in terminals	5.11.1 , 5.11.2
i) Temperature/push-in terminals	5.11.3 – 5.11.8
j) Resistance to heat (70°C)	5.17
k) Effect of heat on actuating members	5.12
l) Door Switch Assembly	5.18

5.2.4 AC/DC pendant switch testing

	Reference
a) Overload	5.6.1 , 5.6.2
b) Endurance No. 1 (resistive)	5.7.1 – 5.7.6
c) Endurance No. 2 (tungsten)	5.7.3

d) Temperature	5.8.1
e) Dielectric	5.9.1
f) Effect of heat on actuating members	5.12
g) Assembly	5.4
h) Temperature (15-day)*	5.8.2
i) Dielectric*	5.9.2
j) Strain relief	5.14
k) Fault current*	5.15
l) Crushing*	5.16
m) Resistance to heat (70°C)	5.17

* Pin-type terminals only

5.2.5 AC-only pendant switch testing

	Reference
a) Contact gap (check)	5.13.1.2
b) Overload	5.6.8 + 5.6.12
c) Endurance No. 1 (resistive)	5.7.6
d) Endurance No. 2 (inductive)	5.7.7
e) Endurance No. 3 (tungsten)	5.7.8
f) Endurance No. 4 (electronic ballast)	5.31.1
g) Temperature	5.8.1
h) Contact gap (repeated)	5.13.1.2
i) Dielectric	5.9.1
j) Effect of heat on actuating members	5.12
k) Assembly	5.4
l) Temperature (15-day)*	5.8.2
m) Dielectric*	5.9.2
n) Strain relief	5.14
o) Fault current*	5.15
p) Crushing*	5.16
q) Resistance to heat (70°C)	5.17

* Pin-type terminals only

5.2.6 AC/DC through-cord switch testing

	Reference
a) Overload	5.6.1 , 5.6.2
b) Endurance No. 1 (resistive)	5.7.1 – 5.7.6

c) Endurance No. 2 (tungsten)	5.7.3
d) Temperature	5.8.1
e) Dielectric	5.9.1
f) Effect of heat on actuating members	5.12
g) Assembly	5.4
h) Temperature (15-day)*	5.8.2
i) Dielectric*	5.9.2
j) Strain relief	5.14
k) Fault current*	5.15
l) Crushing*	5.16
m) Resistance to heat (70°C)	5.17

* Pin-type terminals only

5.2.7 AC-only through-cord switch testing

	Reference
a) Contact gap (check)	5.13.1.2
b) Overload	5.6.8 – 5.6.12
c) Endurance No.1 (inductive)	5.7.7
d) Endurance No. 2 (tungsten)	5.7.8
e) Endurance No. 3 (electronic ballast)	5.31.1
f) Temperature	5.8.1
g) Contact gap (repeated)	5.13.1.2
h) Dielectric	5.9.1
i) Effect of heat on actuating members	5.12
j) Assembly	5.4
k) Temperature (15-day)*	5.8.2
l) Dielectric*	5.9.2
m) Strain relief	5.14
n) Fault current*	5.15
o) Crushing*	5.16
p) Resistance to heat (70°C)	5.17

* Pin-type terminals only

5.2.8 AC/DC fixture switch testing

	Reference
a) Overload	5.6.1 , 5.6.2
b) Endurance No.1 (resistive)	5.7.1 – 5.7.6

c) Endurance No. 2 (tungsten)	5.7.3
d) Temperature	5.8.1
e) Dielectric	5.9.1
f) Security of Leads	5.10
g) Pull-out/push-in terminals	5.11.1 , 5.11.2
h) Temperature/push-in terminals	5.11.3 – 5.11.8
i) Effect of heat on actuating members	5.12
j) Resistance to heat (70°C)	5.17

5.2.9 AC/DC flush switches and ac/dc surface switch testing

	Reference
a) Overload	5.6.1 , 5.6.2
b) Endurance No.1 (resistive)	5.7.1 – 5.7.6
c) Endurance No. 2 (tungsten)	5.7.3
d) Temperature	5.8.1
e) Dielectric	5.9.1
f) Security of leads	5.10
g) Pull-out/push-in terminals	5.11.1 , 5.11.2
h) Temperature/push-in terminals	5.11.3 – 5.11.8
i) Effect of heat on actuating members	5.12
j) Resistance to heat (70°C)	5.17

5.2.10 AC only flush switch testing

	Reference
a) Contact gap (check)	5.13.1.2
b) Overload	5.6.8 – 5.6.12
c) Endurance No.1 (resistive)	5.7.6
d) Endurance No. 2 (inductive)	5.7.7
e) Endurance No. 3 (tungsten)	5.7.8
f) Endurance No. 4 (electronic ballast)	5.31.1
g) Temperature	5.8.1
h) Contact gap (repeated)	5.13.1.2
i) Dielectric	5.9.1
j) Security of leads	5.10
k) Pull-out/push-in terminals	5.11.1 , 5.11.2
l) Temperature/push-in terminals	5.11.3 – 5.11.8
m) Effect of heat on actuating members	5.12

- | | |
|---|----------------------|
| n) Resistance to heat (70°C) | 5.17 |
| o) Combination wire binding/pressure-type terminal assembly | 5.30 |
| p) Field Replacement Actuator | 5.32 |

5.2.11 Self-contained switch testing

- | | Reference |
|---|---|
| a) Contact gap (check) | 5.13.1.2 |
| b) Overload | 5.6.8 – 5.6.12 |
| c) Endurance No. 1 (resistive) | 5.7.6 |
| d) Endurance No. 2 (inductive) | 5.7.7 |
| e) Endurance No. 3 (tungsten) | 5.7.8 |
| f) Endurance No. 4 (electronic ballast) | 5.31.1 |
| g) Temperature | 5.8.1 |
| h) Contact gap (repeated) | 5.13.1.2 |
| i) Dielectric | 5.9.1 |
| j) Security of leads | 5.10 |
| k) Pull-out/push-in terminals | 5.11.1 , 5.11.2 |
| l) Temperature/push-in terminals | 5.11.3 – 5.11.8 |
| m) Effect of heat on actuating members | 5.12 |
| n) Heat cycling and vibration | 8.3.2.1.1 – 8.3.2.4.1 |
| o) Cable pullout | 8.3.3.1 , 8.3.3.2 |
| p) Mounting strength | 8.3.5.1.1 , 8.3.5.2.1 |
| q) Panel mount | 8.3.5.2.1 |
| r) Mounting bracket | 8.3.5.3.1 |
| s) Field replacement | 8.3.6.1 , 8.3.6.2 |
| t) Fault current | 8.3.7.1 , 8.3.7.2 |
| u) Knockout | 8.3.8.1 , 8.3.8.2 |
| v) Creep | 8.3.9.1 , 8.3.9.2 |
| w) Mold stress (90°C) | 8.3.10.1 , 8.3.10.2 |
| x) Flammability | 8.3.11.1 – 8.3.11.3 |

5.2.12 Separable terminal assembly testing

- | | Reference |
|-------------------------------------|----------------------|
| a) Retention of Tab Connection Test | 5.19 |
| b) Separable Connector Pull Test | 5.20 |
| c) Mold Stress Relief Test | 5.21 |

d) Separable Terminal Assembly Humidity Conditioning followed by Dielectric Test	5.22
e) Short Circuit Withstand Test	5.23
f) Latching Mechanism Test	5.24
g) Abnormal Overload Test	5.25
h) Temperature Test	5.26
i) Continuity Impedance Test	5.27

5.2.13 Separable jumper connector testing

	Reference
a) Separable Connector Pull Test	5.20
b) Mold Stress Relief Test	5.21
c) Dielectric Voltage-Withstand Test	5.9.1.1
d) Latching Mechanism Test	5.24
e) Abnormal Overload Test	5.25
f) Temperature Test	5.26

5.2.14 For ratings other than those specified for ratings B and D in [Table 19](#), overload and endurance tests conducted at the highest voltage may represent tests at lower voltage of the same frequency if volt-amperes at the high voltage are the same as, or more than, volt-amperes at the lower voltages. Overload and endurance tests at the higher voltage for ratings B and D in [Table 19](#) represent the lower voltage. The temperature test shall be conducted at the highest ampere rating that the test represents.

5.2.15 A switch in which there are two or more "on" and "off" positions of the switch mechanism shall be tested under conditions representing those of actual service, including the position or positions that involve making and breaking the maximum current.

5.2.16 Each set of contacts of a three-way switch shall be subjected to the required overload test. This may be accomplished by wiring two switches to control a single load as in actual service and operating the switches so that both sets of contacts of both switches are tested.

5.2.17 For three-way switches subjected to the endurance test, each of three devices shall be tested with one set of contacts making and breaking the required test current. Each of three others shall be tested with the other set of contacts making and breaking the circuit.

5.2.18 Each set of contacts of a four-way switch shall be subjected to the required overload test. This may be accomplished by wiring the switch in conjunction with two three-way switches as in actual service and operating the switches so that all four sets of contacts of the four-way switch are tested.

5.2.19 Of the six four-way switches subjected to the endurance test, four shall be connected differently so that their operation for 6000 cycles (10,000 for each test of a general-use ac switch) will result in testing each of the four possible combinations of contacts with respect to making and breaking the required test current. Each set of contacts of the other two switches shall be subjected to 1500 cycles of operation (2500 for each test of a general-use ac switch) making and breaking the required test current, which may be accomplished by wiring and operating each switch as described in [Clause 5.2.18](#).

5.2.20 A general-use ac/dc switch shall be subjected to the overload and endurance tests with direct current and with a noninductive resistance load.

5.2.21 During the overload and endurance tests, all dead metal parts of the switch that are exposed to user contact, including the intended mounting surface, shall be connected through a 15 A fuse to earth ground or to the neutral (identified or grounded) conductor of the test circuit. This shall be accomplished in accordance with Clause 5.2.22. A switch shall be tested with a properly installed metal faceplate or the equivalent.

5.2.22 The fuse shall be of a type and voltage rating intended for branch-circuit protection. The potential rating of the fuse shall be equal to or greater than the maximum potential from the switch to the point at which the dead metal parts and intended mounting surface are connected. The connection shall be such that:

- a) On a direct-current circuit, dead metal parts are positive with respect to the nearer arcing point in the switch; and
- b) The potential between live parts and conductive dead metal parts is the full test potential.

Note: Switches rated 250 V that are not marked as indicated in Clause 7.1.3 may be tested with one-half the test potential between live parts and conductive dead metal parts. The neutral or identified (grounded) conductor of a 125/250 V test circuit shall not be derived from a 2-wire, 250 V circuit by tapping off at the midpoint of resistors in series across the circuit.

5.2.23 If tests are conducted using alternating current, the circuit frequency shall be the same as the rated frequency of the switch or, if no frequency is indicated, 60 Hz alternating current shall be used. In either case, a lower frequency may be employed if agreeable to those concerned.

Note: A switch rated 50 Hz shall be tested on a 60 Hz circuit, except that the currents used for the overload and endurance tests shall be 120 percent of the current that would have been used had this switch been tested in a 50 Hz circuit.

5.2.24 In testing a switch, a cycle of operation shall include operation of the switch from the "off" position through every electrical position of the switch, and back to the "off" position.

5.2.25 A switching mechanism shall not be adjusted, lubricated, or otherwise conditioned either before or during any test.

Note: Switching mechanisms may be lubricated if it is done by the manufacturer during the manufacturing process.

5.2.26 With reference to Clause 5.2.20, a noninductive load may consist of any convenient combination of carbon-filament lamps or resistors, or both, which will cause the required current to flow through the test circuit, and which will have a power factor of 0.98 – 1.0 at 60 Hz. The power factor may be lower if agreeable to those concerned.

5.2.27 The reactive components of an inductive load for testing a switch for either an ampere or horsepower ac rating shall not be in parallel with other reactances or resistances, except that an air-core reactor in any phase shall be shunted by resistance (R_{SH}) in which the power loss is approximately 1 percent of the total power consumption in that phase, calculated in accordance with the following formula:

$$R_{SH} = 100 \left(\frac{1}{PF} - PF \right) \frac{E}{I}$$

in which:

PF is the power factor,

E is the closed-circuit phase voltage, and

I is the phase current.

Parallel individual loads made up of resistance and inductive-reactance components connected in series may be used if the power factor of the parallel loads are equivalent.

5.3 Tungsten-Filament-Lamp Load Characteristics

5.3.1 The test circuit, including the generator or other source of supply for a switch with a tungsten-filament-lamp load rating for use on direct current, shall provide a current inrush through the switch and load of not less than eight times the normal current when the circuit is closed on a 20 A load, and the circuit shall be such that peak value of the inrush current will be reached within 1/240 of a second after the circuit is closed. If a synthetic load is employed, its characteristics shall, in addition, be such that the current-inrush factor is not less than eight times the rated current of the switch or the peak values indicated in [Table 8](#) when tested to the corresponding current.

Note: If the required inrush current is available for a lower current rating with testing limited to such rating, a tungsten-filament-lamp load and the supply circuit need not be sufficient for the 20 A load test described above.

5.3.2 The test circuit, including the generator or other source of supply for a switch with a tungsten-filament-lamp load rating used on alternating current, shall provide a peak current inrush through the switch and load not less than the value given in [Table 8](#) when the circuit is closed on a load corresponding to a rating equal to or greater than the rating of the switch, and the circuit shall be such that the highest value of the inrush current will be reached within 1/240 of a second after the circuit is closed.

Note: If the required inrush current is available for a lower current rating with testing limited to such rating, a tungsten-filament-lamp load and the supply circuit need not be sufficient for the 20 A load test described above.

Table 8
Tungsten-filament-lamp load test circuit characteristics

(see Clause [5.3.1](#), [5.3.2](#), [5.3.4](#), [6.2](#))

Steady-state current (rms), amperes	Minimum inrush current (peak), amperes
1	18
2	35
3	51
5	78
10	141
15	191
20	226

5.3.3 A synthetic load and a combination synthetic and tungsten-filament-lamp load used to simulate a tungsten-filament-lamp load for testing on alternating current shall be investigated as described in Clauses [5.3.4](#) and [5.3.9](#), and also with respect to special conditions that are introduced by use on alternating current.

5.3.4 The acceptability of a test circuit, including the generator or other source of supply, for testing with tungsten-filament lamps shall be determined by means of oscillograph studies. If the circuit is tested at a normal (steady-state) current flow of 20 A and inrush currents as indicated in [Table 8](#) are recorded, the test circuit shall be considered to have the capacity for testing switches rated up to and including 60 A. With

reference to a 60 Hz timing wave, the peak values of inrush current as shown by oscillograms shall be reached within 1/4 cycle.

5.3.5 The characteristics of a direct-current test circuit shall be determined from a number of oscillograms (12 or more), and testing equipment shall be acceptable if not less than half the oscillograms show at least the minimum current-inrush factor.

