



UL 98

STANDARD FOR SAFETY

Enclosed and Dead-Front Switches

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UL Standard for Safety for Enclosed and Dead-Front Switches, UL 98

Fourteenth Edition, Dated February 12, 2016

Summary of Topics

This new edition of ANSI/UL 98 is being issued to incorporate multiple substantive and editorial changes.

As noted in the Commitment for Amendments statement located on the back side of the title page, UL, CSA, and ANCE are committed to updating this harmonized standard jointly.

The new/revised requirements are substantially in accordance with Proposal(s) on this subject dated February 20, 2015.

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Association of Standardization and Certification
NMX-J-162-ANCE-2016
Fourth Edition



CSA Group
CSA-C22.2 No. 4-16
Eighth Edition



Underwriters Laboratories Inc.
UL 98
Fourteenth Edition

Enclosed and Dead-Front Switches

February 12, 2016



ANSI/UL 98-2016

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This ANSI/UL Standard for Safety consists of the Fourteenth edition. The most recent designation of ANSI/UL 98 as an American National Standard (ANSI) occurred on February 12, 2016. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

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Preface

This is the harmonized ANCE, CSA Group, and UL standard for *Enclosed and Dead-Front Switches*. It is the Fourth edition of NMX-J-162-ANCE, the Eighth edition of CSA C22.2 No. 4, and the Fourteenth edition of UL 98. This harmonized standard has been jointly issued February 12, 2016.

This harmonized standard was prepared by the Association of Standardization and Certification (ANCE), CSA Group, and Underwriters Laboratories Inc., (UL). The efforts and support of the Technical Harmonization Committee for Enclosed Switches, of the Council on the Harmonization of Electrotechnical Standards of the Nations of the Americas (CANENA), are gratefully acknowledged.

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

This standard was reviewed by the CSA Subcommittee on Enclosed and Dead-Front Switches, under the jurisdiction of the CSA Technical Committee on Industrial 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 approved by the American National Standards Institute (ANSI) as an American National Standard.

Where reference is made to a specific number of samples to be tested, the specified number shall 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 uses the IEC format but is not based on, nor is it considered equivalent to, an IEC standard. This standard is published as an equivalent standard for ANCE, CSA Group, and UL.

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.

Reasons for differences from IEC

The THC determined the safe use of enclosed and dead-front switches is dependent on the design and performance of the products in relation to the North American Electrical Codes with which they are intended to be installed.

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.

1 Scope

1.1 These requirements cover individually enclosed air switches, rated 4000 A or less at 600 V or less, having all current-carrying parts enclosed, manually operable by means of external handles, and intended to be employed in accordance with the national installation codes listed in Annex A, Ref. No. 1.

1.2 As used in this Standard, the term switch is intended to mean an enclosed switch or deadfront switch unless specifically stated otherwise.

1.3 These requirements also cover deadfront switches that have all current-carrying parts enclosed when mounted in an enclosed panelboard, deadfront switchboard, or the like. These switches are manually operable by means of external handles and are intended to be employed in accordance with the national installation codes listed in Annex A, Ref. No. 1.

1.4 These requirements cover enclosed switches with or without provision for fuses suitable for use as branch circuit, feeder, and service overcurrent protection.

1.5 The following fuses are deemed suitable for use as branch circuit, feeder, and service overcurrent protection:

- a) Cartridge Fuses (Ref. Annex B, Low-Voltage Fuses – Parts 1 – 10, 12 and 15),
- b) Plug Fuses (Ref. Annex B, Low-Voltage Fuses – Parts 1 and 11), and
- c) Special Purposes Fuses marked as meeting the performance specifications of a specific Class Fuse.

1.6 These requirements cover enclosed switches intended for general use and having ampere ratings, with or without horsepower or kilowatt ratings, and enclosed switches intended for motor-circuit use only and having horsepower or kilowatt ratings but no general-use ampere ratings.

1.7 These requirements cover double-throw switches intended for use in optional standby systems (see Annex A, Ref. No. 1).

1.8 These requirements cover fused electrically tripped switches rated over 600 A and rated 600 A or less employing Class J, R or T fuses.

1.9 These requirements also cover electrically tripped switches that have been investigated to determine their acceptability for ground-fault protection when combined with ground-fault sensing and relaying equipment as follows:

- a) Switches for use with Class I ground-fault sensing and relaying equipment include those that are capable of interrupting 12 times their rated current or that have integral means to prevent disconnecting at levels of fault current exceeding the contact interrupting capability of the switch.
- b) Switches for use with Class II ground-fault sensing and relaying equipment are capable of interrupting 10 times their rated current and are for use in ground-fault protection systems in which means to prevent disconnecting at levels of fault current exceeding the contact interrupting capability of the switch are incorporated within the ground-fault sensing and relaying equipment when combined with Class I and II ground-fault sensing and relaying equipment.

1.10 These requirements do not cover:

- a) Common forms of snap switches,
- b) Switches having features intended primarily for the starting and protection of motors, including the switches arranged to shunt out fuses during the starting of motors,
- c) Switches provided with automatic trips for opening them and constructed to afford overload protection without other circuit breakers or fuses,
- d) Devices in which the pulling of fuses or the removal of a detachable pullout member is designed to accomplish a switching operation, or
- e) Circuit breakers, molded-case switches, magnetic-only circuit interrupters, instantaneous-only circuit breakers, and supplementary protectors.

2 Normative References

2.1 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. See Annex A.

2.2 Products covered by this standard shall comply with the referenced installation codes and standards noted in this clause as appropriate for the country where the product is to be used. When the product is intended for use in more than one country, the product shall comply with the installation codes and standards for all countries where it is intended to be used.

2.3 In Canada, general requirements are as indicated in Annex A, Ref. Item No. 12, and grounding and bonding requirements are as indicated in Annex A, Ref. Item No. 13.

3 Components

3.1 Except as indicated in 3.2, a component of a product covered by this standard shall comply with the requirements for that component. See Annex B for a list of standards covering components generally used in the products covered by this standard. A component shall comply with the ANCE, CSA Group, or UL standards as appropriate for the country where the product is to be used.

3.2 A component is not required to comply with a specific requirement that:

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

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

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

4 Units of Measurement

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

5 Definitions

5.1 ACCESSORY – a device that performs a secondary or minor duty as an adjunct or refinement to the primary or major duty of a unit of equipment.

