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Underwriters Laboratories Inc.
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Fourteenth Edition

Enclosed and Dead-Front Switches

February 12, 2016

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Approved American National Standard

ANSI/UL 98-2023

Standard for Safety for Enclosed and Dead-Front Switches

Eighth Edition, Dated February 12, 2016

Summary of Topics

This revision dated January 16, 2023 includes the following changes in requirements:

– Barriers to Address Inadvertent Contact on Line Side of Service Disconnect; 6.4.2 – 6.4.5, 9.2.64, and Figure 6.

– Revision of Values for Dielectric Test Frequencies; 6.6.2.5, 7.5.1, and 7.6.1

– Overload and Endurance Time Constant Correction/Addition; 7.3.1.1, 7.3.1.2, 7.3.2.3, 7.4.1.

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 Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the standard may be submitted to ANCE, CSA Group, or UL at anytime. Revisions to this standard will be made only after processing according to the standards development procedures of ANCE, CSA Group, and UL. CSA Group and UL 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 UL pages.

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This Standard is subject to review 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 January 16, 2023. The most recent designation of ANSI/UL 98 as an American National Standard (ANSI) occurred on January 16, 2023. 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 revised on January 16, 2023. For this purpose, CSA Group and UL are issuing revision pages dated January 16, 2023, and ANCE is issuing a new edition dated January 16, 2023.

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.

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.

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.

6.4.2 Enclosed switches marked for service equipment use shall be constructed such that, with the switch in the off position, no ungrounded uninsulated live part is exposed to inadvertent contact by persons while servicing any field connected load terminal or fuseholder, including a neutral load terminal, an equipment grounding terminal, or the neutral disconnect link. Exposure to inadvertent contact is determined by use of the probe illustrated in Figure 6. If restriction to the line-side of the service disconnect is dependent on the installation of field installed service conductors, conductors sized in accordance with Table 8 shall be installed in the terminals when determining exposure to inadvertent contact. All live parts of the line side service terminal, including the connector body and pressure screw shall be evaluated. For enclosed switches suitable for more than one type of fuse or terminals, the evaluation shall be conducted with all types of fuses and terminals.

NOTE: In accordance with the Standard for Electrical Safety in the Workplace, NFPA 70E, an electrically safe work condition should be established prior to working on electrical equipment. Accessibility requirements do not endorse working on energized electrical equipment. In Canada, refer to CSA Z462, Workplace electrical safety.

6.4.3 Metal barriers provided to limit exposure to inadvertent contact shall:

a) Have a thickness not less than 0.032 inch (0.81 mm) if uncoated, not less than 0.034 inch (0.86 mm) if galvanized, and not less than 0.050 inch (1.27 mm) if aluminum.

b) Be constructed so that they can be readily removed or repositioned, and then reinstalled, without the likelihood of contacting bare live parts or damage the insulation of any insulated live part.

NOTE: Factory installed barriers that limit access to factory installed wiring and terminations are not required to be constructed so that they can be removed or repositioned.

6.4.4 Nonmetallic barriers provided to limit exposure to inadvertent contact shall:

a) Comply with requirements in 6.6.2.6 for barriers used in conjunction with a minimum air space of 0.013 inch (0.33 mm).

b) Be constructed so that they can be readily removed or repositioned, and then reinstalled, to allow access to the terminal for servicing.

NOTE: Factory installed barriers that limit access to factory installed wiring and terminations are not required to be constructed so that they can be removed or repositioned.

6.4.5 Enclosed switches marked “Suitable for use as service equipment” shall be permitted to provide the protection from inadvertent contact in 6.4.2 in a field installable kit when marked in accordance with 9.2.64.