5.3.6 The characteristics of an alternating current test circuit shall also be determined from a number of oscillograms (12 or more). Those which indicate that the current is decreasing (that the part of the sinewave in question is approaching the zero point) should be disregarded. Twelve or more oscillograms taken at other points on the sinewave should indicate whether the capacity of the test circuit can produce the minimum required current-inrush factor, based on observed peak values.

5.3.7 If tungsten-filament lamps are used as the load for a switch intended for use with such lamps, the load shall consist of the smallest possible number of lamps having standard ratings. In determining the smallest number of lamps necessary, the maximum lamp size required shall be 500 W. Larger lamps may be used if desired. The operating cycle shall 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, at least 10 banks of lamps controlled by a commutator shall be necessary for each switch under test.

5.3.8 A synthetic load may be used instead of tungsten-filament lamps. The synthetic load may consist of noninductive resistors if they 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 shall be calibrated immediately after the capacitor has been charged and discharged in the usual manner. A combination load consisting of tungsten-filament lamps and resistors and/or capacitor shall be considered a synthetic load.

5.3.9 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 Clause 5.3.6, consideration being given to the provision of higher current-inrush factors with the lower current loads, as required in Clause 5.3.1.

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

5.3.11 The characteristics of a synthetic load shall be such that the inrush current will be as specified in Clauses 5.3.1 – 5.3.3. In addition, the current in the capacitor/resistance load or the combination load mentioned in Clause 5.3.8 shall not 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 shall be the full inrush value for a minimum of 15 milliseconds after the circuit is closed

5.4 Assembly Test

5.4.1 A pendant or through-cord switch shall be capable of assembly to the flexible cords with which it is intended to be used without damage to the housing, terminals, or contacts, separation of the device body, or any other damage that may increase the risk of fire or electric shock.

5.4.2 Devices shall be assembled using the maximum and minimum size of each type of flexible cord that the switch can physically accommodate, following the instructions provided by the manufacturer. The switch need not be tested on flexible cord types and sizes that are specifically excluded from use in the installation instructions. See Clause 7.1.9.

5.4.3 A switch intended for use on 18 AWG (0.82 mm²) Types SP-1 or SPT-1 flexible cord shall be assembled to 18 AWG (0.82 mm²) Type SPT-1 cord with the following dimensions:

- a) A cord with a maximum width of 5.21 mm (0.205 inch) and a maximum overall thickness of 2.79 mm (0.110 inch); and
- b) A cord with a minimum overall width of 5.33 mm (0.210 inch).

Exception: Consideration shall be given to the effects of anticipated variations of insulation thickness of other types of flexible cord.

5.4.4 Each assembly shall be made on a 0.6 m (2 ft) length of flexible cord. A pendant switch shall be assembled at one end of the flexible cord. A through-cord switch shall be assembled in the center of the cord.

5.4.5 The assemblies shall then be subjected to the following tests:

- a) Six assemblies using each size and type of flexible cord shall be subjected to the temperature test described in Clause [5.8.2](#), and then subjected to the dielectric voltage-withstand test in Clause [5.9.2](#).
- b) Twelve assemblies using each size and type of flexible cord shall be subjected to the strain relief test described in Clause [5.14](#).
- c) Six assemblies using each size and type of flexible cord shall be subjected to the fault current test described in Clause [5.15](#).
- d) Six assemblies using each size and type of flexible cord shall be subjected to the crushing test described in Clause [5.16](#).

5.5 Test Conditions

5.5.1 During the overload, and all endurance tests, a switch shall be connected to a load (as described in the applicable test method) and, except as noted in Clauses [5.7.3](#) and [5.7.8](#), to a supply circuit, the voltage of which is within 5 percent of the rated voltage of the switch. The capacity of the test circuit shall be such 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.

5.5.2 A flush switch that is intended for mounting in an outlet box shall be mounted with a metal flush plate or equivalent metal surface in position over the switch.

In Mexico, if the switch is intended for mounting with a non-metallic flush plate and non-metallic mounting yoke, the switch may be mounted with a non-metallic flush plate.

5.5.3 With reference to the requirement in Clause [5.5.1](#), it is impracticable to describe the details of connections that must be made in order to obtain all operating conditions because of the different arrangements of terminals of switches of various manufacturers. The connections to a switch in the test circuit shall be such that the load controlled will have the same position, relative to the switch and the supply, that it will have in actual service. Two- and three-circuit switches shall be tested simultaneously with multiple supply and loads present to represent actual service conditions and shall be marked in accordance with Clause [7.2.4](#).

5.5.4 The switch shall be connected in the test circuit between the supply mains and the load.

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

5.6 Overload Test

5.6.1 After being subjected to the applicable overload test, a general-use ac/dc switch shall be electrically and mechanically operable. At the conclusion of the test, the switch shall be capable of performing its intended function and shall show no wear, loosening of parts, or defects of any other description that will diminish the usefulness and reliability of the switch. The fuse described in Clause [5.2.21](#) and [5.2.22](#) shall not open at the conclusion of this test.

5.6.2 A general-use ac/dc switch shall be operated manually by means of its actuating member for 50 cycles at a rate of 6 – 10 cycles per minute, making and breaking the required test current. The rate of speed of operation may be greater than 10 cycles per minute if agreeable to those concerned. If the switch rating is 10 A or less, the test current shall be 150 percent of the rated current. If the switch rating is more than 10 A, the test current shall be 125 percent of the rated current.

5.6.3 A switch rated in horsepower and intended for use in dc circuits only shall be subjected with an overload test for 50 cycles at the rate of 6 – 10 cycles/min with dc and a noninductive load so that the switch makes and breaks an overload current of the value given in [Table 9](#), equal to 10 times the full load current of a motor of the horsepower rating in question.

Table 9
Overload-test currents for dc switches with horsepower ratings

(see Clause [5.6.3](#))

Switch rating, hp	125 V	250 V	600 V
1/10	20.0 A	10.0 A	—
1/8	22.0	11.0	—
1/6	24.0	12.0	—
1/4	30.0	15.0	—
1/3	38.0	19.0	—
1/2	54.0	27.0	—
3/4	74.0	37.0	16.0 A
1	96.0	48.0	20.0
1-1/2	132.0	66.0	27.0
2	170.0	85.0	36.0

5.6.4 A switch rated in horsepower for use on ac circuits only shall be subjected to an overload test for 50 cycles at the rate of 6 – 10 cycles/min with ac and an inductive load so that the switch makes and breaks an overload current of the value given in [Table 10](#) or [Table 11](#), and having a power factor of 0.40 – 0.50, except that a lower power factor may be used with the agreement of those concerned.

5.6.5 A switch rated in horsepower and intended for use on direct as well as alternating current shall comply with the applicable requirements when tested with alternating current as well as direct current, with different devices used for the ac and dc tests.

5.6.6 If a switch has horsepower ratings at more than one voltage, a test shall be conducted at the overload current corresponding to the horsepower rating at the highest voltage. An additional test shall be conducted 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 greater current involved at a lower voltage may necessitate a separate heating test. If more than one test is made, three devices shall be used for each test.

Table 10
Single phase overload-test current for ac switches with horsepower ratings

(see Clause [5.6.4](#))

Switch rating in horsepower	120 VAC	240 VAC
1/10	18.0	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	29.4
3/4	82.8	41.4
1	96.0	48.0
1-1/2	120.0	60.0
2	144.0	72.0

Table 11
2- and 3-phase overload-test current for ac switches with horsepower ratings

(see Clause [5.6.4](#))

Switch rating in horsepower	120 VAC		240 VAC		480 VAC		600 VAC	
	Motor Designations		Motor Designations		Motor Designations		Motor Designations	
	B, C, D	E	B, C, D	E	B, C, D	E	B, C, D	E
1/2	40	40	20	20	10	10	8	8
3/4	50	50	25	25	12.5	12.5	10	10
1	60	60	30	30	15	15	12	12
1-1/2	80	80	40	40	20	20	16	16
2	100	100	50	50	25	25	20	20

5.6.7 An overload test of a switch in a three-phase circuit shall be representative of performance of the switch in a two-phase circuit of the same voltage, for the same horsepower rating.

5.6.8 After being subjected to the overload test described in Clauses [5.6.9](#) – [5.6.12](#), a general-use ac switch shall be electrically and mechanically operable. At the conclusion of the test, the switch shall be capable of performing its intended function and shall show no wear, loosening of parts, or defects of any other description which will diminish the usefulness and reliability of the switch. Sticking of the contacts that self-clears before the next operation of the switch shall not be considered to diminish the usefulness and reliability of the switch.

Exception: Switches rated 347 V ac shall be subjected to the overload tests in Clauses [5.6.9](#), [5.6.10](#) and [5.6.12](#), except that power factor shall be 0.75 – 0.80. If the rated current of the switch is 15 A, the test current shall be 150 percent of the rated current. If the rated current of the switch is more than 15 A, the test current shall be 125 percent of the rated current.

5.6.9 The test shall consist of 100 cycles of operation at a rate of 6 – 10 cycles per minute, and the on time for each cycle shall be not more than 1 second. The load shall be inductive, with a power factor of 0.40 – 0.50. A load with a lower power factor may be employed if agreeable to all concerned.

5.6.10 A switch with a single voltage rating shall be tested at that voltage, at 4.8 times the rated current.

5.6.11 A switch with multiple voltage ratings and a single current rating shall be tested at the highest rated voltage, at 4.8 times the rated current.

5.6.12 In the case of any switch with multiple current ratings, half the devices shall be tested at the highest voltage, and half shall be tested at the lowest voltage. The test in each case shall be made at 4.8 times the rated current corresponding to the voltage at which the device is being tested.

5.7 Endurance Test

5.7.1 After being subjected to the endurance test described in Clause [5.7.2](#), an ampere-rated general-use ac/dc switch or a combined ampere rated and horse power rated (ac/dc) switch shall be mechanically and electrically operable. At the conclusion of the test, the switch shall be capable of performing its intended function and shall show no wear, loosening of parts, or defects of any other description that will diminish the usefulness and reliability of the switch. Also, the fuse described in Clause [5.2.21](#) and [5.2.22](#) shall not open at the conclusion of this test.

5.7.2 A switch shall be operated by means of its actuating member either manually or by a machine for 6000 cycles of operation at a rate of 6 – 10 cycles per minute, making and breaking its rated current. The rate of operation may be greater than 10 cycles per minute, but should not exceed 20 cycles/minute, if agreeable to those concerned.

5.7.3 A general-use ac/dc switch shall be operated for an additional 6000 cycles following the endurance test specified in Clause [5.7.2](#), making and breaking a direct-current 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. The open-circuit potential of the test circuit shall be 120 ±5 V, and the closed-circuit potential at the load with normal current flowing shall be within 5 percent of the open-circuit potential.

5.7.4 An ac-rated switch that has been subjected to the endurance tests described in Clauses [5.7.6](#) – [5.7.8](#) shall be electrically and mechanically operable. At the conclusion of the test, the switch shall be capable of performing its intended function and shall show no wear, loosening of parts, or defects of any other description that will diminish the usefulness and reliability of the switch. Sticking of the contacts that separate during the next three operation cycles shall not be considered to diminish the usefulness and reliability of the switch. Additional mechanical cycles may be required to ensure that each switch electrically makes and breaks the specified load for the required number of cycles. A maximum of 25 additional cycles for any one switch shall be permitted. An operation cycle shall be defined as a normal on and off actuation, either manual or by machine. A verification method shall be incorporated in the test set-up to confirm that no more than three consecutive operation cycles with the contacts sticking have occurred and to verify the maximum 25 additional cycles on each switch under test. The test set-up shall include an electrical counter located across the load to monitor the total number of electrical test cycles of each switch under test. Cycling of a switch by hand to separate sticking contacts shall be acceptable and shall be manually verified and recorded to meet the above requirements.

5.7.5 A switch shall be operated by means of its actuating member, either manually or by a suitable machine. It shall be operated at the specified cyclic rate, except that where the rate of operation specified introduces a condition that could not occur in normal use, the switch may be operated at a reduced rate.

5.7.6 The first test shall consist of 10,000 cycles of operation, controlling rated current at maximum rated voltage, at a rate of operation of 18 – 24 cycles per minute. The load shall be noninductive, with a power factor of 0.98 – 1.0 at 60 Hz. The power factor may be lower if agreeable to those concerned.

Exception: An ac only through-cord switch shall not be required to comply.

5.7.7 The second test shall consist of 10,000 cycles of operation, at a rate of operation of 18 – 24 cycles per minute, controlling rated current at maximum rated voltage. The load shall be inductive, with a power factor of 0.75 – 0.80.

Exception No. 1: For ac-only through-cord switch or ac-only door switch rated in amperes, the number of cycles shall be 6000.

Exception No. 2: For an ac switch rated 347 V ac or an ac switch marked as specified in Clause [7.6.10](#), the number of cycles shall be 20,000.

5.7.8 The third test shall consist of 10,000 cycles of operation, controlling a tungsten-lamp (or equivalent) load with rated current at 120 V, at a rate of operation of 6 – 10 cycles per minute. The open-circuit potential of the test circuit shall be 120 ±5 V, and the closed-circuit potential at the load with normal (steady-state) current flowing shall be within 5 percent of the open-circuit potential.

Exception No. 1: For an ac-only door switch or ac-only through-cord switch, the number of cycles shall be 6000.

Exception No. 2: An ac switch rated 347 V ac or an ac switch marked as specified in Clause [7.6.10](#) shall not be required to comply.

5.8 Temperature Test

5.8.1 General

5.8.1.1 A switch shall carry continuously the maximum rated current for which it was tested, in any "on" position, without showing greater rise in temperature than 30°C (54°F) on the wiring terminals; on a device with wire leads, the temperature shall be measured 6 – 12 mm (0.24 – 0.47 inch) from the surface of the enclosure of the wire leads of switches provided with leads. See Clause [5.2.14](#).

5.8.1.2 The temperature test described in Clause [5.8.1.1](#) may be conducted at any ambient temperature within the range of 10 – 40°C (50 – 104°F).

5.8.1.3 A switch having one or more push-in (screwless) terminals shall also comply with Clause [5.11.3](#).

5.8.1.4 As indicated in Clause [5.2](#), the temperature test shall always follow 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 also be conducted following the overload test and prior to the endurance test.

5.8.1.5 To determine whether a switch complies with the requirements in Clause [5.8.1.1](#), the switch shall carry its maximum rated current continuously until constant temperatures are attained on the plates of wiring terminals or on wire leads used instead of wiring terminals. Unless the switch is provided with attached leads, connections to the switch shall be made with fixture or building wire in lengths not less than 305 mm (12 inches) having 0.76 mm (30 mils) or greater average thickness of thermoplastic insulation rated for 60°C (140°F) and of the size indicated in [Table 12](#). The temperature test shall be conducted in open air at any convenient voltage, using either alternating or direct current.