5.2 AIR SWITCH – a switching device designed to close and open one or more electric circuits by means of guided separable contacts that separate in air.

5.3 AMBIENT TEMPERATURE – the temperature of the surrounding medium that comes in contact with the exterior of the switch enclosure.

5.4 AUXILIARY SWITCH – a switch mechanically operated by the main switching device for switching, signaling, interlocking, or other purposes.

5.5 AUXILIARY SWITCH contacts may be designated as "a" or "b" as indicated below, but other contact arrangements may be used:

"a" – Contacts that are open when the switch contacts are open and closed when the switch contacts are closed.

"b" – Contacts that are closed when the switch contacts are open and open when the switch contacts are closed.

5.6 AVAILABLE FAULT CURRENT – the maximum current that the power system can deliver through a given circuit point to any negligible impedance short-circuit applied at that point.

5.7 CARTRIDGE FUSE – a fuse consisting of a current-responsive element inside a fuse body with contacts on both ends.

5.8 CLEARING I^2t (AMPERE-SQUARED SECONDS) – the measure of heat energy developed as a result of current flow between the time that current begins to flow and until the fuse clears the circuit. I^2 stands for the square of the effective (rms) let-through current and t stands for the time of current flow in seconds.

5.9 CLEARING I^2t (OF A FUSE) – the amount of ampere-squared seconds passed by a fuse during total clearing time under specified conditions.

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5.10 CURRENT-LIMITING FUSE (AC) – a fuse that safely interrupts all available currents within its interrupting rating and, within its current-limiting range, limits the clearing time at rated voltage to an interval equal to or less than the first major or symmetrical current loop duration and limits peak let-through current to a value less than the peak current that would be possible with the fuse replaced by a solid conductor of the same impedance.

5.11 CURRENT-LIMITING FUSE RATING – a rating expressed in terms of three characteristics that measure the degree by which the fuse limits current. These are threshold ratio, maximum peak let-through current, and maximum clearing I^2t .

5.12 CURRENT RATING – the designated maximum direct or alternating operating current in rms amperes at rated frequency for which the switch qualifies under specified test conditions.

5.13 DEADFRONT SWITCH – a switch that has all current-carrying parts enclosed when it is mounted in an enclosed panelboard, deadfront switchboard, or the like.

5.14 DETACHABLE PULLOUT – a type of pullout switch that is operated by physical removal and reinsertion of a detachable pullout member.

5.15 DIELECTRIC TESTS – tests made to determine the ability of insulating materials and spacings used to withstand specified overvoltages.

5.16 DOUBLE-THROW SWITCH – a switch by means of which a change in circuit connections can be obtained by operating the switch into either of two closed positions or into an open position.

5.17 DUMMY FUSE – a current-carrying part made of copper and having dimensions such that it will fit its fuse mounting means with the same conditions of pressure, contact, and cross-section area as are obtained on terminals of the fuse that it is intended to replace. A dummy fuse is not a protective device.

5.18 ELECTRICALLY TRIPPED SWITCH – a switch whose closing is performed manually, but whose contact opening may be performed by a release which is energized by a voltage source in addition to the manual operating means.

5.19 ENCLOSED PULLOUT SWITCH – a pullout switch, with or without fuseholders, having all current-carrying parts completely enclosed when the hinged cover is in the closed position (in the case of hinged pullouts) or when the detachable member is in the installed position (in the case of detachable pullouts).

5.20 ENCLOSED SWITCH – a switch, with or without fuseholders, having all current-carrying parts completely enclosed, that is operable without opening the enclosure.

5.21 ENCLOSURE – a surrounding case constructed to provide a degree of protection to personnel against incidental contact with the enclosed equipment and to provide a degree of protection to the enclosed equipment against specified environmental conditions.

5.22 FUSE – a protective device that opens by the melting of a current-sensitive element during specified overcurrent conditions.

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5.23 FUSE CLIPS – the contacts of the fuseholder that support the fuse and connect the fuse terminals with the circuit.

5.24 FUSED MOTOR-CIRCUIT SWITCH – a switch rated in horsepower (or kilowatts) capable of interrupting the maximum operating overload current of a motor of the same horsepower (or kilowatts) rating as the switch at the rated voltage.

5.25 FUSEHOLDER – an assembly of base, fuse clips, and necessary insulation for the mounting or connecting of a fuse into a circuit.

5.26 FUSED SWITCH – a switch in which one or more poles have a fuse in series in a composite unit. These switches should not be confused with switches in which the fuse forms the moving contact.

5.27 GROUND (EARTH) (ELECTRIC SYSTEM) – a conducting connection, whether intentional or accidental, by which an electric circuit or equipment is connected to the earth or to some conducting body of relatively large extent that serves in place of the earth. A ground is used for establishing and maintaining the potential of the earth (or of the conducting body), or approximately that potential, on conductors connected to it, and for conducting ground current to and from the earth (or the conducting body).

5.28 ISOLATING SWITCH – a switch intended for isolating an electric circuit from the source of power. It has no interrupting rating, and it is intended to be operated only after the circuit has been opened by some other means.

5.29 KNOCKOUT – a portion of the wall of an enclosure so fashioned that it can be removed readily by a hammer, screwdriver, and pliers at the time of installation in order to provide a hole for the attachment of an auxiliary device or raceway, cable, or fitting.

5.30 LIVE PARTS – parts that are designed to operate at a voltage different from that of the earth.

5.31 NORMAL-FREQUENCY RECOVERY VOLTAGE – the normal-frequency-root-mean-square voltage that occurs across the terminals of an ac circuit-interrupting device after the interruption of the current and after the high-frequency transients have subsided.

5.32 OPERATING MECHANISM OF A SWITCH – the mechanism by which the contacts of a switch are actuated to open or close the circuit.

5.33 OVERLOAD TESTS – tests to which a switch is subjected to determine the ability of the switch, under specified conditions, to make and break currents greater than the current rating of the switch.

5.34 PEAK LET-THROUGH CURRENT, I_p – the highest instantaneous current passed by the over-current protection device during the interruption of the current.