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 48 – 62 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:				

Table 5 Continued on Next Page

7.2.13 The deadfront switch being tested shall be mounted in the open, not in a panelboard, with the front in a vertical plane and the load terminals at one side. Connections shall be made with cables in accordance with 7.2.4, and loading shall be in accordance with 7.2.1 or 7.2.10 as appropriate. Where wire cannot be connected to the line end of the switch, copper bus bars shall be connected to the line terminals. The bus bars shall have an ampacity not more than the rating of the switch based on a current density not less than 1.55 A/mm^2 (1 000 A/in^2), shall extend approximately 76 mm (3 inches) beyond the switch enclosure, and shall terminate in wire connectors appropriate for the rating of the switch. Bus bars of cross-section other than specified above may be used if agreeable to the submitter and the testing agency.

7.2.14 Temperatures shall be recorded for the top two load terminals, on the top front corner of the wire connectors farthest from the center of the switch.

7.2.15 The same sample used in the test of 7.2.13 shall be tested in the same manner, except that the conductors to the lower switch pole shall be disconnected from the switch and reconnected together outside and below the switch enclosure or shell. Results shall be considered acceptable if the temperature rises on the top two load terminals are not higher than those observed in the test of 7.2.13.

7.2.16 A two-pole deadfront switch marked for multi-phase application having a steel shell as described in 7.2.12, and that has an enclosure smaller than the equivalent three-pole switch of the same voltage and ampere rating, shall be subjected to the test described in 7.2.13 except that

a) Dummy fuses shall be used in the two poles,

b) A 3-phase current shall be adjusted to 100 percent of the switch rating, and

c) The third-phase conductor shall be connected outside and below the enclosure or shell.

Results shall be considered acceptable if the temperature rises at the load terminals do not exceed 30°C. A switch employing Class L, C, or T fuses or 400 or 600 A Class J fuses shall be tested with fuses in place and when carrying 80 percent of its rated current. Results shall be considered acceptable if temperatures at the load terminals comply with Table 16.

7.3 Overload test

7.3.1 General

7.3.1.1 A general-use switch shall perform successfully when operated:

a) For 50 cycles,

b) Making and breaking 150 percent of its rated current, except as noted in 7.3.1.3 and 7.3.2.10,

c) With the rate of speed being the number of cycles per minute given in Table 19,

d) At the test voltage described in 7.3.2.4,

e) For ac rated switches, a load with a power factor of 0.75 – 0.80 maximum; and

f) For dc rated switches, with a noninductive resistance load.

There shall not be any electrical or mechanical malfunction of the device or welding of the contacts. The ground fuse shall not have opened. Burning or pitting of the contacts shall be considered to be acceptable, but line-to-line breakdown shall be considered to be unacceptable.

7.3.1.2 A horsepower- or kilowatt-rated switch shall perform successfully when operated:

a) For 50 cycles of operation for switches rated 74.6 kW or 100 horsepower or kilowatt and less, or 10 cycles of operations for switches rated over 74.6 kW or 100 horsepower,

b) Making and breaking current given in Table 17 and Table 18,

c) With the rate of speed being the number of cycles per minute given in Table 19 (operations with current); the switch rating in amperes shall be assumed to be equal to 60 percent of the required overload test current. A switch rated in excess of 74.6 kW or 100 hp need not be operated faster than 1 cycle per minute,

d) A test voltage as described in 7.3.2.4;

e) For ac rated switches, a load with a power factor of 0.45 – 0.50 maximum; and

f) For dc rated switches, a load with a time constant of not less than 0.003 seconds.

There shall not be any electrical or mechanical malfunction of the device or welding of the contacts. The ground fuse shall not have opened. Burning or pitting of the contacts shall be considered to be acceptable, but line-to-line breakdown shall be considered to be unacceptable.