Table 12
Wire size for temperature test

(see Clause [5.8.1.5](#))

Test current, A	Wire size, AWG
0.0 – 6	18
6.1 – 10	16
10.1 – 15	14
15.1 – 20	12
20.1 – 30	10
30.1 – 45	8*
45.1 – 60	6*

* In Canada, compact wire shall be used.

5.8.1.6 Temperature readings shall be obtained by using thermocouples consisting of 28 – 32 AWG (0.08 – 0.032 mm²) iron and constantan wires. Measurements shall be made on the terminals outside the switch enclosure but adjacent thereto. If a switch has wire leads, the measurements shall be made on the copper conductors at the point of entrance of the leads to the switch. A temperature shall be considered to be constant when three successive readings, taken at 5-minute intervals, indicate no change.

5.8.2 Pendant and Through-Cord Switches with Pin terminals

5.8.2.1 The temperature rise of a switch with pin terminals shall be not more than 30°C (54°F) when tested as described in Clauses [5.8.2.2](#) and [5.8.2.3](#).

5.8.2.2 The assemblies specified in Clause [5.4.5](#) shall be connected in a series circuit and subjected to a test current equal to the ampacity of the flexible cord size and type used in the assemblies. Thermocouples shall be attached to the bared copper conductors as close as possible to the point where the flexible cord enters the switch. All switch contacts shall be in the closed ("on") position.

Exception: The switch may be tested at its rated current if the current rating of the switch is less than the ampacity of the flexible cord.

5.8.2.3 The test shall continue for 15 days without interruption. The temperatures of each assembly shall be measured at the end of each working day.

5.9 Dielectric Voltage-Withstand Test

5.9.1 General

5.9.1.1 A switch shall withstand without breakdown a 50 – 60 Hz essentially sinusoidal potential applied as described in Clauses [5.9.1.2](#) and [5.9.1.3](#) for 1 minute between live parts of opposite polarity and between live parts and dead metal parts, with the switch at the maximum operating temperature reached in intended use. The test potential shall be as indicated in [Table 13](#).

5.9.1.2 To determine that a switch complies with the requirements in Clause [5.9.1.1](#), the switch shall be tested by means of a 500 VA or larger capacity transformer whose output voltage is essentially sinusoidal and can be varied. The applied potential shall be increased from zero until the required test level is reached, and shall be held at that level for 1 minute. The increase in the applied potential shall be at a uniform rate and as rapid as is consistent with its value being correctly indicated by a voltmeter.

5.9.1.3 Compliance of switches with the foregoing requirements shall be determined by means of a suitable transformer of not less than 500 VA capacity, the output voltage of which can be regulated, except that the capacity may be less than 500 VA if there is a meter of not more than 2 percent error connected across the secondary terminals to directly measure the applied voltage. Starting from zero, the applied voltage shall be increased gradually and at a uniform rate until the required test value is reached or until breakdown occurs.

Table 13
Dielectric strength test voltages

(see Clause [5.9.1.1](#))

Switch rating, V	Test voltage, V
120 – 300 V ac	1500
301 – 600 V ac	2 x rated + 1000
125 – 250 V ac/dc	1000
251 – 600 V ac/dc	2 x rated + 1000

5.9.2 Pendant and Through-Cord Switches with Pin Terminals

5.9.2.1 Immediately following the temperature test of Clause [5.8.2](#), the assembly of a cord and switch employing pin terminals shall be capable of withstanding, without breakdown, for a period of 1 minute, the application of a 60 Hz essentially sinusoidal potential of 1250 V between the two conductors of the flexible cord. For this test, three assemblies shall be selected from each set of those used for the temperature test, Clause [5.8.2](#).

5.9.2.2 The test potential shall be supplied from a 500 VA or larger capacity testing transformer whose output is essentially sinusoidal and can be varied. The applied potential shall be increased from zero until the required test voltage is reached, and shall be held at that voltage for a period of 1 minute. The increase in the applied potential shall be at a uniform rate and as rapid as is consistent with its value being correctly indicated by the voltmeter.

5.10 Security of Switch Leads Test

5.10.1 The connection of a lead wire to a switch shall be capable of withstanding without damage or disconnection from the terminal the application of a straight pull of 90 N (20 lbf) for a period of 1 min. The pull shall be applied gradually and in the direction most likely to cause failure.

5.11 Push-In Terminal Tests

5.11.1 A push-in (screwless) terminal shall withstand, without pull-out or breakage of the conductor, the application of a straight pull, applied for 1 minute and as further described in Clause [5.11.2](#).

5.11.2 14 AWG (2.1 mm²) conductors shall be connected to both terminals of one circuit in each of six devices in accordance with the manufacturer's instructions. Each conductor shall be subjected to a gradual increasing pull maintained at 90 N (20 lbf) for 1 minute. Untested devices may be used for this test.

5.11.3 A push-in (screwless) terminal shall perform with a temperature rise of the attached conductor that shall not exceed 30°C (54°F), based on an ambient temperature of 25°C (77°F), with the terminal connection carrying maximum rated current of the switch.

5.11.4 Separate sets of six previously unused switches shall be assembled with solid copper wire, using 14 AWG (2.1 mm²). Internal components of the switches, including the switching mechanism, may be short-circuited by means of a soldered shunt.

5.11.5 The terminals of a switch employing a release mechanism shall be subjected to a conditioning regimen consisting of nine insertions and withdrawals of a conductor of the size and type to be used for the test. A tenth insertion of a newly stripped, previously unused length of wire shall be made and left in place for the test.

5.11.6 With the devices connected as described in Clauses [5.11.4](#) and [5.11.5](#), a current of 15A shall be passed through the assemblies.

5.11.7 The assemblies shall be continued under test for 30 days without interruption. Temperature values shall be measured at the end of each working day.

5.11.8 The test described in Clauses [5.11.4](#) – [5.11.7](#) may be conducted in conjunction with the temperature test, Clause [5.8](#).

5.12 Effect of Heat on Actuating Members Test

5.12.1 An actuating member of insulating material, other than thermoset material, shall not soften or become damaged when caused to operate the mechanism after being exposed to a temperature of 65 ±3°C (149 ±5°F).

5.12.2 To determine whether or not an actuating member complies with the requirement in Clause [5.12.1](#), the switch shall be subjected to a temperature of 65 ±3°C (149 ±5°F) until the insulating material under consideration is thoroughly heated (usually 1 hour in a constant-temperature oven). The actuating member shall then be operated manually (not controlling a load) and shall not be adversely affected to the extent that it is appreciably deformed or fails to operate the mechanism for 25 cycles of make and break. In conducting this test, the actuating member shall be operated with no more force or greater impact than would be the case in service. The test shall be conducted immediately after removal of each individual device from the oven.

5.13 Switching Mechanism Test

5.13.1 General

5.13.1.1 The switching contacts of a general-use switch for use on direct current as well as alternating current shall be such that the switching mechanism will trip free from the actuating member when the switch is operated – that is, the switch shall make and break the circuit with a quick snap by a blade or blades whose rate of motion, while the switch is actually making or breaking the circuit, cannot be affected by manipulation of the actuating member.

5.13.1.2 When the actuating force is removed from the actuating member of a general-use ac snap switch, the contacts shall:

- a) With the actuator in the "on" position, make contact with sufficient pressure to comply with the temperature test, Clause [5.8](#); and
- b) With the actuator in any position other than "on", be separated by a distance sufficient to withstand a 60 Hz essentially sinusoidal potential of 1500 V rms applied between them for 1 minute without breakdown.

5.13.1.3 The applied potential test mentioned in Clause [5.13.1.2\(b\)](#) shall be made prior to the overload test, and shall be repeated at the conclusion of the heating test.

5.13.1.4 A three-way and a four-way switch shall be constructed so that they cannot be left in a position in which the circuits corresponding to both operating positions of the actuating member are on simultaneously.

5.13.2 AC/DC fixture switch with pull chain

5.13.2.1 General

5.13.2.1.1 The chain of 3 fixture switches shall be pulled to the "off" position and then released. This test shall be repeated a total of 5 times for each fixture switch. The chain shall not become energized and the mechanism shall not jam.

5.13.2.2 Dielectric Strength – Chain Mechanism Without External Insulating Link

5.13.2.2.1 Specimens of the switch shall be subjected to an ac voltage as outlined in Clause [5.9](#).

5.13.2.3 Dielectric Strength – Chain Mechanism with Insulating Link

5.13.2.3.1 An insulating link shall withstand without breakdown for a period of 1 minute the application of a 60 Hz essentially sinusoidal potential of 1500 V between metal chains attached to both ends, after the link has been exposed to a saturated moist atmosphere for a period of 48 hours.

5.13.2.3.2 Prior to testing, the insulating links shall be conditioned by exposure for 48 hours in a saturated moist atmosphere at a temperature of $32.0 \pm 2.0^{\circ}\text{C}$ ($89.6 \pm 3.6^{\circ}\text{F}$). The devices shall be suspended over water in a small, flat-bottomed vessel with a tight-fitting cover – the water to be about 12.7 mm (1/2 inch) deep and the devices to clear the water by 25.4 mm (1 inch) or more. The closed vessel containing the water and the suspended devices shall be placed in a controlled-temperature cabinet, with a free circulation of air around the vessel, and the temperature of the air within the cabinet shall be maintained at the value specified.

5.13.2.4 Mechanical Strength of Insulating Links Test

5.13.2.4.1 An insulating link shall withstand for a period of 1 minute a direct pull of 178 N (40 lbf) applied between the chain attachments at either end, except that, in the case of a factory-assembled link that is not detachable from the chain, the link shall not break before the chain breaks when the complete assembly is subjected to a direct pull of not more than 178 N (40 lbf) between the chains at either end.

5.13.2.4.2 Equipment for the mechanical-strength test shall consist of a pair of special connectors for the attachment of the two ends of an insulating link. Each connector shall consist of a 3.96 mm (0.156 inch) diameter steel rod with one end formed into a hook (for convenience in attaching it to a testing machine) and the other end machined to provide a sphere 3.25 mm (0.128 inch) in diameter (approximately the same as the ball section of the conventional chain). The steel between the sphere and the rod proper shall have a rectangular, 0.76 by 1.65 mm (0.03 by 0.065 inch), cross-section – the smaller dimension corresponding to the diameter of the dumbbell section of the chain. A connector shall be attached to each end of an insulating link, the assembly connected in a testing machine, and the load applied slowly and gradually until the force is 178 N (40 lbf). The load shall then be held constant for 1 minute or until failure occurs.

5.14 Strain-Relief Test

5.14.1 When tested in accordance with this Clause, a pendant or through-cord switch shall not exhibit any:

- a) Damage to the flexible cord insulation, nor any displacement of the flexible cord, cord conductors, or insulation exceeding 0.79 mm (1/32 inch);
- b) Breakage of the switch that may affect the enclosure of live parts or the strain relief; or
- c) Other damage that may increase the risk of fire or electrical shock.

5.14.2 The assemblies specified in Clause 5.4.5 shall be subjected to this test. Six of each type of assembly shall be tested as-received. In addition, if the device employs pin-type terminals, six shall be tested after conditioning in a full-draft circulating-air oven for 30 days at 67.0°C (153.0°F).

5.14.3 Each switch shall be securely supported by the body in a manner that will not restrict the motion of the flexible cord. The force specified in Table 14 shall be applied for one minute between the free ends of the flexible cord with the switch in between in the case of a through-cord switch and between the switch and the free end of the flexible cord in the case of a pendent type switch.

Table 14
Strain-relief test values

(see Clause 5.14.3)

Flexible cord size	Pull force, lbf (N)
Smaller than 18 AWG (0.82 mm ²)	20 (89)
18 AWG (0.82 mm ²)	30 (133)

5.15 Fault Current Test

5.15.1 When tested as described in this Clause, a pendant or through-cord switch that employs pin terminals shall not experience ignition of the switch enclosure, the flexible cord insulation, or a surrounding fire indicator. The switch contacts need not be able to function at the completion of this test.

5.15.2 The assemblies specified in Clause 5.4.5 shall be subjected to this test as follows:

- a) Two of each assembly type as-received;
- b) Two of each assembly type after being subjected to a 67 N (15 lbf) pull force applied for one minute to the flexible cord along the major axis of the cord and perpendicular to the plane where the cord enters the switch; and
- c) Two of each assembly type after being conditioned in an oven at 67°C (153°F) for 30 days.

5.15.3 Each assembly shall be connected into a circuit capable of drawing 1000 A when the system is short-circuited at the supply terminals. A standard, nonrenewable 20 A cartridge fuse or a thermal-type circuit breaker (calibrated and determined to meet the calibration requirements for circuit breakers) shall be connected in series with the assembly. The two conductors of the flexible cord shall be twisted together and soldered at one end. The switch contacts shall be in the closed ("on") position before the fault current is applied.

5.16 Crushing Test

5.16.1 When tested as described in this Clause, a pendant or through-cord switch shall be capable of withstanding for a period of one minute a crushing force of 333 N (75 lbf) applied at right angles to the major axis of the body without complete permanent collapse, without damage to the switching mechanism, and without exposure of bare live parts to contact by the probe shown in [Figure 2](#).

5.16.2 A device shall be laid flat on a slab of wood, such as maple, 12.7 mm (1/2 inch) thick, resting on a smooth steel plate suitably supported in a horizontal position. A round steel rod 19.1 mm (0.75 inch) in diameter shall be placed on the switch body at right angles to the longitudinal axis of the switch and midway between the points of contact of the ends of the switch body with its supporting surface, except that modifications shall be made where necessary so that the force is not applied to an actuating member. By means of weights, levers, or other suitable means, forces gradually increasing up to the required values shall be applied to the rod in a direction normal to the surface of the wood slab.

5.17 Resistance to Heat Test

5.17.1 As a result of oven conditioning, devices employing thermoplastic materials shall not have a change in any dimension greater than 10 percent nor any warpage creating an opening greater than 0.79 mm (1/32 inch) in any butt joint forming the enclosure of each device. Each device shall remain capable of functioning as intended.

5.17.2 The unwired devices shall be placed in a circulating air oven for 7 hours at 70°C (158°F). The devices shall be removed from the oven and allowed to cool to room temperature before determining compliance.

5.18 Door Switch Assembly Test

5.18.1 One previously untested representative device shall have the switch assembled into the special switch box in accordance with the manufacturer's instructions referenced in Clause [7.6.14](#). The special switch box shall have a volume sufficient to accommodate the electrical assembly of the switch into the box when wired with the maximum number of conductors indicated in the manufacturer's instructions. Following assembly, the unit shall also be checked for compliance with required spacings.