5.35 PEAK LET-THROUGH CURRENT, I_p (aC) – the maximum instantaneous current during the total clearing time.

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5.36 **PLUG FUSE** – fuse consisting of a current-responsive element inside a housing with coaxial terminals on one end, one terminal being a threaded metal ring or shell on the outside of the housing.

5.37 **POLE OF A SWITCHING DEVICE** – the portion of a switching device associated exclusively with one electrically separated conducting path of its main circuit and excluding those portions which provide a means for mounting and operating all poles together.

5.38 **PRESSURE WIRE CONNECTOR** – a reusable connector into which the conductor (wire) is secured by mechanical pressure applied by integral screw, cone, or other mechanical parts.

5.39 **RATING** – a designated limit of operating characteristics based on specified conditions of current, voltage, frequency, and such.

5.40 **SERVICE EQUIPMENT** – the necessary equipment, usually consisting of a circuit breaker or switch and fuses, and their accessories, located near the point of entrance of supply conductors to a building or other structure, or an otherwise defined area, and intended to constitute the main control and means of cutoff of the supply.

5.41 **SHORT-CIRCUIT CURRENT RATING** – the maximum available rms symmetrical ac current or maximum available dc current (which is marked on the switch) to which the (fused or unfused) switch is intended to be connected when protected by the specified overcurrent protective device or devices.

5.42 **SINGLE-THROW SWITCH** – a switch which has an open and a closed circuit position only.

5.43 **SWITCH** – a device, manually operated, unless otherwise designated, for opening and closing or for changing the connection of a circuit.

5.44 **SWITCHING DEVICE** – called “single-pole” if it has only one pole. If it has more than one pole, it is called “multipole” (two-pole, three-pole, and so on) provided the poles are coupled in such a manner as to operate together.

5.45 **TYPE TESTS** – tests made to determine the adequacy of the design of a particular type, style, or model of equipment or its component parts to meet its assigned ratings and to operate satisfactorily under usual service conditions. Type tests should be made only on representative equipment to substantiate the ratings assigned to all other apparatus of basically the same design. These tests are not intended to be used as a part of normal production. The applicable portion of these type tests may also be used to evaluate modifications of a previous design and to assure that performance has not been adversely affected. Test data from previous similar designs may be used for current designs, where appropriate.

6 Construction

6.1 General

6.1.1 A switch shall employ materials throughout that are acceptable for the particular use, and shall be made and finished with the degree of uniformity and quality of work practicable in a well-equipped factory.

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6.1.2 All parts of a switch shall be assembled in place when the switch is shipped from the factory, except as noted in 6.1.3.

6.1.3 A switch may have provision for factory- or field-installed accessories such as neutral assemblies or auxiliary switches provided that:

- a) The switch is for use with and without such assemblies,
- b) Each accessory is acceptable for the intended use,
- c) Each accessory can be installed without the disassembly of factory-assembled parts and without the use of a special tool unless such a tool and instructions for its use are furnished with each accessory,
- d) A barrier that is necessary because spacings would otherwise be less than required, or for any other reason, is securely attached at the factory to either the switch or to the accessory to be installed,
- e) The accessory is an essentially complete unit and does not require detailed assembly in the field. Cutting, splicing of existing wires, or resoldering of connections shall not be permitted, and
- f) The accessory and switch are marked in accordance with 9.2.47.

6.1.4 With reference to 6.1.3, screws for mounting the neutral assembly shall be furnished with that assembly but need not be assembled in place.

6.1.5 A switch (including all of its parts) shall be strong and rigid enough for the intended application.

6.1.6 All ferrous metal parts other than enclosures, unless of corrosion-resistant material, shall be galvanized, painted, enameled, plated, or otherwise acceptably treated to provide protection against corrosion.

6.2 Enclosure

6.2.1 An overall enclosure shall comply with the requirements in Annex A, Ref. No. 4, except for modifications and additional requirements as specially described in this Standard.

6.2.2 A deadfront switch shall comply with the requirements in Annex A, Ref. No. 4, only with regard to those parts of its enclosure that will be exposed when the switch is installed behind the deadfront of a panelboard or the like.

6.2.3 The entire enclosure of a switch intended for surface mounting and the box proper of a switch intended for flush mounting shall be permitted to be formed of steel not less than 1.07 mm (0.042 inch) thick (base metal thickness not including a coating thickness) if:

- a) The length does not exceed 457 mm (18 inch) and the width does not exceed 356 mm (14 inch),
- b) The depth of the box proper is not more than 127 mm (5 inch), and
- c) The thickness of a cover, front, door, trim, and similar parts, provided as part of an enclosure intended for flush mounting, is as specified in Annex A, Ref. No. 4.

6.2.4 An opening for a closely fitting operating handle shall be permitted if the opening is substantially closed when the switch handle is in any operating position. The clearance between the edge of the hole and the handle shall not exceed 2.4 mm (3/32 inch) on either side (one side only) and 3.2 mm (1/8 inch) total (both sides). The clearances shall be measured with the handle in the full on and off positions. The handle and its supporting member shall be assembled in the position resulting in the largest clearance that can result from ordinary factory assembly.

6.2.5 A single door may be provided regardless of the width of a door.

6.2.6 A door or cover intended to give access to fuses shall be hinged, sliding, or similarly attached so as to prevent its removal.

6.2.7 Switches shall be provided with a means for locking the door closed. Switches marked as suitable for use as service equipment shall be provided with a means for sealing.

6.2.8 The enclosure shall be constructed so that all doors can be opened to a minimum of 90 degrees from the closed position.

6.2.9 When knockouts are provided in the enclosure of a switch, they shall be located so that the installation of conduit bushings will not result in electrical spacings less than the minimum requirements of this Standard. In measuring electrical spacings it shall be assumed that the bushings are of suitable size for the largest conduit that can be used.

6.2.10 An external operating means, such as one for a disconnect, a pilot device, or a resetting operation, mounted on or through an enclosure shall withstand the environmental tests specified in Annex A, Ref. No. 4, for the marked enclosure type.

6.3 Operating mechanism

6.3.1 The operating mechanism shall be designed and constructed in such a manner as to provide the strength and rigidity necessary to perform its intended function. Screws and nuts serving to attach operating parts to crossbars or other movable members shall be staked, upset, or otherwise locked in position to prevent loosening under the jars of continued use. Stops shall be provided so as to remove undue strain from switch parts.