Table 17
Overload-test currents in amperes for alternating-current switches

Switch in rating		120 V			240 V			480 V			600 V		
kW	hp	1φ	2φ 4-Wire	3φ	1φ	2φ 4-Wire	3φ	1φ	2φ 4-Wire	3φ	1φ	2φ 4-Wire	3φ
0.125	1/6	26.4	–	–	13.2	–	–	–	–	–	–	–	–
0.187	1/4	34.8	–	–	17.4	–	–	–	–	–	–	–	–
0.248	1/3	43.2	–	–	21.6	–	–	–	–	–	–	–	–
0.373	1/2	58.8	–	40	29.4	–	20	–	–	10	–	–	8
0.56	3/4	82.8	28.8	50	41.4	14.4	25	21	7.2	12.5	16.8	6	10
0.746	1	96	38.4	60	48	19.2	30	24	9.6	15	19.2	7.8	12
1.119	1-1/2	120	54	80	60	27	40	30	13.8	20	24	10.8	16
1.492	2	144	70.8	100	72	35.4	50	36	18	25	28.8	14.4	20
2.238	3	204	99.6		102	49.8	64	51	25.2	32	40.8	19.8	25.6
3.73	5	336	158		168	79.2	92	84	39.6	46	67.2	31.8	36.8
5.6	7-1/2	480	228		240	114	127	126	54	63.5	96	48	50.8
7.46	10	600	288		300	144	162	156	72	81	120	60	64.8
11.19	15		432			216	232		108	116		84	93
14.92	20		564			282	290		138	145		114	116
18.65	25		708			354	365		174	183		144	146
22.38	30		828			414	435		210	218		168	174
29.84	40		1 080			540	580		270	290		216	232
37.3	50		1 360			678	725		336	363		270	290
44.76	60						870			435			348
55.95	75						1 085			543			434
74.6	100						1 450			725			580

Table 17 Continued on Next Page

b) With the line connected to the hinge jaws and the load connected to the other set of contact jaws,

c) With the line connected to one set of contact jaws and the load connected to the hinge jaws, and

d) With the line connected to the other set of contact jaws and the load connected to the hinge jaws.

7.3.1.5 A double-throw switch for use as optional standby systems in accordance with Annex A, Ref. No. 1, shall be tested according to one of the following methods:

a) Subjected to the overload test using both sets of contacts simultaneously. During the test, the source of one set of contacts shall be displaced 120 electrical degrees from the source of the other set of contacts for a 3-phase supply or 180 electrical degrees for a single-phase supply.

b) If the double-throw switch is provided with a mechanical means to reduce the likelihood of the load switching from the normal source of supply to an alternate source of supply in one continuous motion, testing in accordance with 7.3.1.4 shall be permitted.

c) If the double-throw switch is constructed such that the movable contact of the normal supply is not in motion at the same time as the movable contact of the alternate supply, testing in accordance with 7.3.1.4 shall be permitted.

7.3.1.6 A cycle for a double throw-switch for use as optional standby systems in accordance Annex A, Ref. No. 1, is defined as making and breaking the required test current on both sets of contacts.

7.3.2 Test conditions

7.3.2.1 A switch shall be mounted as in actual service with the door or cover and any other openings closed. The line terminals shall be connected to a supply circuit, and the load terminals shall be connected to the necessary resistance or impedance.

7.3.2.2 A deadfront switch shall be mounted in a panelboard or on a representative chassis, provided spacings from live parts in the switch to the main bus structure and to grounded chassis metal are representative of those in the complete panelboard.

7.3.2.3 A switch intended for use on dc circuits and a switch not specially marked for alternating current only shall be tested with direct current, and with the device so connected that the enclosure will be positive in potential with respect to the nearest arcing point.

7.3.2.4 The open-circuit voltage shall not be less than 100 percent of the rated voltage of the switch, and the closed-circuit voltage shall not be less than 90 percent of the rated voltage of the switch or the normal-frequency recovery voltage shall be equal to the rated voltage of the device.

7.3.2.5 A switch intended for ac circuits only shall be tested with alternating current with an inductive load. The test shall be made on a circuit having a maximum frequency of 60 Hz. Resistance and reactance components of the load shall not be connected in parallel, except that an air-core reactor in any phase may be shunted by resistance, the loss in which is approximately 1 percent of the total power consumption in that phase. The shunting resistance used with an air-core reactor may be calculated from the following formula:

$$R_{SH} = 100[(1 / PF) - PF]E / I$$

in which PF is the power factor, E is the closed-circuit phase voltage, and I is the phase current.