5.19 Retention of Tab Connection Test

5.19.1 Six representative terminals shall be removed from their enclosure. Once removed, each individual terminal and lead assembly shall be inserted and attached to the switch as intended. The switch shall be supported on a steel plate with the individual terminals projecting downward. A static force of 2.2 N (0.5 lbf) shall be applied to individual terminals for one minute in a direction tending to remove the individual terminal from the tab on the switch. There shall be no displacement more than 2 mm (0.079 in) for each individual lead terminal and blade tab.

Exception: A separable terminal assembly having a pin construction where the pin is formed in a shape that provides a self-retaining locking feature is not required to be subjected to this test.

5.20 Separable Connector Pull Test

5.20.1 Six representative switches employing a separable terminal shall have their latching or locking features defeated from either the connector or the body of the switch. The connector shall then be inserted and attached to the switch as intended, but without the locking feature. The switch shall be supported on a steel plate with the connector projecting downward. A static force of 13.3 N (3 lbf) shall be applied to all conductors simultaneously for one minute in a direction tending to remove the connector from the body of

the switch. There shall be no displacement more than 2 mm (0.079 in) of the special purpose connector from the back of the switch body.

5.20.2 For a separable jumper connector, the test method described in Clause [5.20.1](#) shall be performed except the switch shall be replaced using the separable jumping connector.

5.20A Spring Action Clamp Terminal Pull Test

5.20A.1 A switch employing spring action clamp terminals shall be subjected to the test conditions as specified in [5.20A.2](#) – [5.20A.6](#).

5.20A.2 Upon completion of this test, there shall not be any damage to the terminal or its securement mechanism. The spring action clamp shall remain capable of functioning as intended. There shall not be any damage, arcing or dielectric breakdown during application of the test potential. The conductor shall not pull free from the terminal during application of the test force.

5.20A.3 Each terminal of each device (three terminals minimum) shall be tested. Each terminal shall be wired with the smallest AWG conductor size and wired with the largest conductor size, as specified by the manufacturer. If the spring action clamp is also intended for both solid and stranded AWG conductors, both solid and stranded shall be tested.

5.20A.4 The conductor insulation shall be prepared by removing the insulation from the conductor according to manufacturer's strip gauge and then inserted into the spring action clamp terminal as intended. The lever of the spring action clamp shall then be operated to the fully latched and locked position and back to the unlatched and unlocked position. This sequence of operation shall be repeated for a total of 100 cycles.

5.20A.5 Following the 100 cycles, the conductor shall be reattached to the spring action clamp terminal and the lever shall be placed in the latched and locked position as intended. A static pull force as specified in [Table 14A](#) shall be applied to the conductor for 1 minute in a direction perpendicular to the plane of the switch yoke, tending to remove the conductor.

Table 14A
Test values for spring action clamp terminal pull test

Size of conductor AWG	Pullout force N (lbf)
16	40 (9)
14	51.2 (11.5)
12	60.0 (13.5)
10	80.1 (18.0)
8	91.2 (20.5)
6	93.4 (21)
4	133.4 (30)

5.20A.6 Each device is then to be subjected to a 50 – 60 Hz essentially sinusoidal potential equal to twice the rated voltage plus 1000 V applied between live parts of opposite polarity and between live parts and grounding or dead metal parts. The test voltage is to be increased at a uniform rate and as rapidly as is consistent with its value being correctly indicated by a voltmeter and maintained at the test potential for 1 minute.

5.21 Mold Stress Relief Test

5.21.1 After the temperature conditioning specified in Clause [5.21.3](#), a separable terminal assembly shall not warp, shrink or result in any of the following:

- a) Making internal wiring or uninsulated live parts, other than exposed wiring terminals, accessible to contact by the probe illustrated in Figure 2;
- b) Defeating the integrity of the enclosure or interference with the intended securement or installation of the separable terminal assembly; and
- c) Any other evidence of damage that could increase the risk of fire or electric shock.

5.21.2 For a separable jumper connector, the same test method as described in Clause [5.21.1](#) shall be used except the switch shall be replaced using the separable jumper connector.

5.21.3 Six samples of a switch employing a separable terminal assembly shall be placed in a circulating air oven maintained at a temperature of $90 \pm 2^{\circ}\text{C}$ ($194 \pm 4^{\circ}\text{F}$) for 72-hour period. The devices shall be removed from the oven and allowed to cool to room temperature before determining compliance.

5.21.4 Following the completion of this test, the devices shall be subjected to a Dielectric Voltage-Withstand Test as described in Clause [5.9.1.1](#), except the test potential shall be 3000 V applied for one minute between live parts of opposite polarity and between live parts and dead metal parts with the switch at ambient room temperature.

5.22 Separable Terminal Assembly Humidity Conditioning Followed By Dielectric Test

5.22.1 Six representative switches, including their disconnected special purpose connectors, shall be placed in an environmental chamber and conditioned in sequence as follows:

- a) 4 hours at a temperature of $75 \pm 1^{\circ}\text{C}$ ($167 \pm 1.8^{\circ}\text{F}$) at a relative humidity of 92 ± 3 percent;
- b) 16 hours at a temperature of $75 \pm 1^{\circ}\text{C}$ ($167 \pm 1.8^{\circ}\text{F}$) at a relative humidity of 40 ± 3 percent; and
- c) 4 hours at a temperature of $30 \pm 1^{\circ}\text{C}$ ($86 \pm 1.8^{\circ}\text{F}$) at a relative humidity of 60 ± 3 percent.

5.22.2 Upon completion of the humidity conditioning, each special purpose connector shall be connected to the corresponding switch. The completed assembly shall be subjected to the Dielectric Voltage-Withstand Test as described in Clause [5.9.1.1](#), except the test potential shall be 3000 V.

5.23 Short Circuit Withstand Test

5.23.1 For a switch employing a separable terminal assembly when tested as described in Clauses [5.23.2](#) – [5.23.6](#), the grounding path shall retain its integrity as demonstrated by a continuity check between the separable terminal grounding lead and a metallic wall plate installed as intended.

5.23.2 Six samples shall be used in this test. The separable terminal assembly shall be inserted and assembled to mating AC only switches as intended. The completed assembly shall be tested.

5.23.3 The fuse shall open when the test circuit is closed and there shall not be any ignition of the cotton.

5.23.4 The switch shall be installed in a metallic outlet box with a metallic cover plate. Surgical cotton shall be placed at all openings surrounding the cover plate. The switch shall be wired in a test circuit capable of delivering 1000 A rms. The grounding lead of the special purpose connector shall be connected to a 20 A branch circuit fuse and in turn wired to the supply using 1.22 m (4 ft) of 12 AWG (3.3 mm^2)

copper wire. The test circuit shall be completed by securing an additional 1.22 m (4 ft) of 12 AWG (3.3 mm²) copper wire to a metallic wall plate (welded, bolted, etc.).

5.23.5 The open circuit test voltage shall be between 100 – 105 percent of the voltage rating of the device under test. The test circuit shall be closed on the assembly.

5.23.6 Upon completion each assembly shall be checked for continuity using any indicating device, such as a ohmmeter or battery-and-buzzer combination or the like, between the grounding conductor lead and metallic wall plate.

5.24 Latching Mechanism Test

5.24.1 The latching mechanism used to secure a separable terminal to a switch or a separable terminal assembly to a separable jumper connector, shall be subjected to the conditions as specified in Clauses [5.24.3](#) – [5.24.5](#).

Exception: The latching means used to secure a separable terminal assembly to a switch may serve to represent a separable terminal assembly to a separable jumper connector provided the latching means are the same.

5.24.2 Upon completion of this test, there shall not be any damage to the separable terminal assembly connector or separable jumper connector and its latching mechanism. The latching mechanism shall remain capable of functioning as intended. There shall not be any damage, arcing or dielectric breakdown during application of the test potential. The separable terminal assembly connector or separable jumper connector shall not pull free from the mated half during application of the test force.

5.24.3 The latching mechanism on one sample shall be operated to lock the separable terminal assembly connector to the switch or separable jumper connector to a separable terminal assembly connector. The locking means shall then be operated to withdraw the mated pairs. This sequence shall be repeated for a total of 100 cycles.

5.24.4 Following the 100 cycles, the mated pairs shall be reattached as intended to the latched and locked position. A static 89 N (20 lbf) shall be applied to all conductors of the special purpose connector separable terminal assembly simultaneously for 1 minute in a direction, tending to remove the separable terminal assembly.

5.24.5 Following the test of Clause [5.24.4](#), the mated pairs shall be subjected to the dielectric voltage-withstand test described in Clause [5.9.1.1](#), except the test potential shall be 3000 V applied for one minute between live parts of opposite polarity and between live parts and dead metal parts with the switch at ambient room temperature. The test voltage shall be increased at a uniform rate and as rapidly as is consistent with its value being correctly indicated by a voltmeter, and maintained at the test potential for one minute. For mated pairs consisting of a separable terminal assembly and switch, the test voltage shall be applied between all individual conductors and grounding conductor and dead metal parts including the mounting yoke. For mated pairs consisting of a separable terminal assembly and separable jumper connector, the test voltage shall be applied between all conductors and grounding conductor.

5.25 Abnormal Overload Test

5.25.1 Six previously untested samples each of a separable terminal assembly to a switch and a separable terminal assembly to a separable jumper connector shall be capable of performing acceptably when subjected to the abnormal overload test as described in Clauses [5.25.2](#) – [5.25.11](#). In either case, there shall not be any electrical or mechanical failure of the device, opening of a line or grounding fuse, welding of the contacts, nor burning or pitting of the contacts that would affect the intended function of the device.

5.25.2 For a separable jumper connector, the same test method described in Clauses [5.25.3](#) – [5.25.11](#) shall be used except the switch shall be replaced using the separable jumping connector and shall be only investigated as a single pole device.

5.25.3 The switch employing a separable terminal assembly shall be supported to allow without any interference mating and un-mating of the separable terminal assembly from the switch. The latching or locking mechanism used to secure both halves of the separable terminal assembly may be removed or defeated so as to permit the unrestricted connection and disconnection of the mating halves.

5.25.4 The switch employing a separable terminal assembly shall be wired to a test circuit capable of drawing 150 percent of rated current at 347 VAC, between separable halves of the terminal assembly.

5.25.5 The closed circuit test voltage shall be 95 to 105 percent of the 347 VAC terminal assembly rating.

5.25.6 The test shall be conducted using alternating current, with a power factor of 0.75 to 0.80.

5.25.7 The actuator of the single pole switch shall be placed in the on position to allow current flow.

5.25.8 In the case of a three-way switch, each set of contacts shall be subjected to the required abnormal testing. Three devices shall be tested with one set of contacts closed and three others shall be tested with the other set of contacts closed.

5.25.9 In the case of a four-way switch, each set of contacts shall be subjected to the required abnormal testing. This may be accomplished by wiring the switch in conjunction with two three-way switches with one set of contacts closed so that all four sets of contacts of the four-way switch are in the closed position

5.25.10 Mating halves of the separable terminal shall be inserted and withdrawn manually or mechanically while connected to a suitable load. Mating halves shall make and break the current for 10 cycles of operation at a rate not greater than 10 cycles/min. Contacts shall not be lubricated, or otherwise conditioned before or during the test.

5.25.11 The equipment-grounding path shall be connected to ground through a 15 A fuse.

5.26 Temperature Test

5.26.1 Following the abnormal overload test of Clause [5.25](#), the temperature rise of either a separable terminal assembly to a switch, or a separable terminal assembly to a separable jumper connector, shall not exceed 30°C (86°F) while continuously carrying the maximum rated current in any "on" position.

5.26.2 Temperatures shall be measured on the copper leads within 6 mm (0.24 in) from the point of entrance to the separable terminal assembly.

5.26.3 The temperature test may be conducted at any ambient temperature within the range of 10 – 40°C (50 – 104°F). The temperature test shall be conducted in open air at any convenient voltage, using either alternating or direct current.

5.26.4 Temperature readings shall be obtained by using thermocouples consisting of 28 – 32 AWG (0.08 – 0.032 mm²) iron and constantan wires. A temperature shall be considered to be constant when three successive readings, taken at 5-minute intervals, indicate no change.

5.27 Continuity Impedance Test

5.27.1 For a previously untested switch employing a separable terminal assembly, the voltage drop between the grounding conductor lead and wall plate shall not be greater than 4 V.

5.27.2 To determine whether a switch employing a separable terminal assembly complies with the requirement of Clause [5.27.1](#), a special purpose connector shall be attached to the switch as intended. The grounding lead of the special purpose connector shall be wired to a 60 H supply capable of continuously delivering 40 A, using 1.22 m (4 ft) of 12 AWG (3.3 mm²) copper wire. The test circuit shall be completed by securing an additional 1.22 m (4 ft) of 12 AWG (3.3 mm²) copper wire to a metallic wall plate (welded, bolted, etc.). The test circuit shall be closed on the assembly for 2 minutes. Immediately following the 2 minutes, the voltage measurement shall be recorded.

5.27.3 Immediately following the completion of the continuity impedance test, the same sample shall be subjected to the dielectric voltage withstand test as described in Clause [5.9.1.1](#), except the test potential shall be 3000 V.

5.28 Bonding (Fault Current) Test

5.28.1 When tested as described in Clauses [5.28.2](#) – [5.28.9](#), the cotton surrounding the flush switch with integral adjustable mounting yoke shall not ignite. Electrical continuity between the cover plate, mounting yoke or any other dead metal and the grounding terminal shall be maintained. The circuit breaker shall operate as a result of this test. See [5.28.9](#).

5.28.2 Twelve untested flush switches shall be tested. Six of the twelve shall be tested at the maximum adjustment position and six at the minimum adjustment position.

5.28.3 Each flush switch shall have a 1.22 m (4 ft) length of 12 AWG solid copper wire connected to the grounding terminal of the flush switch.

5.28.4 Each flush switch shall be mounted to a non-metallic outlet box using the mounting screws provided with the flush switch or steel flat-headed No. 6-32 mounting screws when mounting screws are not provided.

5.28.5 The non-metallic outlet box shall be secured to a simulated wall surface with the outlet box set back 6.4 mm (1/4 in) from the simulated wall surface. See [Figure 6](#).

5.28.6 The adjustable mounting means shall be adjusted to both the maximum and minimum position ten times.

5.28.7 Following the tenth cycle of adjustment, a metallic cover plate shall be secured to the flush switch as intended using the cover plate screws provided with the cover plate or steel flat-headed No. 6-32 screw of a suitable length capable of engaging at least two full threads. A 1.22 m (4 ft) length of 12 AWG stranded copper shall be connected to a ring terminal wire connector and secured under the head of a cover plate screw. The complete assembly shall be loosely covered with cotton. For a flush switch that employs a mounting means that is not integrally formed with the grounding terminal, the test shall be repeated where the ring terminal is connected under the head of the mounting screw.

5.28.8 The free ends of the conductors shall be connected to a source capable of delivering a test current of 1000 A at the flush switch's rated voltage to ground with a power factor of 75 to 80 percent. A circuit breaker intended for branch circuit protection of the same rating as the flush switch under test shall be installed in series with the conductor connected to the grounding terminal.