6.3.2 A handle shall be provided for convenient operation of a switch and shall be constructed so as not to present a risk of fire, electric shock, or injury to persons. An operating handle and door of conducting material shall be in electrical connection with the enclosure.

6.3.3 A metal rod using the wall of the box as a bearing shall be considered to be in electrical connection with the enclosure.

6.3.4 If the position of a switch is indicated by the position of the operating handle, there shall be definite off and on positions for the handle, and the construction of the operating mechanism shall be such that the handle cannot be left readily at or near the off position when the switch is on. See also 9.2.13.

6.3.5 If a switch is operated such that movement of the operating handle is vertical between the on and off positions resulting in one position being above the other position, then the upper position shall be the on position. A switching device having more than one on position, such as a double-throw switch, need not comply with this requirement.

6.3.6 A handle or other member that indicates the position of the switch contacts (closed or open) shall be so constructed that the door, front, or cover cannot be secured in place in the intended manner so that the handle or member indicates off with the switch contacts in the closed position.

6.3.7 There shall be provision for locking an enclosed switch in the off position without opening the enclosure.

6.3.8 An isolating switch shall have provision for locking the switch in the on position. A current-interrupting switch may have provision for locking the switch in the on position.

6.3.9 A switch so constructed that it will tend to close by gravity shall be provided with means for holding the operating mechanism in the off position.

6.3.10 Switches rated greater than 250 V, 30 A shall have the design of the operating mechanism in conjunction with the contact structure, such that in normal operation, the operator of the switch cannot restrain the operation of the contacts after they have initially touched or parted when closing or opening the switch. Isolating switches complying with 6.3.8 and 9.2.12 are exempt from this requirement.

6.4 Accessibility of live parts

6.4.1 Openings in enclosures that provide access to live parts shall be evaluated in accordance with Annex A, Ref. No. 14.

6.5 Electrical insulation material

6.5.1 Insulation material in contact with live parts shall have at least the minimum values specified in Table 1 and additionally be subjected to the mold stress relief test in 7.13.

6.5.2 An insulation material having values below those contained in Table 1 may be accepted based on acceptable end-product performance tests. See Annex A, Ref. No. 9.

Note: This requirement does not apply in Canada.

6.5.3 The mold stress relief test is not required for rigid thermosetting materials.

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Table 1
Minimum values for insulating materials

Test specified	Flammability rating of material			
	V-0	V-1	V-2	HB
Hot wire ignition (HWI) ^e , ignition time in sec. (Annex A, Ref. No. 3)	7	15	30	30
High current arc ignition (HAI) ^d , number of arcs (Annex A, Ref. No. 10)	15	30	30	60
Comparative tracking index (CTI) under moist conditions ^c , volts (Annex A, Ref. No. 2)	175 ^{a,b}	175 ^{a,b}	175 ^{a,b}	175 ^{a,b}
a) A material having a minimum comparative tracking value of 100 may be used if the voltage involved is 250 volts or less. b) Not applicable if the over-surface spacing is greater than or equal to 12.7 mm (1/2 inch). c) Material surface is in contact with or in close proximity [within 0.8 mm (1/32 inch)] to: 1) uninsulated live parts of opposite polarity, or 2) uninsulated live parts and either i) metal parts that may be grounded in service, or ii) any surface exposed to contact. d) Material is in contact with or in close proximity to uninsulated live parts 0.8 mm (1/32 inch) for nonarcing parts or 12.7 mm (1/2 inch) for arcing parts. e) Material is in contact with or close proximity to uninsulated live parts [within 0.8 mm (1/32 inch)].				

6.5.4 The overall thickness of switch bases shall not be less than 12.5 mm (1/2 inch) if made of porcelain.

6.5.5 Vulcanized fiber, impregnated hard wood, and molded composition are acceptable as materials for crossbars. Cold-molded and phenolic compositions are acceptable generally, but ordinary fiber, rubber, and so-called hot-molded shellac and tar compositions shall not be used for the mounting of uninsulated live parts.

6.6 Spacings

6.6.1 General

6.6.1.1 Except as noted in 6.6.1.4 – 6.6.1.6, the spacings in a switch shall be as indicated in Table 2. Grounded metal includes the enclosure and any metal that may be in electrical connection with the enclosure.

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Table 2
Minimum spacings^a

Voltage between parts involved	Minimum spacings in mm (inches)			
	Between uninsulated live parts of opposite polarity		Between uninsulated live parts and any grounded metal	
	Over surface	Through air	Over surface	Through air
0 – 130	19 (3/4)	12.5 (1/2)	12.5 (1/2)	12.5 (1/2)
131 – 250	31 (1-1/4)	19 (3/4)	12.5 (1/2)	12.5 (1/2)
251 – 600	50 (2)	25 (1)	25 (1)	12.5 (1/2)

^a The SI units are minimum values and are not a direct conversion from the corresponding values in inches.

6.6.1.2 Terminals and other live parts intended to be connected to the grounded conductor of a circuit shall be considered to be uninsulated live parts unless such parts are mounted directly on or in permanent electrical connection with the enclosure.

6.6.1.3 If the connection mentioned in 6.6.1.2 is solely by means of a screw, strap, or other bonding device that can be readily removed and is not depended upon to perform a mechanical function, the switch shall:

- a) Comply with the requirement in 6.6.1.1 when the bonding device is removed, or
- b) Be marked as described in 9.2.33.

6.6.1.4 The spacings between screw-shells of plug fuseholders that are protected by surrounding walls of insulating material, and between such screw-shells and a metal cover plate, may be less than those indicated in Table 2 but not less than 6.4 mm (1/4 inch) in any case, if the depth of the receptacle, as measured from the top of the wall to the plane of the center contact, is not less than 19.1 mm (3/4 inch).

6.6.1.5 The distance between a door or cover over a fuseholder and:

- a) The center contact of an Edison-base plug fuseholder shall not be less than 39.7 mm (1-9/16 inches).
- b) The center contact of a Type S plug fuseholder shall not be less than 33.3 mm (1-5/16 inches).

6.6.1.6 The spacings given in Table 2 are not required to be maintained between switch blades and the enclosure cover when the switch is in the off position and the blades are deenergized, but such spacings shall not be less than 3.2 mm (1/8 inches).