7.3.2.6 A switch intended for use on circuits having one conductor grounded shall be tested with the enclosure connected through a 30 ampere non-delay, non-renewable-type cartridge fuse to the grounded conductor. If an enclosed switch is intended for use on other types of circuits, the enclosure shall be connected through a similar fuse to the live pole least likely to strike to ground.

7.3.2.7 A 2-wire and a 3-wire switch intended for use on either 3-wire dc or single-phase ac circuits with grounded neutral shall be tested on a 3-wire dc circuit with grounded neutral, with the switch connected to the outside conductors of the circuit, and with the enclosure grounded as indicated in 7.3.2.6. If the switch is intended for use with alternating current only, it shall be tested with alternating current in a similar manner and in accordance with 7.3.2.5.

7.3.2.8 A 3-wire switch without a solid neutral intended for use on ac circuits other than that described in 7.3.2.7 and a 4-wire switch having a solid neutral shall be tested on a 3-phase circuit with a 3-phase balanced load.

7.3.2.9 A 4-wire switch without a solid neutral and a 5-wire switch shall be tested on a single-phase circuit with connections to adjacent poles, one pole being that nearest the enclosure. If the spacings between the poles differ, an additional test shall be made with connections to the pair of poles having the least separation.

7.3.2.10 A switch marked for isolating use only and rated at more than 1 200 A at 250 V or less shall be subjected to the overload test with a current of 1 800 A. A switch marked for isolation use only and rated at more than 600 A at more than 250 V shall be subjected to the overload test with current 900 A. See 9.2.12.

7.4 Endurance test

7.4.1 The same switch previously subjected to the overload test shall perform successfully when operated:

a) For the number of cycles and rate of speed indicated in Table 19,

b) Making and breaking 100 percent of its rated current. Switches for isolating use only, rated at more than 1 200 A at 250 V or less, and switches rated at more than 600 A at more than 250 V may be operated without current, if the switch is marked in accordance with 9.2.12,

c) With the test potential as described in 7.3.2.4 for an ac switch and within 5 percent of the rated voltage of the switch if direct current is used, and

d) For ac rated switches, a load with a power factor of 0.75 – 0.80 maximum; and

e) For dc rated switches, a noninductive resistance load.

There shall not be any electrical or mechanical malfunction of the device or welding of the contacts. The ground fuse shall not have opened. Burning or pitting of the contacts shall be considered to be acceptable, but line-to-line breakdown shall be considered to be unacceptable.

7.4.2 For a switch having both ampere and horsepower or kilowatt horsepower ratings, the endurance test for the horsepower- or kilowatt-rated sample need not be conducted if represented by the endurance test for the general-use rating.

7.5 Dielectric voltage-withstand test

7.5.1 A single-throw switch (with fuses, if any, in place) shall withstand for 1 minute without breakdown the application of a 48 – 62 Hz essentially sinusoidal voltage of 1 000 V plus twice the maximum rated voltage:

a) Between live parts and the enclosure with the switch closed,

b) Between terminals of opposite polarity with the switch closed, and

c) Between the line and load terminals with the switch open.

7.5.2 A double-throw switch for use in optional standby systems in accordance with Annex A, Ref. No. 1, shall have the potential voltage applied:

a) Between live parts and the enclosure with the contact alternately closed to each supply source,

b) Between terminals of opposite polarity with the contacts closed,

c) Between live parts of different circuits, and

d) Between terminals of the normal source and the alternate source with the switch in both normal and alternate positions.

7.5.3 To determine if a switch complies with the requirements in Clause 7.5, Dielectric voltage-withstand test, the device shall be stressed by means of a 500 VA or larger transformer, the output voltage of which can be varied. The applied voltage shall be increased from zero until the required test value is reached and held at that value for 1 minute. The increase in the applied voltage shall be at a substantially uniform rate and as rapid as is consistent with its value being correctly indicated by the voltmeter. A transformer less than 500 VA shall be permitted if the output voltage is measured directly.