5.28.9 After subjecting each flush switch to one application of the test current, the cotton shall be examined for ignition. Electrical continuity between the cover plate, mounting yoke or any other dead metal and the grounding terminal shall be checked using an ohmmeter, battery-and-buzzer combination, or other similar indicating device.

5.29 Mounting Yoke Resistance Test

5.29.1 The total resistance between a metallic coverplate, mounting yoke or any other dead metal and the grounding terminal of a flush switch employing an integral adjustable mounting yoke shall not exceed $0.01\ \Omega$ when tested as described in Clauses [5.29.2](#) – [5.29.3](#).

5.29.2 Six previously untested flush switches shall be conditioned by tightening and loosening the adjustment screw, or screws if more than one is provided, or any other adjustment means to both the maximum and minimum position ten times.

5.29.3 Compliance with Clause [5.29.1](#) shall be determined by passing an alternating current of 22 A from a power supply of 12 V or less from a metallic cover plate and through the grounding terminal of the flush switch. The adjustment means shall be adjusted to a position resulting in the highest resistance available in the bonding path. The resulting drop in potential shall be measured between these two points. The resistance in ohms shall be determined by dividing the drop in potential in volts by the current in amperes passing between the two points. For a flush switch that employs a mounting means that is not integrally formed with the grounding terminal, the test shall be repeated between the mounting yoke or any other dead metal and the grounding terminal of the flush switch.

5.30 Combination Wire Binding/Pressure-Type Terminal Assembly Test

5.30.1 A flush switch employing combination wire binding/pressure-type terminals shall not exhibit:

- a) Damage to the switch, including but not limited to breakage of the housing or stripping of the terminal; and
- b) Visible displacement of the conductors following the pull test described in Clause [5.30.5](#).

5.30.2 A flush switch employing a combination wire binding/pressure-type terminal shall be wired as outlined in [Table 15](#).

Table 15
Terminal testing configurations

Terminal type	No. of devices	Terminals to be wired on each device
Combination wire-binding screw and pressure-wire terminal	1	Two pressure-wire terminals wired using Configuration No. 1 ^a
	1	Two pressure-wire terminals wired using Configuration No. 2 ^a
	1	Two pressure-wire terminals wired using Configuration No. 3 ^a

^a The wiring configurations are shown in [Figure 7](#).

5.30.3 Each terminal shall be wired with each conductor size and type as specified by the manufacturer. The conductors shall be wired by applying the tightening torque as specified in [Table 16](#) to the terminal screw. The wire shall be stripped to the length specified in the manufacturer's installation instructions. Terminals shall be wired by placing the stripped conductor into the terminal. The conductor shall be positioned to follow any wire guides or other openings provided to align the conductor with the back of the switch housing. The terminal screw shall be tightened with a clutch-type torque screwdriver which has

been calibrated and preset to release at the specified value. The switch shall comply with Clause [5.30.1](#) upon completion of this procedure.

Table 16
Terminal screw tightening torque

Screw size	Tightening torque – pound-inches (N·m)
No. 6 or less	12 (1.4)
No. 8 or greater	14 (1.6)

5.30.4 Each termination shall then be disassembled and the assembly and torquing repeated once using newly stripped wire. The switch shall comply with Clause [5.30.1](#) upon completion of this procedure.

5.30.5 Following the last torquing, each terminal shall be subjected to a straight 20-lbf (89-N) pull applied to each wire for 1 minute perpendicular to the plane of the back cover of the switch. The switch shall comply with Clause [5.30.1](#) upon completion of this procedure.

5.31 Inrush Current

5.31.1 A switch intended for general use with electronic ballasts, self-ballasted compact fluorescent lamps, and LED drivers shall be tested to withstand the ballast inrush current. The test shall be done with the synthetic load described in Clauses [5.31.2](#) – [5.31.4](#). The test shall consist of 10,000 cycles of operation, at a rate of operation of 6 – 10 cycles per minute.

Exception No. 1: For an ac-only door switch or ac-only through-cord switch, the number of cycles shall be 6000.

Exception No. 2: General-use AC only flush switches and self-contained snap switches rated up to 30 A at 347 VAC or less, that comply with the test requirements of Clause [5.7.8](#) for 120 V tungsten inrush at their rated current are considered to comply with this requirement.

5.31.2 The test circuit, as shown in [Figure 8](#), shall have inrush characteristics meeting or exceeding the requirements of [Table 17](#) in parallel with an AC resistive load based on the steady-state current rating of the switch being tested. Test methods using the circuit shown in [Figure 8](#) apply to loads such as ballasts or electronic devices with a maximum allowable input capacitance as specified in [Table 18](#) and not in excess of peak inrush current values in [Table 17](#).

Table 17
Peak inrush current values

Steady-state current, A	Peak current (120 VAC), A	Pulse width ^a (120 VAC), ms	I ² t (120 VAC), A ² /sec ^b	Peak current (277 VAC), A	Pulse width (277 VAC), ms ^a	I ² t (277 VAC), A ² /sec ^b	Peak current (347 VAC), A	Pulse width (347 VAC), ms ^c	I ² t (347 VAC), A ² /sec ^d
0.5	75	0.34	11	77	0.50	11	198	0.34	92
1	107	0.48	24	131	0.71	27	270	0.47	173
2	144	0.70	41	205	0.85	76	354	0.70	294
3	166	0.89	51	258	0.98	111	396	0.86	369
5	192	1.20	74	320	1.20	205	450	1.15	476
8	221	1.25	98	370	1.25	274	492	1.5	569

Table 17 Continued on Next Page

Table 17 Continued

Steady-state current, A	Peak current (120 VAC), A	Pulse width ^a (120 VAC), ms	I^2t (120 VAC), A ² /sec ^b	Peak current (277 VAC), A	Pulse width (277 VAC), ms ^a	I^2t (277 VAC), A ² /sec ^b	Peak current (347 VAC), A	Pulse width (347 VAC), ms ^c	I^2t (347 VAC), A ² /sec ^d
10	230	1.50	106	430	1.50	370	508	1.67	606
12	235	1.80	110	440	1.80	387	529	1.86	658
15	239	2.00	114	458	2.00	420	550	2.05	711
16	242	2.10	117	480	2.10	461	552	2.10	716

^a Pulse widths shown above are documented in Figures 3 through 14 of NEMA 410 and are adequate to use with electronic devices having pulse widths up to 2 ms, in accordance with ANSI C82.11 or ANSI C82.14.

^b The values used to calculate I^2t are the peak current shown above and a pulse duration of 2 ms (t).

^c Pulse widths shown above are documented in NEMA 410 and are adequate to use with electronic devices having pulse widths up to 2.35 ms, in accordance with ANSI C82.11 or ANSI C82.14.

^d The values used to calculate I^2t are the peak current shown above and a pulse duration of 2.35 ms (t).

Table 18
Maximum allowable input capacitance

System (VAC)	120	277	347
Bulk energy capacitance, μF per A of steady-state current	175	125	125

5.31.3 The series coil values shall be adjusted according to the characteristics of input line at the test laboratory so as to achieve the peak currents listed in [Table 17](#). The series coil shall be sized such that it does not saturate during testing and shall be able to handle the resulting power dissipation with less than a 10°C temperature rise. Peak inrush current amplitude and duration for each value of steady state current as specified in [Table 17](#).

5.31.4 The circuit shall have means of discharging the capacitor bank between test cycles without influencing the performance of the device under test. These means shall be a capacitor discharge switch and a bleeder resistor as shown in [Figure 8](#) (S2 and R2). The capacitor discharge switch should be switched alternately with the device under test, and the bleeder resistor should be sized to allow for complete discharge of the capacitor load bank during the period that the device under test is open.

5.31.5 Devices rated 20 A (or equivalent) for use on 20 A branch circuits shall be tested with a 16 A load, representing 80 percent of the branch circuit rating.

5.32 Field Replacement Actuator

5.32.1 A flush switch provided with a field replacement actuator shall not permit contact to be made between the probe shown in [Figure 10](#) and any live part when the actuator assembly is removed.

5.32.2 A flush switch with a field replacement actuator shall be supported with the actuator removed and cover plate installed. The probe shown in [Figure 10](#) is to be applied to any opening with a force of 8 ounces (2.2 N) in an attempt to contact live parts. A suitable indicating device (such as an ohmmeter, battery-and-buzzer combination, or similar device) is to be connected between the probe and the wiring terminals connected together. The flush switch actuating means shall be placed in any possible position to determine whether contact is made. The probe is to be manipulated in the opening areas in any orientation that may permit access to live parts within the flush switch.

6 Ratings

6.1 Switches shall be rated in amperes and volts. In addition, they may be rated in horsepower.

6.2 The ampere rating of switches shall be one of the ratings given in [Table 8](#) or [Table 19](#). If ampere ratings are given at two voltages, the switch shall have both ratings and shall be capable of performing successfully at both ratings in accordance with the requirements of this Standard. If only one ampere rating is given, the switch shall have only that rating.

6.3 An ampere rating on a general-use switch marked for appliance use in addition to its standard rating shall be considered a special use rating. A switch with a special use rating shall be judged on the basis of its compliance with the requirements in this Standard, insofar as they apply, and further appropriate tests in accordance with the applicable requirements in the Standard for Special Use Switches, CSA C22.2 No. 55, or Standard for Switches for Appliances – Part 1: General Requirements, UL 61058-1.

6.4 A general-use ac/dc switch may have an additional "T" rating at 125 V for a switch intended for the control of tungsten-filament lamps operating on direct current.

6.5 For two-circuit and three-circuit switches (including fan-motor and double-throw switches), the ampere rating of the switch shall not be greater than the minimum rating of any single pair of contacts in the switch, unless the ampere rating of each pair of contacts is indicated on the switch.

6.6 The marked horsepower rating of a general-use ac/dc or ac-only switch shall be 1/10, 1/8, 1/6, 1/4, 1/3, 1/2, 3/4, 1, 1-1/2, 2 hp, or an appropriate combination of such values at different voltages.

In Mexico, the marked horsepower rating of a general-use ac/dc or ac-only switch shall be 74,4 W (1/10 hp), 93,2 W (1/8 hp), 123,7 W (1/6 hp), 186,4 W (1/4 hp), 246 W (1/3 hp), 372,8 W (1/2 hp), 559,2 W (3/4 hp), 745,6 W (1 hp), 1 118,5 W (1-1/2 hp), 1 491,3 W (2 hp), or an appropriate combination of such values at different voltages.

6.7 The marked horsepower rating of a general-use ac/dc switch at any single voltage indicates that the switch is acceptable for that horsepower rating or less at that voltage only. If the 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.

In Mexico, the power may be measured in watts.

6.8 Instead of the horsepower ratings in Clause [6.6](#), switches may be rated in full load current and locked rotor current not to exceed the horsepower rating permitted in this Standard for the equivalent ampere and voltage ratings of the switch.

In Mexico, the power may be measured in watts.

6.9 An ac-only pendant switch shall be rated at 10, 15, 20, or 30 A at 120 VAC.

6.10 An ac-only door switch shall be rated either 3, 6, 10, or 15A at 120 VAC or in wattage as described in Clause [6.11](#).

6.11 An ac-only door switch if rated in wattage shall be rated minimum 300 W at 120 VAC only and marked as described in Clause [7.6.9](#).

6.12 An ac-only through-cord switch shall be rated at 1, 3, 6, 10 or 15A at 120 VAC.

7 Markings

7.1 General

7.1.1 A general-use switch, separable terminal assembly, and separable jumper connector shall be permanently and legibly marked with the following:

- a) The name, tradename, trademark, or other recognized symbol of the organization responsible for the product can be identified;
- b) The electrical ratings; and
- c) The catalog number or some suitable equivalent shall appear on the switch where practicable, or the smallest unit of package.

7.1.2 A general-use switch provided with No. 6 wire-binding terminal screw having heads less than 7.0 mm (0.276 inch) in diameter shall be marked, where readily visible during installation, 12 AWG (3.3 mm²) maximum or the equivalent.

7.1.3 An AC/DC switch rated 250 V that has been tested with full potential to ground in accordance with Clause [5.2.22](#)(b) shall be marked with the voltage rating 250 V (double underline).

7.1.4 The voltage rating of ac/dc switches rated 250 V that have been tested in accordance with the Note to Clause [5.2.22](#)(b) shall not be underlined, nor shall the switch be marked to indicate that they have been tested at full potential to ground.

7.1.5 All flush switches provided with separable terminal assembly shall be marked on the device where visible while in the mated condition "CAUTION: Do Not Connect or Disconnect Under Load" or an equivalent statement.

7.1.6 A separable jumper connector intended for use with a separable terminal assembly shall be marked on the device where visible while in the mated condition. "CAUTION: Do Not Connect or Disconnect Under Load" or an equivalent statement following the word "CAUTION".

7.1.7 All flush switches provided with separable terminal assembly shall be marked on both the flush switch and separable terminal assembly where visible during installation "USE ONLY WITH _____ SERIES DEVICES" or equivalent statement where the blank includes the manufacturer's name and product series designation.

7.1.8 A separable jumper connector intended for use with a separable terminal assembly shall be marked on the device where visible during installation "USE ONLY WITH _____ SERIES DEVICES" or equivalent statement, where the blank includes the manufacturer's name and product series designation.

7.1.9 A pendant or through-cord switch intended for assembly on flexible cord shall be provided with the following information, on the device or on its individual unit shipping carton:

- a) The intended types of flexible cord, (such as Types S, SJ, SJT, HPN, SPT, and the like). The cord identification may refer to the generic names for each family of cords (such as Hard Service Cord, Vacuum Cleaner Cord, Parallel Cord, and the like), if all types of cords identified in the family can be utilized with the device;
- b) The conductor size or sizes;
- c) The total number of conductors; and

- d) The overall cord diameter range, if the device is intended to be utilized within a limited range of the cord diameters available for a cord type.

Exception: If the switches are to be shipped for OEM assembly with more than one unit to a carton, the information may be provided on a stuffer sheet or on the smallest shipping carton.

7.1.10 The markings mentioned in Clause 7.1.5 may be combined in an abbreviated format (such as wire sizes 18/3 SV to 14/3 SJ, 0.230 – 0.450 inch diameter). The conductor sizes, total number of conductors, and overall diameters may be included individually or as a range with the appropriate cord types. Optionally, a wiring gauge in the form of die-punched holes or printed outlines may be included on the smallest unit carton.