6.6.1.7 In measuring between an uninsulated live part and a conduit bushing installed at a knockout, it shall be assumed that a conduit bushing having the dimensions specified in Table 3 is in place.

Table 3
Conduit bushings

Trade size designators	Overall diameter,		Height,	
	mm	(inches)	mm	(inches)
1/2	25.4	(1)	9.5	(3/8)
3/4	31.4	(1-15/64)	10.7	(27/64)
1	40.5	(1-19/32)	13.1	(33/64)
1-1/4	49.2	(1-15/16)	14.3	(9/16)
1-1/2	56.0	(2-13/64)	15.1	(19/32)
2	68.7	(2-45/64)	15.9	(5/8)
2-1/2	81.8	(3-7/32)	19.1	(3/4)
3	98.4	(3-7/8)	20.6	(13/16)
3-1/2	112.7	(4-7/16)	23.8	(15/16)
4	126.2	(4-31/32)	25.4	(1)
4-1/2	140.9	(5-35/64)	27.0	(1-1/16)
5	158.0	(6-7/32)	30.2	(1-3/16)
6	183.4	(7-7/32)	31.8	(1-1/4)

6.6.1.8 There shall be a spacing of not less than 3.2 mm (1/8 inch) between line and load terminals of the same polarity.

6.6.1.9 Wire connectors shall be kept from turning to the extent that spacings would be reduced to less than those required in 6.6.1.1; however, if such minimum or greater spacings are maintained when wire connectors are turned 30 degrees toward each other or toward other uninsulated live or grounded parts, no means to prevent turning need be provided.

6.6.1.10 Spacings at the wiring terminals of a 30 A switch shall be measured with the device wired in accordance with Table 4.

Table 4
AWG size (mm²) of wire to be used in spacings evaluation of 30 A switches

Terminal acceptable for use with	For use as service equipment		Not for use as service equipment	
	AWG	mm ²	AWG	mm ²
Copper only	8	8.367	10	5.260
Copper/aluminum	6	13.30	8	8.367

6.6.1.11 The spacings at wiring terminals employing wire connectors shall be measured with the device wired with conductors having an ampacity not less than the current rating of the switch (see 6.10.2).

6.6.1.12 In measuring an over-surface spacing, a metal part such as a screw head or washer interposed between uninsulated live parts of opposite polarity or between uninsulated live parts and grounded metal shall be considered as reducing the spacing by an amount equal to the dimension of the metal part in the direction of the measurement.

6.6.1.13 The requirements in 6.6.1.1 and 6.6.1.8 do not apply

- a) Between uninsulated live parts of opposite polarity within a component of the switch (such as an auxiliary switch),
- b) Between uninsulated live parts of the component and deenergized metal that is part of the component, or
- c) Between uninsulated live parts of the component and that part of the deenergized metal surface of the switch on which the component is mounted in the intended manner.

6.6.1.14 The requirements in 6.6.1.1 and 6.6.1.8 shall apply:

- a) between uninsulated live parts in different components, and
- b) between uninsulated live parts of a component and a live part or the deenergized metal of the switch, other than the dead metal surface on which the component is mounted.

6.6.1.15 Live screw heads or nuts on the underside of a base intended for surface mounting shall be countersunk not less than 3.2 mm (1/8 inch) in the clear, and then covered with a waterproof, insulating, sealing compound that will not soften at a temperature 15°C higher than the temperature observed at the point where it is used, but not lower than 65°C in any case; however, if such parts are staked, upset, or otherwise kept from loosening, insulation from the mounting surface by material other than sealing compound or by the provision of a spacing through air from the mounting surface of not less than 12.7 mm (1/2 inch) shall be permitted.

6.6.1.16 A lock washer, properly applied, is acceptable as a means of keeping a screw or nut from loosening as required in 6.6.1.15.

6.6.1.17 A determination of the softening point of a sealing compound shall be made in accordance with the Test for Softening Point by Ring and Ball Apparatus, Annex A, Ref. No. 11.

6.6.1.18 Spacings shall be measured through cracks unless a clamped joint has passed the test covered in Clamped joint test, Clause 7.6, or unless the joint is sealed with adhesive or cement. A clamped joint is a joint between two pieces of insulation that are under pressure. See Figure 5. Adhesive cements, and the like, if used to effect a seal in lieu of a tightly mated joint, shall comply with the requirements in Annex A, Reference Item No. 9.

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6.6.2 Insulating barriers

6.6.2.1 In 6.6.2.2 – 6.6.2.12, the barrier referred to is an insulating material that separates uninsulated live parts of opposite polarity or separates an uninsulated live part from a grounded metal part (including the enclosure) where the through-air spacing between the parts would otherwise be less than the minimum values specified in Table 2.

6.6.2.2 A barrier that constitutes the sole separation or is used in conjunction with an air space less than 0.33 mm (0.013 inch) shall be:

- a) Of insulation material as specified in 6.5.1. However, with regard to the flammability rating in Table 1, the rating may be VTM-0, VTM-1, or VTM-2 rather than V-0, V-1, or V-2, respectively,
- b) Of such strength to withstand the stress associated with normal handling, installation, and use of the equipment,
- c) Secured in place,
- d) Located so that it will not be adversely affected by operation of the equipment in service, and
- e) Of a minimum thickness of 0.71 mm (0.028 inch).

6.6.2.3 A barrier located between the enclosure and an uninsulated live part electrically connected to a grounded circuit conductor (neutral) may be of vulcanized fiber.

6.6.2.4 A barrier material having values below those contained in Table 1 may be accepted based on acceptable end-product performance tests.

6.6.2.5 A barrier of insulating material other than vulcanized fiber may have a thickness less than 0.71 mm (0.028 inch) if it withstands a 60 Hz dielectric-withstand voltage of 5 000 V applied in accordance with 7.14.

6.6.2.6 A barrier used in conjunction with a minimum air space of 0.33 mm (0.013 inch) shall be:

- a) Of material that has insulating properties as specified in 6.5.1 or, other than vulcanized fiber, complying with Table 5,
- b) Of such strength to withstand the stress associated with normal handling, installation, and use of the equipment,
- c) Secured in place,
- d) Located so that it will not be adversely affected by operation of the equipment in service, and
- e) Of a minimum thickness of 0.71 mm (0.028 inch).