7.6 Clamped joint test

7.6.1 A clamped joint between two insulators (reference 6.6.1.18) shall be tested using two samples:

a) The clamped joint on the first sample shall be opened up to produce a space 3.2 mm (1/8 inch) wide. This may be accomplished by loosening the clamping means or by drilling a 3.2 mm (1/8 inch) diameter hole at the joint between the insulators at a point of minimum spacing between the metal parts on the opposite sides of the joint. The drilled hole shall not decrease spacings between the opposite polarity parts as measured through the crack between the insulators. The 48 – 62 Hz dielectric breakdown voltage through this hole shall then be determined by applying a gradually increasing voltage (500 V per second) until breakdown occurs.

b) The second sample, with the clamped joint intact, shall be subjected to a gradually increasing 48 – 62 Hz voltage until 110 percent of the breakdown voltage of item (a) has been reached. If the breakdown voltage of item (a) is less than 4 600 V rms, the voltage to be applied to the second sample shall be further increased to 5 000 V rms and held for 1 second. There shall be no electrical breakdown of the second sample.

7.7 Close-open test

7.7.1 Switches rated higher than 10 000 amperes short-circuit current shall comply with the Close-open test requirements in 7.7.2 – 7.7.6.

7.7.2 A deadfront switch shall be mounted and connected to the test circuit in the same manner as for the overload test as specified in 7.3.2.2.

9.2.56 The characters in the markings described in 9.2.52 – 9.2.54 shall not be less than 2.4 mm (3/32 inch) high.

9.2.57 With respect to the requirement in 6.7.2.21, a switch shall be marked to indicate the specific tightening torque for each wire connector in the switch that is intended for field wiring. If different connectors are used for line or load, the specific torques to be applied to each connector shall be clearly indicated.

9.2.58 A switch shall be marked in a readily visible location to indicate the required temperature rating of all field-installed conductors.

9.2.59 A terminal of a switch capable of securing two or more combinations of conductors in multiple, any of which has an ampacity acceptable for the applications, shall be identified and marked unless the switch is acceptable for use with the combination of wires requiring the largest wiring space, in accordance with 6.10.2.2. The terminal shall be identified by a prominent marking, such as on a wiring diagram, that will state the number and sizes of wires of which the terminal is acceptable.

9.2.60 A marking employing a wording differing from that given in 9.2.50 – 9.2.54 shall be permitted if it clearly and completely conveys the significant information. Any abbreviation designating copper and aluminum shall be "AL-CU", "CU-AL", or equivalent.

9.2.61 In an enclosed switch provided with fuseholders for branch circuits, all branch circuit terminals shall be so marked that the connections of each branch circuit can be readily identified, unless the relative arrangement of the terminals makes this unnecessary. This marking shall appear either on, or near to, the terminal plates and shall not appear only on parts that must be removed in order to wire the switch. A wiring diagram shall be considered a satisfactory alternative.

9.2.62 The month and year of manufacture, at least, shall be marked on each enclosed switch in a location accessible without the use of other than normally available tools such as screwdrivers, pliers, and wrenches.

Note: Date coding, serial numbers, or equivalent means may be used.

9.2.63 A double-throw switch investigated for use in optional standby systems in accordance with Annex A, Ref. No. 1, shall be marked, "Manually-operated switch suitable for use in optional standby power systems in accordance with _____". (where the “blank” is to be filled in with the appropriate text from Annex A, Ref. No. 1) or similar wording. The marking shall be an integral part of the marking containing the manufacturer's name and the electrical rating, unless it is an integral part of another required marking of the switch.

9.2.64 Enclosed switches marked “Suitable for use as service equipment” and provided with protection from inadvertent contact in a field installable kit, as permitted in 6.4.5, shall be marked “Install Service Barrier Kit, Cat. Number ____” or equivalent.

