UL 1682

STANDARD FOR SAFETY

Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type

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UL Standard for Safety for Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type, UL 1682

Fifth Edition, Dated February 15, 2017

SUMMARY OF TOPICS

This revision of ANSI/UL 1682 dated March 11, 2022 includes an alternative terminal identifier for the connection of the grounded conductor; Table 19

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

The revised requirements are substantially in accordance with Proposal(s) on this subject dated September 3, 2021 and November 26, 2021.

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Association of Standardization and Certification
NMX-J-719-ANCE
First Edition

CSA Group
CSA C22.2 No. 182.1:17
Fifth Edition

Underwriters Laboratories Inc.
UL 1682
Fifth Edition

Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type

February 15, 2017

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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 ANSI/UL Standard for Safety consists of the Fifth Edition including revisions through March 11, 2022. The most recent designation of ANSI/UL 1682 as an American National Standard (ANSI) occurred on March 11, 2022. 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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Full document details: UL 1682 2022

CONTENTS

Preface **5**

1 Scope 7
2 Definitions 7
3 General 9
3.1 Components 9
3.2 Reference publications 9
3.3 Units of measurement 15
4 Construction 16
4.1 General 16
4.2 Configurations 16
4.3 Insulating material 16
4.4 Resistance to corrosion 17
4.5 Enclosures 18
4.6 Current-carrying parts 19
4.7 Clearances and creepage distances 19
4.8 Accessibility of live parts 20
4.9 Grounding/bonding and dead-metal parts 21
4.10 Grounding/bonding connections 22
4.11 Terminal parts 22
4.12 Pin-type (insulation-piercing) or insulation-displacement terminals 23
4.13 Assembly 23
4.14 Interlocks 24
4.15 Devices intended to accommodate a fuse 24
4.16 Cord or cable grip 25
5 Tests 26
5.1 Representative devices 26
5.2 Accelerated aging 27
5.3 Comparative tracking index 27
5.4 Glow wire 27
5.5 High-current arc resistance to ignition 27
5.6 Mold stress relief 28
5.7 Moisture absorption resistance 29
5.8 Humidity 29
5.9 Insulation resistance 30
5.10 Dielectric withstand 30
5.11 Conductor secureness 31
5.12 Cord or cable secureness 31
5.13 Impact (plugs and connectors) 32
5.14 Crush 33
5.15 Withdrawal force 33
5.16 Grounding path current (In Mexico and the United States only) 34
5.17 Short circuit withstand (motor rated devices) 34
5.18 Strength of insulating base and support 40
5.19 No-load endurance 40
5.20 Endurance with load 40
5.21 Overload 41
5.22 Abnormal overload 42
5.23 Horsepower rated locked rotor 43
5.24 Electromagnetic (pilot contacts) 43
5.25 Temperature rise 44
5.26 Resistance to arcing 44
5.27 Polarization integrity 45

AVA Documents
Document Sharing Hub
Full document details: UL 1682 2022

5.28 Resistance to corrosion 45
5.29 Moisture resistance 45
5.30 Environmental enclosure type designators 46
5.31 Pin-type (insulation-piercing) or insulation-displacement terminals 46
6 Ratings 50
6.1 General 50
7 Markings 51
7.1 Details 51
7.2 Identification and marking of terminals 57

SUPPLEMENT SA – REPLACEMENT PARTS FOR USE WITH SPECIFIC MANUFACTURER'S PLUGS, RECEPTACLES, and CABLE CONNECTORS of the PIN and SLEEVE TYPE (MANDATORY)

INTRODUCTION

SA1 Scope 75
SA2 General 75
SA3 Definitions 75

CONSTRUCTION

SA4 General 75

PERFORMANCE

SA5 General 75
SA6 Replacement Part Assembly Test 75

MARKINGS

SA7 General 76

INSTRUCTIONS

SA8 General 76

SUPPLEMENT SB – EQUIPMENT WIRING TERMINALS FOR USE WITH COPPER CONDUCTORS (For Mexico Only)