7.1.11 In addition to the markings otherwise required, a pendant or through-cord switch that is made with pin-type (screwless) terminals intended for assembly on a flexible cord shall be provided with an instruction card. The switch shall be attached to the card in such fashion that it cannot be accidentally removed or torn free from the device during shipment, distribution, or normal handling. A blister package or an equivalent means of securing the material to the device may be used. Friction alone shall not be used for attaching the wiring device to an instruction card. The card shall be marked with:

- a) Instructions for assembling the device to the cord. Details shall be provided, which may include pictorial representation, to enable proper assembly by an inexperienced person.
- b) The word "CAUTION" and the following or the equivalent: "To reduce the risk of fire or electric shock, do not strip wires - Cut off end of cord cleanly," and any other specific instructions concerning cord preparation.
- c) Instructions concerning the cord type or types to be used. A description shall be provided of any type of cord that may not be physically excluded but which is not intended to be used (for example, "Not for use with Type TPT extra-flexible cord such as used on electric shavers"). There are some cord groups that are not distinguishable by marking and, where one of these cords is recommended, all must be capable of proper use or be physically excluded. Refer to Clause [4.11.4.1](#).
- d) Electrical rating (in volts and amperes or watts, as applicable) corresponding to the ampacity of the cord, if the current rating of the switch is greater than or equal to the ampacity of the cord. If more than one size or type of cord is intended to be used, the electrical rating shall be as indicated for each type cord. Any cord ampacity rating included in these instructions shall not be in excess of the switch rating.

Exception: Pendant or through-cord switches employing pin-type (screwless) terminals that are packed for OEM assembly and that are not field-wireable need not be provided with individual instruction cards. The above required information may be provided on the smallest unit shipping carton, which shall be additionally marked "For OEM Assembly On Flexible Cords Only."

7.1.12 A flush switch rated 20 A or less and employing a combination wire binding/pressure-type terminal shall be provided with installation instructions for assembly of conductors to the terminals. These instructions shall include a pictorial representation of the placement of the stripped conductor within the channels/guides of the body. The instructions shall be attached to the switch in such fashion that they cannot be accidentally removed or torn free from the flush switch during shipment, distribution, or normal handling. A blister package or an equivalent means of securing the installation instructions to the switch may be used. Friction alone shall not be used for attaching the installation instructions to the flush switch. The installation instructions may appear on a stuffer sheet packaged with each individual switch or printed on its individual unit shipping carton.

7.1.13 A general-use snap switch with wiring terminals shall be provided with the manufacturer's recommended terminal tightening torque. These instructions shall appear on the device where visible during installation, on the smallest unit container, or on an information sheet packed in the smallest unit container.

7.1.14 In Canada, a flush-type switch may be marked on the device, individual package, label, or its instruction sheet with the following or equivalent:

"In Canada, a flush-type switch does not require attachment to a grounding/bonding wire when installed in a grounded/bonded flush device box"

7.1.15 An individually packaged field replacement actuator as described in Clause 4.9A shall be provided with instructions for the proper removal and reattachment to the flush switch.

7.1.16 An individually packaged field replacement actuator shall include "USE ONLY WITH _____ FLUSH SWITCHES" or equivalent statement where the blank includes the manufacturer's name and product series or type designation or an equivalent identifier.

7.2 Supplementary Markings

7.2.1 In addition to the ratings given in Table 19, a general-use ac switch may be marked with a supplementary rating as follows: "For motor loads of (A) full load amps. max. and not more than (B) or equivalent." The values of (A) and (B) to be inserted in the above statement shall be in accordance with Table 20. The marking shall appear on the switch, on a tag attached to the switch, on the smallest unit carton, or on a sheet packaged with each switch.

Table 19
Switch ampere ratings for various voltages

(see Clause 5.2.14, 6.2, 7.2.1)

AC-only rating			AC/DC rating			
			Ampere rating, A voltage, dc			
Ampere rating A	Voltage ac, V	Maximum full load motor current A	Rating designation	125 V	250 V	600 V
15	120	12	A	—	—	1
20	120	16	B ^b	3 ^c	1 ^c	—
30	120	24	C	—	—	2
15	120 – 277 ^{a,e}	12	D ^b	5 ^c	2 ^c	—
20	120 – 277 ^{a,e}	16	E	—	—	3
30	120 – 277 ^{a,e}	24	F	5 ^c or 6 ^c	3 ^c	—
20/15	120 – 277 ^{a,e}	16/12	G	—	5	3
30/15	120 – 277 ^{a,e}	24/12	H	—	—	5
30/20	120 – 277 ^{a,e}	24/16	I	—	5 ^c	—
15	347	Not applicable ^d	J	10 ^c	5 ^c	—
20	347	Not applicable ^d	K	—	10	5
30	347	Not applicable ^d	L	—	—	10

Table 19 Continued on Next Page

Table 19 Continued

AC-only rating			AC/DC rating			
			Ampere rating, A voltage, dc			
Ampere rating A	Voltage ac, V	Maximum full load motor current A	Rating designation	125 V	250 V	600 V
			M	—	10 ^c	—
			N	20 ^c	10 ^c	—
			O	—	20	10
			P	—	—	20
			Q	—	20 ^c	—
			R	30 ^c	20	—
			S	40 ^c	20 ^c	—
			T	—	30	20
			U	—	—	30
			V	—	30 ^c	—
			W	60 ^c	30 ^c	—
			X	—	60	—

^a Switches rated 120 – 277 V ac are acceptable for use on motor circuits up to the ampere ratings shown, at any voltage between 120 and 277 V ac.

^b Ratings B and D apply only to 3-way, 4-way, 2-circuit, 3-circuit, or fixture switches.

^c The current rating indicated may be used as the current rating for an additional "T" rating, at 125 V.

^d Not intended for motor loads.

^e Switches rated as 120 – 277 V AC ONLY that incorporate locator indicators (indicator lamp ON if load switched OFF) or pilot indicators (indicator lamp ON solely if load switched ON) may be marked with restricted voltage ratings (e.g., "208 V", "240 V", "277 V", "120 V OR 277 V") or with restricted voltage ranges (e.g., "120 – 208 V", "120 – 240 V", "208 V – 277 V", "240 – 277 V") instead of the full "120 – 277 V" range, to optimize indicator lamp brightness or indicator lamp life or, for pilot indicators, to omit those supply voltages that inherently do not present grounded (neutral) conductors.

Table 20
Values for marking in supplementary rating

(see Clause 7.2.1)

Switch rating		Supplementary rating	
Amperes	Volts	A	B
15	120	12	1/2 hp
15	120 – 277 ^a	12	1/2 hp, 120 V ^a ; 2 hp, 240 V ^a
15	277	12	2 hp, 277 V
20	120	16	1 hp
20	120 – 277 ^a	16	1 hp, 120 V ^a ; 2 hp, 240 V ^a
20	277	16	2 hp, 277 V
30	120	24	2 hp
30	120 – 277 ^a	24	2 hp ^a
30	277	24	2 hp

^a Switches rated as 120 – 277 V AC ONLY that incorporate locator indicators (indicator lamp ON if load switched OFF) or pilot indicators (indicator lamp ON solely if load switched ON) may be marked with restricted voltage ratings (e.g., "208 V", "240 V", "277 V", "120 V OR 277 V") or with restricted voltage ranges (e.g., "120 – 208 V", "120 – 240 V", "208 V – 277 V", "240 – 277 V") instead of the full "120 – 277 V" range, to optimize indicator lamp brightness or indicator lamp life or, for pilot indicators, to omit those supply voltages that inherently do not present grounded (neutral) conductors.

7.2.2 A switch having push-in (screwless) terminals shall be marked:

- a) Where readily visible during installation, with instructions for connecting acceptably sized wire;
- b) Where readily visible during wiring and rewiring, with instructions for disconnecting a wire from the terminal;
- c) To specify use with "No. 14 AWG solid copper wire only"; and
- d) Where readily visible during installation, with instruction to strip the insulation from conductors a specific length.

7.2.2A Switches employing spring-action clamp terminals shall be provided with installation instructions for assembly of conductors to the terminals. The proper insulation strip length shall be marked either on the device or identified in the individually packaged instruction. Instructions shall include a pictorial description of the placement of the stripped conductor within the channels/guides of the enclosure. The installation instructions shall be provided on the smallest unit container, or on a stuffer sheet provided with each device.

7.2.3 A general-use switch that is intended for the control of more than a single circuit shall be marked to indicate the number of circuits that may be accommodated. In addition, a circuit diagram showing the intended multiple connections shall be provided either on the switch, the smallest carton in which the switch is packaged, on the card in the case of a blister pack, or on a stuffer sheet packaged with the switch.

7.2.4 A general-use switch that is intended for the control of two or three circuits shall be marked "(2 or 3) Circuit Switch – 240 V max between circuits", or equivalent. In addition, a circuit diagram showing the intended multiple connections shall be provided either on the switch, the smallest carton in which the switch is packaged, on the card in the case of a blister pack, or on a stuffer sheet packaged with each individual switch.

7.2.5 An AC-only general-use switch that incorporates a pilot indicator and an associated terminal intended for connection to the grounded circuit conductor shall be clearly and permanently identified on the device at that terminal by

- (a) A wire-binding screw of white metal or plating on a circular screw head;
- (b) A visible pressure wire terminal of white metal or plating on the connector;
- (c) A concealed pressure wire terminal having a distinct white-colored surface adjacent to the wire entrance hole, or the word "white", or the letter "W" distinctively marked adjacent to the wire entrance hole;
- (d) A terminal plate of white metal or plating;
- (e) An insulating enclosure or terminal having the word "white" or the letter "W", marked on or directly adjacent to the terminal, or white metal or plating on the terminal;
- (f) A wire lead having a braid of solid white or gray color (without tracer); or,
- (g) A wire lead having insulation of solid white or gray color, or striped white or gray on contrasting color other than green.

7.3 Location

7.3.1 The marking specified in Clause [7.1.1](#) (for general-use switches) shall be located so that it will be readily visible after the switch is installed. Plaster ears (whether separate pieces or integral with the

mounting means) and fiber linings shall not carry the identifying marking or the electrical rating of the switch, unless such marking or rating, or both, also appear elsewhere on the switch.

7.3.2 The marking may be applied as follows:

- a) On the sub-plate or mounting yoke for flush type switches;
- b) On the inside of the plate or cover for a switch that has an integral flush plate or outlet-box cover of insulating material;
- c) On a modular switch that is intended for installation in a separate mounting yoke, on the body of the switch; or
- d) On the inside of the plate or cover for surface type switches having a detachable cover of porcelain or other insulating material;

The manufacturer's trademark may be on the push buttons or on the rotary or toggle handles of the switches.

7.3.3 Markings and instructions that are alternatively permitted on a stuffer sheet, information sheet etc. may be provided via a manufacturer's web site. The web address shall be marked on the device, packaging and/or information sheet. The web address may be in the form of a Uniform Resource Locator (URL – http://www.____.com/____/), or as a Quick Response Code (QRcode). This does not apply to markings that are specified to be located on the device or the packaging/container only (not a stuffer sheet), but this information may be repeated on the web site.

7.4 Tungsten

7.4.1 An ac/dc switch intended for the control of tungsten-filament lamps shall be marked with the letter "T," located to indicate that it applies only to the rating at 125 V.

7.4.2 An ac/dc 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.

7.5 AC-Only Identification

7.5.1 A general-use switch that is intended for use only on alternating-current circuits shall be identified as such by means of the letters "AC" or "~" or frequency marking (for example, "60 hertz") or a phase marking, which shall be a part of the electrical ratings.

In Mexico, a general-use switch that is intended for use only on alternating-current circuits shall be identified as such by means of the symbol "~" or frequency marking (for example, "60 hertz") or the letters "AC" or "ca", or a phase marking, which shall be a part of the electrical ratings.

7.6 Switch Termination Restrictions

7.6.1 A switch rated 20 A or less that is not marked "CO/ALR" and that has provisions for mounting to a standard outlet box shall be marked as indicated in Clause 7.6.2. This requirement applies only to devices with wire-binding screws, back wired pressure plates (clamp terminals), and/or push-in terminals.

7.6.2 The switch, individual package label, or instruction sheet shall be marked with one of the following, or its equivalent:

- a) "Notice – Use only copper or copper-clad wire with this device;"

- b) "Notice – Connect only copper or copper-clad wire to this device;"
- c) "Notice – Use only devices marked CO/ALR with aluminum wire"; or
- d) "Caution – Use with copper wire only."

Exception: If the device itself carries the marking, one of the abbreviated markings in Clause 7.6.4 may be used.

7.6.3 The marking in Clause 7.6.2 shall be located as follows:

- a) For individually packaged devices, the marking shall appear on the device, a stuffer sheet, a removable label or tag attached to each device, or the device carton.
- b) For OEM-shipped devices, the marking shall be on the device. For the purpose of this requirement, "OEM-shipped" is defined as any carton having more than one device, except for individual packages containing two devices intended for sale directly to the user.

7.6.4 If the marking required in Clause 7.6.1 appears on the device, one of the abbreviated markings shown below may be used to indicate that the switch is for use with either copper or copper-clad wire. The marking shall be legible, with letters at least 1.6 mm (1/16 inch) high.

- a) "Use copper wire only";
- b) "Cu wire only";
- c) "Use copper or copper-clad wire only"; or
- d) "Cu and Cu-clad wire only"; and
- e) The symbol shown in Figure 3.

7.6.5 When molded, the circles and bar of the marking described in Figure 3 shall be formed by lines that have twice the width and thickness of the lines used for the letters "CU" and "AL" within the circles.

7.6.6 Other methods of marking, (i.e., die stamping, labeling, or other contrasting method) may be used, provided an equivalent prominence is achieved.

7.6.7 In all cases, the marking required in Clauses 7.6.1 – 7.6.6 shall have greater prominence than any other marking, unless the other marking is also a required caution marking, in which case they shall have equal prominence.

7.6.8 An individually packaged general-use snap switch as described in Clause 4.5.3.20 shall be provided with instructions for the proper use of the pressure cable connectors furnished with the product. These instructions shall include:

- a) The proper insulation strip length;
- b) The wire sizes and combinations intended to be joined for proper application of the switch;
- c) The phrase "Suitable for dry locations only," or the equivalent, if an AL-CU wire connector is provided; and
- d) The phrase "Suitable for use with copper wire only," or the equivalent, if a copper wire connector is provided.

These instructions shall appear directly on the package or on a sheet to be included in the package.

7.6.9 An AC-only door switch, if rated in wattage, shall be marked where visible after installation with the words "For use with incandescent lighting only".

7.6.10 An AC switch rated 347V, or a three-position or momentary contact ac switch not intended for the control of incandescent luminaries, shall be clearly marked with the following or equivalent wording:

"CAUTION: NOT FOR CONTROL OF INCANDESCENT LUMINARIES" and

"ATTENTION: PAS POUR LA COMMANDE DE LUMINARIES A INCANDESCENCE" or, alternatively, with the symbol shown in [Figure 4](#).

7.6.11 When molded, the circle and bar of the marking described in [Figure 4](#) shall be formed by lines that have twice the width and thickness of the lines used for the lightbulb within the circle.