9.3 Electrically tripped switches

9.3.1 In addition to the requirements of 9.2, a switch provided with electrical tripping means shall be marked with the control circuit ratings as follows:

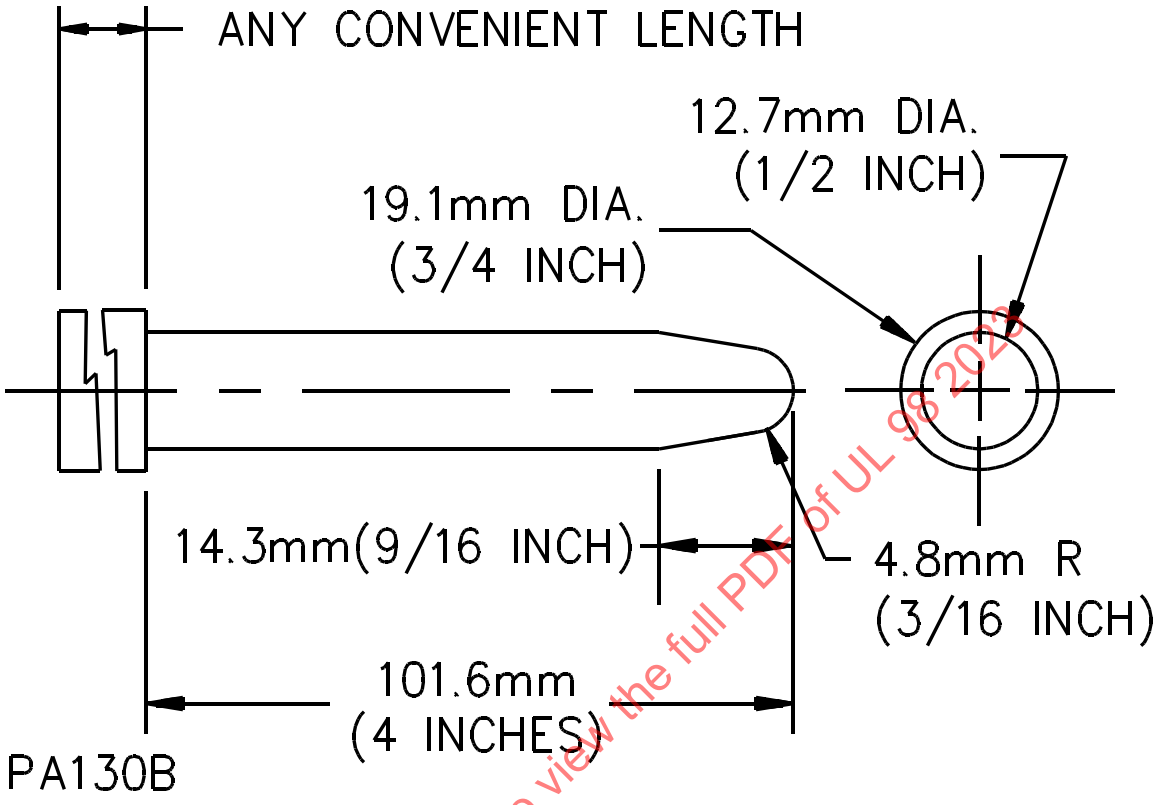
a) Voltage and frequency (or "DC") of tripping circuit, and

b) Amperes, including inrush and sealed value for ac rated devices.

9.3.2 If control fuses are provided, the rating shall be marked adjacent to the control circuit fuseholder.

Figure 6

Straight probe



Revision History

CSA C22.2 No. 4:16, Enclosed and dead-front switches — originally published February 2016

Note: *For information about the **CSA Standards Update Service**, go to **store.csagroup.org** or e-mail techsupport@csagroup.org.*

Update No. 1 — August 2019	**Revision symbol (in margin)**
Title page, copyright page, Preface, and Clauses 1.1, 6.1.3 d), 6.1.7, 6.1.8, 6.4.1, 7.1.7, 7.2.10, 8.2.1, 8.3.1, and 9.2.47, Tables 2, 10, 14, 15, 16, 17, 18, 19, 20, 21, 22, 25, and 26 and Annex A • Update your copy by inserting these revised pages. • Keep the pages you remove for reference.	|

National Standard of Canada — October 2020
Outside front cover, National Standard of Canada text, title page. 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.