SB1 Mechanical Sequence 77
SB1.1 Secureness test 77
SB1.2 Pullout test 80

ANNEX A (informative) Component Standards

ANNEX B (informative)

Documents
Document Sharing Hub
Full document details: UL 1682 2022

Preface

This is the harmonized ANCE, CSA Group, and UL Standard for Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type. It is the First edition of NMX-J-719-ANCE, the Fifth edition of CSA C22.2 No. 182.1, and the Fifth edition of UL 1682. This edition of CSA-C22.2 No. 182.1 supersedes the previous edition published in February 2014. This edition of UL 1682 supersedes the previous edition published on February 7, 2014. This harmonized standard has been jointly revised on March 11, 2022. For this purpose, CSA Group and UL are issuing revision pages dated March 11, 2022, and ANCE is issuing a new edition dated March 11, 2022.

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 Subcommittee, 23H, 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.

The present Mexican standard was developed by the CT 23 – Accesorios eléctricos (Artefactos eléctricos) from the Comite de Normalizacion de la Asociacion de Normalizacion y Certificacion, A.C., CONANCE, with the collaboration of the plugs, receptacles and conductors manufacturers and users.

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

Application of Standard

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

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

Level of harmonization

This Standard is published as an equivalent Standard.

An equivalent Standard is a Standard that is substantially the same in technical content, except as follows. Technical deviations are allowed for Codes and Government Regulations and 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.

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Reasons for Differences From IEC

There is no corresponding IEC standard.

Interpretations

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

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1 Scope

1.1 This standard applies to pin and sleeve type plugs, receptacles, power inlets, and connectors, rated up to 800 amperes and up to 600 volts ac or dc, and which may include up to eight pilot contacts. These devices are intended to provide power from branch circuits, or are for direct connection to the branch circuit in accordance with the Canadian Electrical Code Part I, the National Electrical Code (NEC), ANSI/NFPA 70, and the Mexican Electrical Code, NOM 001 SEDE, using copper conductors, for use in either indoor or outdoor nonhazardous locations. In Canada, the terminals of a device intended to accommodate aluminum conductors also comply with CSA C22.2 No. 65.

1.2 This standard does not apply to single conductor pin and sleeve devices. Single pole locking-type separable connectors are covered by CSA C22.2 No. 1691/UL 1691.

1.3 This standard does not apply to:

a) Devices molded integrally with flexible cord or cable that are covered by UL 817, CSA C22.2 No. 21, and NMX-J-195-ANCE;

b) General and special use devices, such as attachment plugs, receptacles, cord connectors, inlets, current taps, flatiron and appliance plugs, that are covered by UL 498, CSA C22.2 No. 42, CSA C22.2 No. 57, CSA C22.2 No. 182.2, NMX-J-412-ANCE, NMX-J-412/2-1-ANCE, NMX-J-412/2-2-ANCE, NMX-J-412/2-3-ANCE, NMX-J-412/2-4-ANCE, NMX-J-412/2-5-ANCE, and NMX-J-412/2-6-ANCE;

c) Single and multi-pole connectors intended for connection to copper conductors, for use in data, signal, control and power applications within and between electrical equipment, where exposed, that are covered by UL 1977 and CSA C22.2 No. 182.3;

d) Devices intended for use in hazardous (Classified) locations that are covered by UL 1203 and CSA C22.2 No. 159; and

e) Products such as switched interlocks that are covered by UL 508 and CSA C22.2 No. 14.

2 Definitions

2.1 For the purposes of this standard, the following definitions apply.

2.2 CONNECTOR (CABLE CONNECTOR) – A portable receptacle that is intended to provide power, with means for attachment of flexible cord or cable and not intended for permanent mounting.

2.3 CONTACT – A conductive element in a component that mates with a corresponding element to provide an electrical path.

2.4 CONTACT, PILOT – A conductive element intended to carry an indicating or controlling signal.

2.5 DELAYED ACTION – An arrangement that delays the separation of device housings which is intended to reduce the likelihood of exposure of arcing contacts during the breaking of the circuit when the plug is withdrawn.