6.6.2.7 Vulcanized fiber with a minimum thickness of 0.71 mm (0.028 inch) and used in conjunction with a minimum 0.71 mm (0.028 inch) air space need not comply with 6.5.1.

6.6.2.8 Material other than vulcanized fiber used in conjunction with an air space of 50% or more of the required through air spacing may have a thickness:

- a) Not less than 0.33 mm (0.013 inch), or
- b) Less than 0.33 mm (0.013 inch) if it withstands a 60 Hz dielectric-withstand voltage of 2 500 V applied in accordance with the requirements in 7.14.

6.6.2.9 A barrier material having values below those contained in Table 5 may be accepted based on acceptable end-product performance tests.

Table 5
Minimum values for insulating barriers used in place of spacing in conjunction with minimum air space of 0.33 mm (0.013 inch)

Test specified ^f	Flammability rating of material ^e			
	V-0 or VTM-0	V-1 or VTM-1	V-2 or VTM-2	HB
Hot wire ignition (HWI) ^d , ignition time in sec. (Annex A, Ref. No. 3)	7	15	30	30
High current arc ignition (HAI) ^c , number of arcs (Annex A, Ref. No. 10)	15	30	30	60
Comparative tracking index (CTI) ^a under moist conditions ^b , Volts (Annex A, Ref. No. 2)	100	100	100	100

^a Not applicable if the over-surface spacing is greater than or equal to 12.7 mm (1/2 inch).
^b Material surface is in contact with or in close proximity (within 0.8 mm (1/32 inch)) to:
 1) uninsulated live parts of opposite polarity, or
 2) uninsulated live parts and either
 i) metal parts that may be grounded in service, or
 ii) any surface exposed to contact.
^c Material is in contact with or in close proximity to uninsulated live parts 0.8 mm (1/32 inch) for nonarcing parts or 12.7 mm (1/2 inch) for arcing parts.
^d Material is in contact with or close proximity to uninsulated live parts [within 0.8 mm (1/32 inch)].
^e These flammability ratings are derived from Annex A, Ref. No. 5.
^f See Annex A, Ref. No. 10, for these specified tests.

6.6.2.10 The barrier shall also be subjected to the mold stress relief test in 7.13.

6.6.2.11 A wrap of thermoplastic tape, acceptable for use as sole insulation, may be employed if all of the following conditions are met:

- a) At a point where the spacing prior to the application of the tape is not less than half the required through-air spacing, the wrap is not less than 0.33 mm (0.013 inch) thick and is applied in two or more layers,
- b) At a point where the spacing prior to the application of the tape is less than half the required through-air spacing, the wrap is not less than 0.71 mm (0.028 inch) thick,
- c) The tape is not subject to compression,
- d) The tape is not wrapped over a sharp edge, and

e) The temperature rating of the tape is not less than the temperature rise observed during the temperature test plus 40°C. If a temperature test is not required, the temperature rating shall be 105°C minimum.

6.6.2.12 If spacings would otherwise be less than the minimum values specified in Table 2, thermoplastic tubing may be used if all of the following conditions are met:

- a) It is not subjected to compression, repeated flexure, or sharp bends,
- b) All edges of the conductor covered with the tubing are well rounded and free from sharp edges,
- c) For chemically dilated tubing, a solvent recommended by the tubing manufacturer is used,
- d) Its wall thickness (after assembly) is not less than 0.56 mm (0.022 inch) for tubing 12.7 mm (1/2 inch) or less in diameter, not less than 0.69 mm (0.027 inches) for tubing 14.3 or 15.9 mm (9/16 or 5/8 inch) in diameter, and not less than 0.71 mm (0.028 inch) for larger diameter tubing, and
- e) Its temperature marking is not less than the temperature rise observed during the temperature test plus 40°C. If a temperature test is not required, the temperature marking shall be 105°C minimum.

6.7 Current-carrying parts

6.7.1 General

6.7.1.1 The only iron or steel parts that are depended upon to carry current shall be No. 10 or larger binding head screws, machine screws, bolts, studs, nuts, and washers used for terminal parts. These iron or steel parts shall be suitably protected with a plating of zinc having a thickness of not less than 0.005 mm (0.0002 inch) and the conductor or terminal to be secured shall be clamped against a surface of nonferrous metal that will carry the greater part of the current.

6.7.1.2 Copper and brass shall not be used for the plating of steel wire-binding screws, nuts, and stud terminals; a plating of zinc shall be permitted.

6.7.1.3 Bolts, washers, and nuts at the hinges of knife switches shall be considered to be parts that are not depended upon to carry current.

6.7.1.4 A metal other than silver, a silver alloy, copper, or a copper alloy, if used for current-carrying parts, shall be suitable for the particular application.

6.7.1.5 Uninsulated live parts, other than soldering lugs or pressure wire connectors as mentioned in 6.6.1.9, shall be so secured to the mounting surface that they will be kept from turning or loosening.

6.7.1.6 Friction between surfaces shall not be used as a means to keep uninsulated live parts from turning.

Note: Turning may be prevented by the use of two screws or rivets; by shoulders or mortises; by a dowel pin, lug, or offset; by a connecting strap or clip fitted into an adjacent part; or by some other equivalent method.

6.7.1.7 Where parts are held together by screws, a threaded part shall not have less than two full, clean-cut threads, not finer than the threads given in Table 6, if the screw passes entirely through the piece. If the screw does not pass entirely through the threaded part, it shall engage full, clean-cut threads for a distance of not less than the diameter of the screw.

Table 6
Machine-screw threads

American screws		Metric screws	
American National Standard size	Maximum number of threads per inch (per 25.4 mm)	Size (diameter, mm)	Minimum thread pitch (mm)
1/4	20	M8	1.25
1/2	24	M6	1.00
5/8	32	M5	0.80
3/4	32	M4	0.70
1	36	M3.5	0.60

6.7.1.8 If a break jaw, hinge jaw, or fuse contact is held in a slot or hole milled in a mounting piece, the parts shall fit together closely and shall comply with Table 7.