7.6.12 Other methods of marking, i.e., die stamping, labeling, or other contrasting method, may be used provided an equivalent prominence is achieved.

7.6.13 In all cases, the marking required in Clauses [7.6.9](#) – [7.6.12](#) shall have greater prominence than any other marking, unless the other marking is also a required caution marking, in which case they shall have equal prominence.

In Mexico, Clauses [7.6.1](#) – [7.6.13](#) do not apply.

7.6.14 In addition to the markings otherwise required, door switches shall be provided with installation instructions. These instructions shall be provided with each switch and shall contain the following information.

- a) The rough dimensions necessary to mount and secure the special switch box;
- b) The branch circuit conductor size in AWG to be used to attach the switch leads; and
- c) The maximum number of conductors the special switch box can accommodate.

The instructions shall also indicate that the special switch box is only intended to function as an enclosure to terminate the switch leads and is not intended for feed-through applications or to serve as a junction box.

7.6.15 Switches that are marked "OFF" shall completely disconnect all ungrounded conductors in the circuit when in the "OFF" (open) position. Switches that do not disconnect all ungrounded conductors, including switches that incorporate in-line components, such as neon indicators, that pass current through the load when the switch is in the open position, shall not be marked "OFF".

7.7 For Use with Electronic Ballasts

7.7.1 A general-use switch that is intended for the control of electronic ballasts, self-ballasted compact fluorescent lamps, and LED drivers, tested in accordance with Clause [5.31.1](#), shall be permanently and legibly marked with the statement "For Control of Electronic Ballast, CFLs, and LED drivers" or the equivalent. The marking shall also be provided on the packaging and instruction sheet. The mark "ELB" is acceptable.

Exception: General-use AC only flush switches and self-contained snap switches rated up to 30 A at 347 VAC or less, that are required to comply with Clause [5.31.1](#) need not be marked on the product.

8 Self-Contained Switches for Use Without a Separate Outlet Box

8.1 General

8.1.1 The requirements in Clauses [8.2](#) – [8.4](#) are applicable to self-contained general-use switches rated 15 A and 20 A, 125 V and 250 V, for flush mounting without a separate outlet-box and for connection to one or more nonmetallic sheathed cables containing copper conductors. They are for use in accordance with the National Electrical Code or CE Code Part I and primarily used in mobile homes, recreational vehicles, manufactured buildings, and on-site frame construction.

8.2 Construction

8.2.1 General

8.2.1.1 Self-contained switches shall comply with the applicable construction requirements of this Standard as modified by the requirements in Clauses [8.2.2](#) – [8.2.7](#).

8.2.2 Spacings

8.2.2.1 The spacings maintained between live parts of opposite polarity and between live parts and identified (grounded) metal parts shall be at least 1.6 mm (1/16 inch) through air and 3.2 mm (1/8 inch) over surfaces.

8.2.3 Insulation Material

8.2.3.1 The material used for the support, insulation, and overall enclosure of live parts and cable from which any part of the cable covering has been removed shall be either one of the materials in [Table 21](#) or another insulating material determined to be acceptable by means of an investigation which shall include the following requirements:

- a) The material shall have a temperature index of at least 80°C (176°F) at the thickness used, or the equivalent.
- b) The enclosure material shall have a high-ampere arc ignition (HAI) index of at least 30 arcs and a hot wire ignition (HWI) index of at least 15 seconds.
- c) The enclosure material shall have a minimum V-2 flammability classification or comply with the requirements of the specimen flammability test, Clause [8.3.11](#).

Table 21
Insulating materials

(see Clause [8.2.3.1](#), [8.3.11.1](#))

Material: Generic name	
Molded Phenolic ^a	Molded Alkyd ^a
Molded Melamine ^a	Molded Epoxy ^{a,b}
Molded Melamine-Phenolic ^a	Molded Diallyl Phthalate ^a
Urea Formaldehyde ^a	Molded Polyester ^{a,b}
^a Includes materials having filler systems of fibrous (other than synthetic organic) types, but excludes fiber reinforcement systems using resins which are applied in a liquid form.	
^b Includes heat- and pressure-molded types only, not those intended for casting or pouring.	

8.2.4 Enclosure

8.2.4.1 All current-carrying parts and that part of the cable from which any part of the covering has been removed shall be fully enclosed in the insulating body. This does not preclude cable openings to be filled in use or assembly joints designed to butt.

8.2.4.2 The overall insulating enclosure shall be at least 2.54 mm (0.100 inch) thick or a thickness determined to be acceptable for the material when used as the enclosure of an outlet box.

Exception No. 1: Knockouts to be removed for the installation of cable may have a reduced thickness, but shall comply with the knockouts test, Clause [8.3.8](#).

Exception No. 2: An enclosure less than 2.54 mm (0.100 in) thick in the receptacle outlet face or internal barriers that do not form part of the enclosure that is equivalent to an outlet box or flush device cover plate is not prohibited.

Exception No. 3: An enclosure less than 2.54 mm (0.100 in) thick in the areas that form part of the enclosure that is equivalent to an outlet box or flush device cover plate is not prohibited when it complies with the 3/4 inch-flame outlet box flammability test in the Standard for Non-Metallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C.

Exception No. 4: An enclosure less than 2.54 mm (0.100 in) thick in the areas that form part of the enclosure that is equivalent to an outlet box or flush device cover plate is not prohibited when it complies with the flame penetration and flammability tests in the Standard for Cover Plates for Flush-Mounted Wiring Devices, UL 514 D, and CSA C22.2 No. 42.1, Cover Plates for Flush-Mounted Wiring Devices. The flame penetration and flammability tests shall be conducted with 102 x 102 mm (4 x 4 in) square or 114 mm (4.5 in) diameter specimens of the enclosure material. The thickness of the specimens shall be equal to the minimum thickness of the enclosure in the areas that form the part of the enclosure that is equivalent to an outlet box or flush device cover plate.

8.2.5 Mounting Means

8.2.5.1 A self-contained switch shall be provided with a means for mounting to walls or to frame construction brackets.

8.2.5.2 Brackets for mounting a self-contained switch shall not have holes located such that a standard flush device may be readily mounted to the bracket.

8.2.5.3 Self-contained switches shall be constructed so that they cannot readily be mounted in a standard flush-device box using the two threaded openings in the box provided for mounting conventional flush devices.

8.2.5.4 A self-contained device intended for flush installation may be provided with a mounting bracket for fastening the device to a structural member in the walls of the frame construction. The mounting bracket shall either be constructed integral with the device or packaged with the device along with the installation instructions.

8.2.6 Frame-Construction Mounting Brackets

8.2.6.1 Mounting brackets used to fasten self-contained switches to studs or joists of frame construction shall comply with all of the following provisions:

- a) The support or mounting means shall be outside the enclosed interior of the insulating body of the self-contained switch.

b) Ferrous material other than stainless steel shall be protected against corrosion with a zinc coating having a minimum thickness of 0.013 mm (0.0005 inch) or its equivalent. Cut edges and tapped openings need not be protected.

c) A means shall be provided for the temporary retention of the nonmetallic sheathed cable at the bracket so that the cable will be accessible during installation of the self-contained switch. Clips or open hooks integral with the bracket may be used.

8.2.6.2 The mounting bracket used shall also comply with the mounting strength test, Clause [8.3.5](#).

8.2.7 Field Replacement

8.2.7.1 Switches marketed as replacement devices shall be capable of installation without the use of special tools.

8.2.7.2 Those switches which require replacement with specific devices of similar construction shall be marked to include the information indicated in Clause [8.4.1.2](#).

8.3 Performance Testing

8.3.1 General

8.3.1.1 The performance tests described in Clauses [8.3.2](#) – [8.3.11](#) are in addition to the applicable tests specified elsewhere in this Standard. Among the tests applicable to self-contained switches are the overload, endurance, temperature, and dielectric voltage-withstand tests described in Clauses [5.6](#), [5.7](#), [5.8](#), and [5.9](#), respectively.

8.3.1.2 For self-contained switches employing insulation displacement terminals, the temperature test, Clause [5.8](#), shall be performed after the cable pullout test, Clause [8.3.3](#).

8.3.2 Heat cycling and vibration test

8.3.2.1 General

8.3.2.1.1 Following the heat cycling and vibration tests described in this Clause, each switch shall:

- a) Comply with the thermal stability criteria described in Clause [8.3.2.4.1](#); and
- b) Not have a temperature rise of more than 100°C (180°F).

Exception: Self-contained switches for connection only to copper wire employing crimp, screw-terminal, or pressure-wire connector constructions need not be tested for heat cycling or vibration.

8.3.2.1.2 Ten self-contained switches rated 15 A shall be assembled onto a two-conductor 14 AWG (2.1 mm²) nonmetallic sheathed cable with ground and copper conductors. Ten devices rated 20 A shall be assembled onto a two-conductor 12 AWG (3.3 mm²) nonmetallic sheathed cable with ground and copper conductors. For a non-identified (non-grounded) 3-way switch, the ground conductor shall be assembled as indicated in the installation instructions.

8.3.2.1.3 The switches shall be connected with 610 to 686 mm (24 to 27 inches) of cable between each device and wired in series so that the test current passes through the connection point of the entering conductor, the device internal structure, and the exiting conductor. See Clauses [8.3.2.2.2](#) and [8.3.2.2.3](#) for a description of splice and nonsplice connection. See Clauses [8.3.2.3.1](#) – [8.3.2.3.6](#) for devices to be subjected to the vibration test.

8.3.2.2 Heat Cycling Test

8.3.2.2.1 Each heating cycle shall consist of 1-1/2 hours "on" time and 1/2 hour "off" time, with a total of 500 cycles on each device. The test current shall be 53 A for those devices being tested with 12 AWG (3.3 mm²) cable and 40 A for those devices being tested with 14 AWG (2.1 mm²) cable.

8.3.2.2.2 The temperature rises shall be measured using thermocouples placed on the internal wire termination structure, as close as practicable to the wire termination point. If the construction of the device is such that splicing connections are intended (see manufacturer's instructions), all devices shall be so wired, using the minimum number of possible connection points for each wire (a splicing connector is where the incoming wires terminate in the device and a second set of conductors originate in the same device).

8.3.2.2.3 If a splicing connection is not intended, modified devices may be necessary so that unrelated variables will not influence the test results. For example, the line and neutral wire terminations may be jumped by a 14 AWG (2.1 mm²) copper wire soldered in place or 12 AWG (3.3 mm²) copper wire for devices tested with 12 AWG (3.3 mm²) wire, or an equivalent means. Modifications shall not provide any increase in overall thermal or electrical conductivity, mechanical strength, and so forth, beyond that of the basic unmodified device construction.

8.3.2.2.4 The temperature of the conductors shall be recorded at the following intervals, which may be approximate:

- a) Beginning with the 25th cycle and every 25 cycles thereafter for a total of five measurements (125 cycles);
- b) Continuing with the 40th cycle and every 40 cycles thereafter for a total of three measurements (120 cycles); and
- c) Continuing with the 80th cycle and every 80 cycles thereafter for a total of three measurements (240 cycles).

This yields a total of 11 data points for each device tested. Temperature measurements shall be accomplished by using thermocouples with a temperature-indicating instrument. See Clause [5.8.1.6](#) for thermocouple details.

8.3.2.3 Vibration Test

8.3.2.3.1 Following approximately 125 cycles of heat cycling (as described in Clauses [8.3.2.2.1](#) – [8.3.2.2.4](#)), six devices from each group of ten (for a total of 12 devices) shall be disconnected from their circuit and subjected to vibration conditioning.

8.3.2.3.2 Five of each six devices shall be mounted (prior to the start of the heat cycling test) to a special test rack constructed of cast-iron angles not smaller than 3.2 by 31.8 by 31.8 mm (1/8 by 1-1/4 by 1-1/4 inch) welded to form a rigid assembly. Mounting holes shall be provided for attachment to the vibration platform. Insulating strips or clamps shall be provided to secure the wires between devices at 152 – 203 mm (6 – 8 inches) from the point at which they exit the device, and located in the same plane as the mounting means for the device.

8.3.2.3.3 The devices shall be rigidly mounted to the fixture by their mounting means. Equivalent methods of mounting such as bolting or clamping the devices to the frame may be used.

8.3.2.3.4 The sixth device of each group shall be mounted by its normal mounting means in the center of a 533 mm square (21 inch square) piece of panel board having the minimum intended thickness for use with the device. The panel board shall then be bolted to a test rack similar to that described in previous

paragraphs, but sized so that the panel board is supported around its periphery [approximately 52 mm (21 inches) on each side]. Clearance holes through the test rack shall be provided for the test wires opposite where they exit the device. No additional support for the test wire shall be provided.

8.3.2.3.5 Each device shall then be subjected to the following vibration conditioning:

- a) Simple harmonic motion of amplitude 0.75 mm (0.03 inch) [1.5 mm (0.06 inch) peak-to-peak] with the frequency varied uniformly between 10 and 55 and back to 10 cycles per second in one minute; and
- b) Vibration applied for two hours in each of three mutually perpendicular directions for a total of 6 hours of testing.

8.3.2.3.6 At the conclusion of the vibration test described in Clauses [8.3.2.3.1](#) – [8.3.2.3.5](#), all test devices shall be reconnected to their respective circuits to complete the remaining 375 cycles of the heat cycling test (for a total of 500 cycles).

8.3.2.4 Calculations

8.3.2.4.1 The thermal stability shall be evaluated as follows: for each thermocouple location, find the average temperature rise for all 11 data points obtained (from Clause [8.3.2.2.4](#)) and find the deviation of each of the 11 data points from the calculated average. None of the 11 data points shall deviate above the average temperature by more than 10°C (18°F). There shall not be a temperature rise greater than 100°C (180°F) above the room ambient temperature on any device during the heat cycling test.

8.3.3 Cable Pullout Test

8.3.3.1 After being subjected to the cable pullout test described in Clause [8.3.3.2](#), there shall not be:

- a) Any visible indication of conductor pullout;
- b) Damage to the cable insulation; and
- c) Any loosening of the assembly that would enable the cable to be removed by flexing or bending following the removal of the test force.

8.3.3.2 Six switches rated 15 A shall be installed onto two-conductor 14 AWG (2.1 mm²) copper cable with ground, and six switches rated 20 A installed onto 12 AWG (3.3 mm²) copper cable with ground. The cable installation shall be in accordance with the manufacturer's instructions. Wiring terminals having a screw-actuated clamping means shall be fully tightened and then loosened one full turn before application of the test force. Each cable shall then be subjected to a 267 N (60 lbf) applied perpendicular to the plane of the cable entrance (along the wire) for five minutes. Devices shall be rigidly supported by their mounting means during testing. For a non-identified (non-grounded) 3-way switch, the ground conductor shall be assembled as indicated in the installation instructions.

8.3.4 Conductor Pullout Test

8.3.4.1 Following the test pull described in Clause [8.3.4.2](#), no conductor shall be displaced from its connection(s).