2.6 ENCLOSURE – The case or housing into which the insulator and contacts are assembled. The enclosure system can be composed of elements such as outlet boxes, mounting panels, receptacles, plugs, and connectors.

2.7 GROUNDING/BONDING CONDUCTOR – In the U.S. and Mexico, a conductor that is defined in the National Electrical Code (NEC), ANSI/NFPA 70, and the Mexican Electrical Code, NOM 001 SEDE, as an

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Equipment Grounding Conductor, and in Canada, a conductor that is defined in the Canadian Electrical Code Part I, C22.1, as a Bonding Conductor.

2.8 GROUNDING/BONDING PATH – A path between the grounding/bonding pin, or contact and the grounding/bonding terminal or, if the device has no grounding/bonding terminal, the point at which the path makes contact with a part of the metal raceway system, such as a box, box cover, or the raceway itself.

2.9 GROUNDING/BONDING TYPE DEVICE – A device having a grounding/bonding path.

2.10 INSULATION, ELECTRICAL – The insulation necessary for the proper functioning of the product and for basic protection against electrical shock.

2.11 INSULATOR – That portion of a device that provides for separation and support of contacts.

2.12 INTERLOCKED RECEPTACLE (OUTLET) – An outlet having a device, either electrical or mechanical, that is intended to reduce the likelihood of energizing the contacts before proper engagement with the plug, and that either is intended to reduce the risk of the plug being withdrawn while its contacts are energized or deenergizes the line contacts before separation.

2.13 LOCKING RETAINING MEANS – A mechanical arrangement that holds a plug or connector in position when it is in proper engagement and is intended to reduce the likelihood of its unintentional withdrawal. It can also facilitate environmental sealing.

2.14 MOTOR RATING – In Canada and the United States, a rating expressed in horsepower (hp) and/or full load locked-rotor current and voltage assigned to a device that is intended to control a motor load.

In Mexico, a rating expressed in horsepower (hp) /kilowatts (kW) and/or full load locked-rotor current and voltage assigned to a device that is intended to control a motor load.

2.15 PIN AND SLEEVE DEVICE – A plug, receptacle, power inlet, or connector utilizing contacts that generally are cylindrical or circular and telescoping and are shrouded by an extension of the enclosure of the mating devices.

2.16 PLUG (ATTACHMENT PLUG) – A device intended to receive power when inserted in a receptacle or connector, which establishes connection between conductors of the attached flexible cord or cable and the conductors connected to the receptacle or cable connector.

2.17 POWER INLET – A permanently mounted plug intended to receive power from a cable connector.

2.18 RECEPTACLE (OUTLET) – A device that is intended to provide power to an inserted plug, and that is installed as a fixed outlet or on equipment.

2.19 SWITCHED RECEPTACLE – An outlet with an associated or integral switching device to disconnect the supply from the receptacle contacts.

2.20 TERMINAL – A conductive part provided on a contact for connecting a conductor.

2.21 TERMINAL, CRIMP TYPE – A terminal in which an electro-mechanical connection is made between the terminal lug and a conductor by compressing the lug onto the conductors.

2.22 TERMINAL, FIELD WIRING – A terminal to which power supply, load, control, or grounding/bonding connections will be made in the field when the device is installed.

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

2.24 TERMINAL, PIN-TYPE (INSULATION-PIERCING) – A terminal having a contact pin that punctures the conductor insulation to contact the current-carrying conductor.

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

2.26 TERMINAL, SET SCREW – A terminal in which the clamping pressure is applied by the end of the screw bearing directly on the conductor.

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

3 General

3.1 Components

3.1.1 Except as indicated in Clause 3.1.2, a component of a product covered by this standard shall comply with the requirements for that component. See Annex A for a list of standards covering components generally used in the products covered by this standard. A component shall comply with the ANCE, CSA or UL standards as appropriate for the country where the product is to be used.