Table 7
Securing of jaws and contacts

Construction		Rating in amperes	Means of securing
Slots (See Figure 1)		100 or less	Pinning required, soldering not acceptable
		over 100	Pinning and soldering required
Holes (See Figure 1)	Jaw or contact securely swaged on the under-side of the mounting piece	100 or less	Pinning and soldering are both acceptable but neither is required
		over 100	Soldering required, additional pinning is acceptable but not required
	Jaw or contact not securely swaged on the under-side	Any	Pinning and soldering required

6.7.1.9 Hinge jaws, when used to carry current, shall be equipped with spring washers held by locknuts or pins, or some approved equivalent, so arranged that a firm and secure connection will be maintained at all positions of the switch blades. Two spring washers per hinge shall be used for currents of 100 A and over, unless a single washer is shown by investigation to be fully effective.

6.7.1.10 Spring washers shall have sufficient strength to take up wear in the hinge jaw and still maintain good contact.

6.7.1.11 A switch of the knife-blade type shall be so arranged that the blades will be deenergized when the switch is open, unless the blades will not be exposed to inadvertent contact during the replacement or inspection of fuses.

6.7.1.12 Notwithstanding 6.7.1.11, the blades in a double-throw switch are permitted to be energized even if the switch is in the off position.

6.7.2 Wiring terminals

6.7.2.1 Except as noted in 6.7.2.13 and 6.7.2.14:

- a) A switch shall be provided with wiring terminals for the connection of conductors having an ampacity not less than the current rating of the device, and
- b) The terminals of a switch having a horsepower or kilowatt rating shall be capable of accommodating conductors having an ampacity equal to 125% of the motor-running current corresponding to the horsepower or kilowatt rating.

6.7.2.2 A wiring terminal shall be provided with a soldering lug firmly bolted or held by a screw or provided with a pressure wire connector.

6.7.2.3 A wire binding screw shall be permitted at a wiring terminal intended for the connection of a 10 AWG (5.3 mm²) or smaller copper conductor. Upturned edges or the equivalent shall be provided to retain the conductor under the head of the screw when the screw is loosened enough to enable shifting of the conductor.

6.7.2.4 The binding screw shall not be smaller than an M5 with a minimum pitch of 0.80 mm or a No. 10 with not more than 32 threads.

6.7.2.5 A terminal plate tapped for a wire-binding screw shall be of metal not less than 1.27 mm (0.050 inch) thick and shall have not less than two full threads in the metal; however, a special alloy plate less than 1.27 mm (0.050 inch) but not less than 0.76 mm (0.030 inch) thick shall be permitted if the tapped threads have enough mechanical strength.

6.7.2.6 Extrusion of a terminal plate for a wire binding screw at the tapped hole so as to give the thickness necessary for at least two full threads shall be permitted, provided that the thickness of the unextruded metal is not less than the pitch of the thread.

6.7.2.7 A wire-binding screw shall not thread into material other than metal.

6.7.2.8 The point of attachment of a soldering lug, a pressure wire connector, or a wire-binding screw terminal shall not overhang the base unless the construction is such as to provide enough mechanical strength to prevent any reduction of required spacings.

6.7.2.9 A wiring terminal provided for the connection of a service conductor to an enclosed switch marked for service equipment use and rated 30 A shall be acceptable for use with a 8 AWG (8.4 mm²) copper conductor. The terminal shall be acceptable for use with a 6 AWG (13.3 mm²) aluminum conductor if the enclosed switch is marked for use with aluminum wire.

6.7.2.10 Sizes of field-installed conductors shall be determined as follows for current as specified in Table 8:

- a) Conductors rated at 75°C in the 1/0 AWG (53.5 mm²) and larger sizes.
- b) Conductors rated at 60°C in the 1 AWG (42.4 mm²) and smaller sizes, except 75°C conductors if the switch is marked for 75°C conductors in accordance with 9.2.58.

6.7.2.11 Aluminum conductors may be used at any terminal identified on a wiring diagram or the like as being acceptable for use with such conductors, whether or not that terminal is also identified as being acceptable for use with copper conductors. See 9.2.49 – 9.2.59.

6.7.2.12 Multiple wire connectors shall not be provided at the terminals of enclosed switches rated 100 A or less unless at least one of the wire connectors is sized for the current rating of the switch.

Table 8
Ampacity of insulated conductors^{a,b}

Wire size		60°C		75°C	
AWG	mm ²	Copper	Aluminum	Copper	Aluminum
14	2.1	15	–	15	–
12	3.3	20	15	20	15
10	5.3	30	25	30	25
8	8.4	40	30	50	40
6	13.3	55	40	65	50
4	21.2	70	55	85	65
3	26.7	80	65	100	75
2	33.6	95	75	115	90
1	42.4	110	85	130	100
1/0	53.5			150	120
2/0	67.4			175	135
3/0	85.0			200	155
4/0	107.2			230	180
kcmil					
250	127			255	205
300	152			285	230
350	177			310	250
400	203			335	270
500	253			380	310
600	304			420	340
700	355			460	375
750	380			475	385
800	405			490	395
900	456			520	425
1000	507			545	445
1250	633			590	485
1500	760			625	520
1750	887			650	545
2000	1010			665	560

^a For a multiple-conductor connector at a terminal, the value shall be multiplied by the number of conductors that the terminal will accommodate (1/0 AWG or larger).

^b These values of ampacity apply only if not more than 3 conductors will be field-installed in the conduit. If 4 or more conductors, other than a neutral that carries the unbalanced current, will be installed in a conduit (as may occur because of the number of conduit hubs provided in an outdoor switch, because of the number of wires necessary in certain polyphase systems, or other reasons) the ampacity of each of those conductors shall be 80 percent of the value given in the Table if 4 – 6 conductors are involved, and 70 percent of that value if 7 – 24 conductors.

6.7.2.13 Pressure terminal connectors for field connection (line or load) need not be provided if all of the following conditions are met:

- a) Component terminal assemblies shall be available from the equipment manufacturer, or one or more acceptable pressure terminal connectors shall be specified for field installation on the equipment.
- b) Fastening devices, such as studs, nuts, bolts, spring washers, and flat washers, required for an effective installation shall either be provided as part of the component terminal assembly or be mounted on or separately packaged with the equipment.
- c) The installation of the terminal assembly shall not involve the loosening or disassembly of parts other than a cover or other part giving access to the terminal location. The means for securing the terminal connector shall be readily accessible for tightening before and after installation of conductors.
- d) If the pressure terminal connector provided in a component terminal assembly requires the use of a special tool for securing the conductor, any necessary instructions shall be included in the component assembly package or with the equipment.
- e) Installation of the pressure terminal connectors in the intended manner shall result in a product meeting the requirements of this Standard.
- f) The equipment shall be marked in accordance with 9.2.45.