8.3.4.2 Three devices of a device rated 15 A shall be installed with a single copper conductor 14 AWG (2.1 mm²) (Type TW) connected to each terminal. Three devices rated 20 A shall be similarly installed, but with a single 12 AWG (3.3 mm²) copper Type TW conductor connected to each terminal. Each conductor shall be subjected to a pull of 89.0 N (20 lbf) gradually applied perpendicular to the plane of the wire

entrance hole (along the wire) and sustained for 1 minute. Any parts necessary for proper installation of wire in the termination shall be used.

8.3.5 Mounting Strength Test

8.3.5.1 General

8.3.5.1.1 Following the test in Clause [8.3.5.4.1](#), each switch shall not experience:

- a) A permanent displacement of more than 3.2 mm (1/8 inch) from the plane of the wall; or
- b) Any damage that might adversely affect the intended function of the device.

8.3.5.2 Switches Mounted Directly in Panels

8.3.5.2.1 Six devices of a self-contained switch that is intended to be directly mounted in paneling shall be installed in a test wall made using paneling of the minimum thickness for which the device is intended. The paneling shall be supported (typically with a stud) 152 mm (6 inches) from one edge of the opening in which the device is to be installed. Each of the switches shall then be tested as described in Clause [8.3.5.4.1](#).

8.3.5.3 Switches Supported by Mounting Brackets

8.3.5.3.1 Six devices of a self-contained switch that is intended to be supported from a frame construction mounting bracket shall be installed and tested as described in Clause [8.3.5.4.1](#).

8.3.5.4 Testing

8.3.5.4.1 Testing shall be accomplished as follows:

- a) A 222 N (50 lbf) shall be applied for a period of 5 minutes to each of two devices in a direction perpendicular to the face of the mounting surface along the center line of the switch, tending to push it into the mounting opening,
- b) A 222 N (50 lbf) shall be applied to two previously untested switches as described in (a) above, but in the opposite direction (tending to pull the switch out of the opening),
- c) A 267 N (60 lbf) shall be applied to the nonmetallic sheathed cable of each of two previously untested devices in a downward direction from where the cables exit.

8.3.6 Field Replacement with Conventional Outlet Box and Switch

8.3.6.1 A self-contained switch that is intended to be replaced in the field with a conventional outlet box and switch shall be installed on a typical wall panel of the minimum thickness intended in accordance with the manufacturer's instructions. The self-contained switch shall then be removed from the wall. A conventional outlet box and switch shall then be installed.

8.3.6.2 Installation of the conventional outlet box and switch shall be readily accomplished by using wall support tabs furnished with the box or "old work" brackets. The opening in the wall around the replacement outlet box shall be such that it is entirely covered when a standard-sized, not oversized, flush plate is installed.

8.3.7 Fault Current Withstand Test

8.3.7.1 When subjected to the fault current withstand test described in Clause [8.3.7.2](#):

- a) There shall not be any damage to the cable that could render it incapable of being used in the installation of a similar self-contained replacement-type switch, or a conventional outlet box and switch; and
- b) The circuit breaker or fuse shall operate in each case.

8.3.7.2 Typical installations of the self-contained switch shall be made in the intended manner, using the maximum and minimum cables (conductor sizes). The switch contacts shall be bypassed by a short length of the same size conductor soldered, welded, or otherwise secured in place. Each installed device shall be connected using 1.22 m (4 feet) of the maximum size wire to a 60 Hz power supply capable of delivering 1000 A at 120 V when the system is short-circuited at the test terminals. The test circuit shall have a thermal-type circuit breaker or an inverse-time molded-case-type circuit breaker connected in one unidentified (ungrounded) line between the test terminals and the switch. The breaker rating shall correspond to the rating of the wire used in the test. Each of three devices shall be tested by applying the test current to the device by means of a suitable switching device. This procedure shall then be repeated on the same devices using a 200 A, 120 V, circuit.

8.3.8 Knockouts Test

8.3.8.1 Knockouts shall remain intact when subjected to a 44.5 N (10 lbf) force for one minute applied perpendicular to the plane of the knockout. The force shall be applied by means of a mandrel, with a 6.4 mm (1/4 inch) diameter flat end, at the point considered most likely to displace the knockout.

8.3.8.2 Knockouts shall be readily removable without breakage of the insulating body of the enclosure or sharp edges becoming present. Knockouts shall be displaced by means of a screwdriver or by using other conventional tools.

8.3.9 Creep Test

8.3.9.1 Self-contained switches shall be capable of withstanding the cable pullout test, Clause [8.3.3](#), following the oven conditioning described in Clause [8.3.9.2](#).

8.3.9.2 Six devices of a self-contained switch employing thermoplastic material shall be assembled as a splice installation onto nonmetallic sheathed cable of the maximum AWG size conductor intended for use. Each device shall then be conditioned in a circulating-air oven for 300 hours at 90°C (194°F).

8.3.10 Mold Stress Test

8.3.10.1 Following the aging conditioning described in Clause [8.3.10.2](#), there shall not be:

- a) Change in any overall dimension greater than 10 percent; and
- b) An opening larger than 0.8 mm (1/32 inch) at any joint once the device has cooled to room temperature.

8.3.10.2 Six devices of self-contained switches employing thermoplastic material, unassembled and without the cable installed, shall be conditioned in a circulating-air oven for a period of 7 hours at 90°C (194°F). Upon cooling to room temperature, the openings shall be measured after installation on cable as intended.

8.3.11 Specimen Flammability Test

8.3.11.1 Insulating materials of a self-contained switch other than the materials specified in [Table 21](#) shall be subjected to this test. A total of fifteen specimens for each material shall be tested as follows:

- a) Five in an as-received state tested under the conditions described in [Clause 8.3.11.2](#);
- b) Five following seven days of conditioning in an circulating-air oven at $90.0 \pm 1.0^{\circ}\text{C}$ ($194.0 \pm 1.8^{\circ}\text{F}$), tested under the condition described in [Clause 8.3.11.2](#); and
- c) Five in an as-received state-tested under the conditions described in [Clause 8.3.11.3](#).

8.3.11.2 When tested as described for V-2 material in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94 or CSA C22.2 No. 0.17, each 127 by 12.7 mm (5.0 by 0.50 inch) specimen shall not burn with:

- a) Flaming combustion for more than 30 seconds after each withdrawal of the test flame;
- b) Flaming or glowing combustion up to the holding clamp; and
- c) Glowing ember for more than 50 seconds after the second withdrawal of the test flame.

8.3.11.3 When tested as described for HB material in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94 or CSA C22.2 No. 0.17, each 127 by 12.7 mm (5.0 by 0.50 inch) specimen shall cease to burn before the flame reaches the reference mark located 102 mm (4.0 inches) from its free end.

8.4 Markings and Instructions

8.4.1 General

8.4.1.1 Each self-contained switch shall be plainly marked where readily visible after installation with:

- a) The manufacturer's name, trademark, or trade name;
- b) A distinctive catalog number or the equivalent; and
- c) The electrical rating

8.4.1.2 Each self-contained switch that is not capable of being replaced with a conventional outlet box and switch shall be marked with:

- a) The type of switch necessary for replacement purposes; and
- b) Instructions for disassembly prior to replacement.

Switches intended for replacement with similar devices without the use of special tools shall be specifically marked to indicate this.

8.4.1.3 The following information shall be provided on the outer surface of the smallest unit package or on a tag or stuffer sheet (or its equivalent) or included therein:

- a) Manufacturer's name and complete address;
- b) Catalog number or its equivalent;
- c) Intended conductor material, cable type, and cable size;

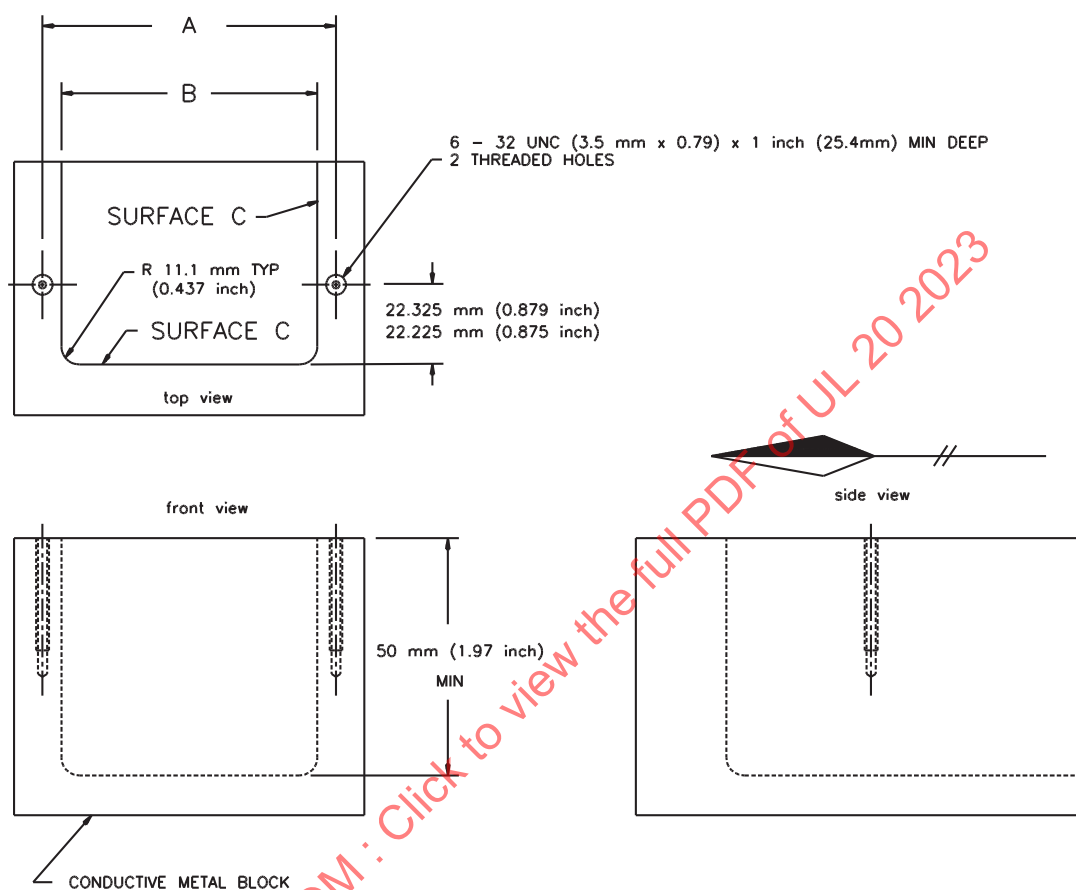
- d) Limitations of use – for example, “mobile homes”; and
- e) Necessary installation instructions such as:
 - 1) Wall or ceiling limitations (material, thicknesses, and the like);
 - 2) Cable preparation (required slack, tools, and the like);
 - 3) Selection of wiring materials; and
 - 4) Bracket references and the like.

8.4.1.4 With regard to Clause [8.4.1.3](#), the installation instructions shall specifically state that the maximum slit length of nonmetallic sheathed cable being prepared for installation on a self-contained switch shall be 54 mm (2.125 inch).

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Figure 1
Test fixture for flush device clearance to flush-device box

(see Clause [4.10.5](#))



Dimensions	Flush devices			
	all except 347 V ac switches		347 V ac switches	
	mm	(inch)	mm	(inch)
A	83.44 mm	(3.285) max	89.80 mm	(3.535) max
	83.24 mm	(3.277) min	89.60 mm	(3.528) min
B	71.625 mm	(2.820) max	85.10 mm	(3.350) max
	71.425 mm	(2.812) min	84.90 mm	(3.342) min

Notes When determining the clearance of live parts of the device to Surface C:

- thread the device's mounting screws through the slot in the device's mounting yoke into the holes in the metal block. Do not tighten the device to the block;
- position the device shown by the arrow until the slot in the device's mounting yoke contacts the mounting screw;
- perform the continuity test, and;
- if the device is asymmetrical, repeat steps (a) – (c) with the device reoriented 180° within its proper mounting.

S5037B

Figure 2
Accessibility probe

(see Clauses [4.7.3](#), [5.16.1](#), [5.21.1](#))

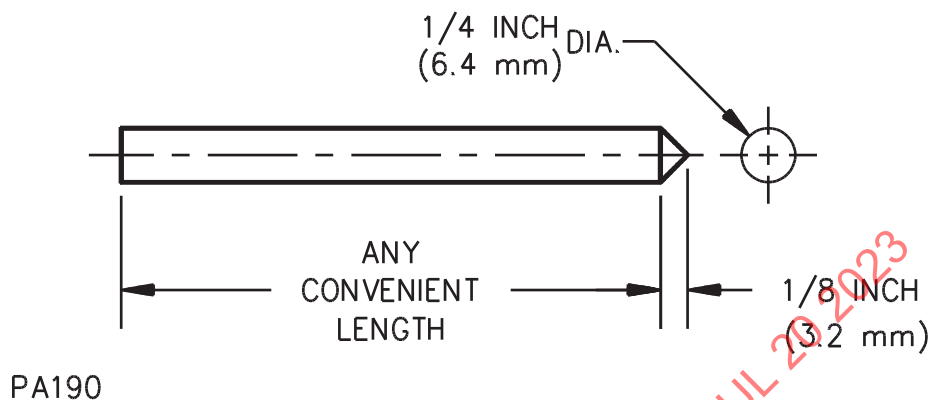
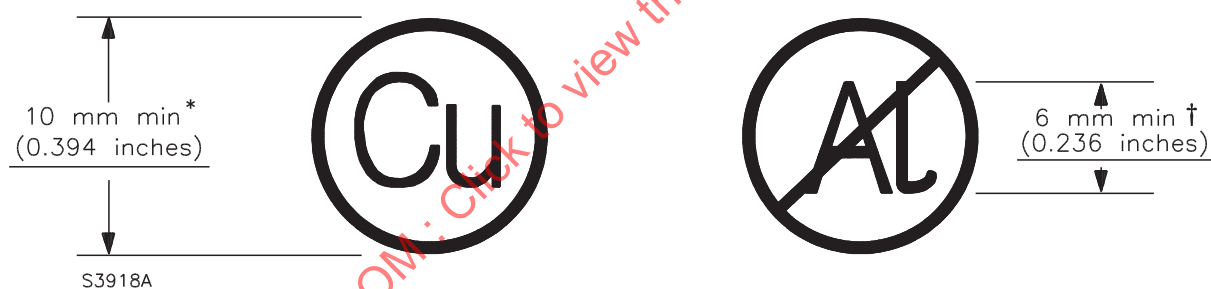


Figure 3
For use with copper only

(see Clause [7.6.4](#), [7.6.5](#))



*4 mm (0.157 inch) if marked on the device

†2.4 mm (0.094 inch) if marked on the device