3.1.2 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.

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

3.1.4 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.

3.1.5 For products intended for use in Canada, general requirements are given in CAN/CSA-C22.2 No. 0, General Requirements – Canadian Electrical Code, Part II.

3.2 Reference publications

3.2.1 Products covered by this standard shall comply with the reference installation codes and standards 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.

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

ANCE Standards

NOM 001 SEDE,
Mexican Electrical Code

NMX-J-005-ANCE-2005,
General Use Switches for Fixed Electrical Installations – General Requirements and Test Methods

NMX-J-009/4248/1-ANCE-2009,
Low Voltage Fuseholders – Part 1: General Requirements

NMX-J-009/4248/4-ANCE-2009,
Low Voltage Fuseholders – Part 4: Fuseholders Class CC

NMX-J-009/4248/5-ANCE-2009,
Low Voltage Fuseholders – Part 5: Fuseholders Class G

NMX-J-009/4248/6-ANCE-2009,
Low Voltage Fuseholders – Part 6: Fuseholders Class G

NMX-J-009/4248/8-ANCE-2009,
Low Voltage Fuseholders – Part 8: Fuseholders Class J

NMX-J-009/4248/9-ANCE-2009,
Low Voltage Fuseholders – Part 9: Fuseholders Class K

NMX-J-009/4248/11-ANCE-2007,
Fuseholders – Part 11: Type C (Edison Base) and Type S Plug Fuse

NMX-J-009/4248/12-ANCE-2009,
Low Voltage Fuseholders – Part 12: Fuseholders Class R

NMX-J-009/4248/15-ANCE-2009,
Low Voltage Fuseholders – Part 15: Fuseholders Class T

NMX-J-162-ANCE-2014,
Enclosed and Dead-Front Switches

NMX-J-195-ANCE-2006,
Power Supply Cords and Extension Cord Sets for Electrical Appliances – Specifications and Test Methods

NMX J 235/2-ANCE-2014,
Enclosures – Enclosures for Electrical Equipment, Environmental Considerations

NMX-J-266-ANCE-2014,
Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

NMX-J-412-ANCE-2008,
Attachment Plugs and Receptacles – General Specifications and Test Methods

Documents
Document Sharing Hub
Full document details: UL 1682 2022

NMX-J-412/2-1-ANCE-2008,
Attachment Plugs – Specifications and Test Methods

NMX-J-412/2-2-ANCE-2008,
Receptacles – Specifications and Test Methods

NMX-J-412/2-3-ANCE-2009,
Cord Connectors – Specifications and Test Methods

NMX-J-412/2-4-ANCE-2009,
Current Taps and Adapters – Specifications and Test Methods

NMX-J-412/2-5-ANCE-2009,
Flat Iron and Appliance Plugs – Specifications and Test Methods

NMX-J-412/2-6-ANCE-2009,
Hospital Grade Devices – Specifications and Test Methods

NMX-J-515-ANCE-2008,
Distribution and Control Equipment – Safety General Requirements - Specifications and Test Methods

NMX-J-565-ANCE-2004,
Safety Requirements – Humidity Conditioning - Test Conditioning

NMX-J-565/2-10-ANCE-2010,
Fire Hazard Testing – Part 2-10: Glowing / Hot-Wire Based

NMX-J-565/3-ANCE-2006,
Safety Requirements – Flammability of Plastic Materials for Parts in Devices and Appliances – Test Methods

NMX-J-565/6-ANCE-2007,
Safety requirements – Hot wire resistance to ignition – Test method

NMX-J-565/7-ANCE-2007,
Safety requirements – High-current arc resistance to ignition – Test method

NMX-J-597/1-ANCE-2007,
Insulation Coordination for Equipment within Low Voltage Systems – Part 1: Principles, Requirements and Tests

NMX-T-024-SCFI,
Rubber Industry – Determination of Shore "A" Hardness – Tests Methods

NMX-T-144-SCFI,
Rubber Industry – Raw Materials – Softening Point – Ring and Ball Test Method