6.7.2.14 A terminal may be omitted if:

- a) The switch is specifically intended to be used with such other equipment that the terminal is unnecessary,
- b) A means, such as bus-bar link or the equivalent, is provided to connect the two pieces together, and
- c) Both pieces of equipment are marked in accordance with 9.2.46.

6.7.2.15 A soldering lug or other connection that depends upon solder shall not be provided for the connection of bonding conductors, the service conductors, or the service grounding conductor to an enclosed switch marked as acceptable for use as service equipment.

6.7.2.16 A wiring terminal provided for the connection of a grounded neutral conductor or an electrode grounding conductor shall be readily accessible so that the wires can be disconnected after installation.

6.7.2.17 A pressure wire connector that is not intended to be removable or interchangeable shall be capable of receiving and holding properly the range of wire sizes with which the switch is intended to be used.

6.7.2.18 With reference to the requirement in 6.7.2.17, the range of wire sizes with which an ampere-rated switch may be used shall be considered to correspond to the range of fuse sizes accommodated by the switch. For a switch having both ampere and horsepower or kilowatt ratings, the range of wire sizes shall be considered to include those acceptable for the ampere rating and also the wire sizes acceptable for the horsepower or kilowatt ratings at which the switch can be used; however, a connector need not be acceptable for all the horsepower or kilowatt ratings less than the maximum if acceptable markings show the range of acceptable wire sizes.

6.7.2.19 A pressure wire connector provided with or specified for use with a switch shall comply with the applicable requirements for wire connectors and soldering lugs, as outlined in Annex A, Ref. No. 6.

6.7.2.20 Switches that are marked for use with aluminum conductors shall have means for terminating aluminum grounding conductors separate from copper grounding conductors.

6.7.2.21 The tightening torque for a field-wiring terminal shall be as specified by the switch manufacturer and shall be marked as required by 9.2.57. The specified tightening torque shall not be less than 90 percent of the value employed in the static heating test as specified in the requirements in Annex A, Ref. No. 6.

6.7.2.22 A torque value of less than 90 percent shall be permitted if the connector is investigated in accordance with the requirements in Annex A, Ref. No. 6, using the lesser assigned torque value.

6.7.3 Neutral

6.7.3.1 A neutral need not be insulated from grounded metal parts when the switch is marked in accordance with 9.2.34.

6.7.3.2 A switched neutral shall be permitted only if the switch mechanism disconnects all ungrounded conductors simultaneously or previously.

6.8 Fusing

6.8.1 Fuseholders and fuse terminals shall be of either the cartridge-enclosed, plug-fuse, or special purpose fuse type and shall comply with the requirements in Annex A, Ref. No. 8, except as modified by this Standard. Fuseholders of the special purpose fuse type shall also comply with the requirements in 6.8.6.

6.8.2 The construction of a switch and the location of fuses shall be such that fuses will be readily accessible when the switch is open, so that they may be replaced without a person touching any live part. The electrical arrangement of a single-throw switch shall be such that, if properly connected, fuse terminals will be deenergized when the switch is open. See also 9.2.41 and 9.2.42.

6.8.3 A plug fuse shall be considered to be accessible if, when the switch is in the full off position, the test gauge described in 6.8.5 can be inserted and bottomed in each plug fuseholder by using the fingers of one hand and without causing a reduction in the break distance between the stationary and moving switch contacts to less than 12.7 mm (1/2 inch).

6.8.4 A neutral need not be insulated from grounded metal parts when the switch is marked in accordance with 9.2.34.

6.8.5 The test gauge mentioned in 6.8.3 shall be in the form of a plug fuse having the dimensions specified for plug fuses and having an overall height of 44.5 mm (1-3/4 inches) and a diameter of 31.8 mm (1-1/4 inches) at the section above the male screw-shell.

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6.8.6 Special purpose fuseholders may be used if evaluated for use with specific special purpose fuses, which are suitably rated for use as branch circuit, feeder, or service overcurrent protection. When used, special purpose fuseholders shall:

- a) Be non-interchangeable with fuses of incompatible ratings. This requires that the fuseholder be of a design so that it will be difficult to install a fuse of any given class into a fuseholder that is designed for a current lower, or voltage higher, than that of the fuse intended for use with the fuseholder; and
- b) Be marked for use with the specific special purpose fuses for which it is intended to be used.

6.9 Field conversion

6.9.1 A switch constructed to accommodate Class "H" type fuses and for field conversion to accept Class "J," "R," "T," or "C" fuses shall be marked in accordance with 9.2.25 – 9.2.30 and shall comply with 6.9.2 – 6.9.12.

6.9.2 A switch shipped from the factory with complete fuseholders shall have them positioned to accept Class "H" fuses.

6.9.3 A switch intended to accept Class "J" fuses by repositioning the load base or fuseholder may have the fuseholders in the "J" fuse position when the known use is for "J" fuses.

6.9.4 A switch may be shipped by the factory without load fuse clips or without the complete load fuse base.

6.9.5 A switch shipped without load fuse clips or complete load fuse base shall be provided with explicit instructions for ordering the necessary components to complete the switch to accept either Class "H", "J", or "R" type fuses.

6.9.6 The intended repositioning of a load side fuseholder assembly (common or individual pole construction) or the individual fuse clips to accommodate "J" fuses shall have factory-provided mounting holes. The repositioning shall be by the use of common tools by front access to the switch.

6.9.7 A load side fuseholder assembly (common or individual pole construction) or individual fuse clips that are intended to be installed to permit the acceptance of Class "R" fuses only shall be installed by the use of common tools by front access to the switch.

6.9.8 Fuse clips that are intended to be added or replaced shall be capable of being added or replaced in such a manner that proper alignment of the clips shall be maintained and other parts such as the terminal assembly shall not be disturbed.

6.9.9 The field installation of a fuse clip shall not require the spreading of the fuse clip or adversely affect the fuse clip in any manner.

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