The following is a list of revisions, additions and deletions to CSA C22.2 No. 4:16:

National Standard of Canada — October 2020

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CSA C22.2 No. 4:16
Enclosed and dead-front switches

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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

(Title Page Reprinted: August 30, 2019)

ANSI/UL 98-2019

Revision History

C22.2 No. 4-16, Enclosed and dead-front switches — originally published February 2016

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Title page, copyright page, Preface, and Clauses 1.1, 6.1.3 d), 6.1.7, 6.1.8, 6.4.1, 7.1.7, 7.2.10, 8.2.1, 8.3.1, and 9.2.47, Tables 2, 10, 14, 15, 16, 17, 18, 19, 20, 21, 22, 25, and 26 and Annex A • Update your copy by inserting these revised pages. • Keep the pages you remove for reference.	|

Safety for Enclosed and Dead-Front Switches

Eigth Edition, Dated February 12, 2016

Summary of Topics

This revision dated August 30, 2019, includes the following changes in requirements:

Revisions for Field Installed Barriers

Addition of Requirements for Class CA, CB and G Fuses

Revisions for the Addition of Voltage Ratings From 601 to 1000 V

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.

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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 Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the standard may be submitted to ANCE, CSA Group, or UL at anytime. Revisions to this standard will be made only after processing according to the standards development procedures of ANCE, CSA Group, and UL. CSA Group and UL 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 UL pages.

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This Standard is subject to review 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 inquires@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 August 30, 2019. The most recent designation of ANSI/UL 98 as an American National Standard (ANSI) occurred on August 30, 2019. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

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

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CONTENTS

SUPPLEMENT SA - Enclosed and Deadfront Switches Intended for Marine Use

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 revised on August 30, 2019. For this purpose, CSA Group and UL are issuing revision pages dated August 30, 2019, and ANCE is issuing a new edition dated August 30, 2019.

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.

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 1000 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 as 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.

No Text on This Page

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.

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 either:

i) Securely attached at the factory to either the switch or to the accessory to be installed, or

ii) Provided in the form of a kit made available by the manufacturer that complies with 6.1.7 and 6.1.8.

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.

6.1.7 A DC rated multipole switch that requires poles to be wired in series and allows for different series configurations of the poles, barriers and/or jumpers may be field installed if all of the following are met:

a) Barriers are either supplied with or made available by the manufacturer as part of a kit;

b) Jumpers, if other than wire, are supplied with the barriers mentioned in a) or made available by the manufacturer as part of the kit;

c) The kit complies with 6.1.3 (c), (e), and (f);

d) The kit contains all required hardware; and

e) Instructions for the use of barriers and/or jumpers are permanently marked on the switch for each of the different configurations. In lieu of applying all markings to the switch, a separate document shall be included with the switch and the switch shall be marked with a permanently affixed label that reads: ″For the proper configuration of connections of the terminals, refer to Publication No. _____ provided with this switch.″ The document shall include:

1) The switch manufacturer's name and type designation or equivalent;

2) Publication number and date or equivalent;

3) Switch electrical ratings, number of poles; and

4) A schematic of each of the intended wiring configurations for each marked rating.

6.1.8 If the manufacturer's instructions specify the installer is to provide the wire, detailed information as to the wire size, insulation type, length, strip length, and physical configuration shall be provided. If the instructions require the wire to be bent with a radius less than the cold bend mandrel requirements of Annex A, Ref. No. 16, the jumpers shall be provided with the switch or kit as required in 6.1.7.

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.

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