CSA Group Standards

C22.1-15,
Canadian Electrical Code, Part I

Documents
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Full document details: UL 1682 2022

CAN/CSA-C22.2 No. 0-10 (R2015),
General Requirements – Canadian Electrical Code, Part II

C22.2 No. 0.2-16,
Insulation Coordination

CAN/CSA-C22.2 No. 0.4-04 (R2013),
Bonding of Electrical Equipment

C22.2 No. 0.15-15,
Adhesive Labels

CAN/CSA-C22.2 No. 0.17-00 (R2013),
Evaluation of Properties of Polymeric Materials

C22.2 No. 4-16,
Enclosed and Dead-Front Switches

C22.2 No. 5-16,
Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

C22.2 No. 14-13,
Industrial Control Equipment

C22.2 No. 21-14,
Cord Sets and Power Supply Cords

C22.2 No. 42-10,
General Use Receptacles, Attachment Plugs, and Similar Wiring Devices

C22.2 No. 57-15,
Appliance Plugs for Heater Cord Sets

C22.2 No. 65-13,
Wire Connectors

CAN/CSA-C22.2 No. 94-M91 (R2011),
Special Purpose Enclosures

C22.2 No. 94.2-15,
Enclosures for Electrical Equipment, Environmental Considerations

C22.2 No. 111-10 (R2015),
General-Use Snap Switches

C22.2 No. 158-10 (R2014),
Terminal Blocks

C22.2 No. 159-M1987 (R2014),
Attachment Plugs, Receptacles, and Similar Wiring Devices for Use in Hazardous Locations, Class I, Groups A, B, C, and D; Class II, Group G, in Coal or Coke Dust, and in Gaseous Mines

Documents
Document Sharing Hub
Full document details: UL 1682 2022

C22.2 No. 182.2-M1987 (R2014),
Industrial Locking Type, Special Use Attachment Plugs, Receptacles and Connectors

C22.2 No. 182.3-M1987 (R2014),
Special Use Attachment Plugs, Receptacles and Connectors

C22.2 No. 1691-12,
Single Pole Locking-Type Separable Connectors

CAN/CSA-C22.2 No. 4248-1-07 (R2012),
Fuseholders – Part 1: General Requirements

CAN/CSA-C22.2 No. 4248-4-07 (R2012),
Fuseholders – Part 4: Class CC

CAN/CSA-C22.2 No. 4248-5-07 (R2012),
Fuseholders – Part 5: Class G

CAN/CSA-C22.2 No. 4248-6-07 (R2012),
Fuseholders – Part 6: Class H

CAN/CSA-C22.2 No. 4248-8-07 (R2012),
Fuseholders – Part 8: Class J

CAN/CSA-C22.2 No. 4248-9-07 (R2012),
Fuseholders – Part 9: Class K

CAN/CSA-C22.2 No. 4248-11-07 (R2012),
Fuseholders – Part 11: Type C (Edison Base) and Type S Plug Fuse

CAN/CSA-C22.2 No. 4248-12-07 (R2012),
Fuseholders – Part 12: Class R

CAN/CSA-C22.2 No. 4248-15-07 (R2012),
Fuseholders – Part 15: Class T

UL Standards

UL 20
General-Use Snap Switches

UL 50E
Enclosures for Electrical Equipment, Environmental Considerations

UL 94
Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

UL 98
Enclosed and Dead-Front Switches

UL 486E
Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

Documents
Document Sharing Hub
Full document details: UL 1682 2022

UL 489
Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

UL 498
Attachment Plugs and Receptacles

UL 508
Industrial Control Equipment

UL 746A
Polymeric Materials – Short Term Property Evaluations

UL 746B
Polymeric Materials – Long Term Property Evaluations

UL 746C
Polymeric Materials – Use in Electrical Equipment Evaluations

UL 817
Cord Sets and Power-Supply Cords

UL 840
Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment

UL 969
Marking and Labeling Systems

UL 1203
Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations

UL 1686
Pin and Sleeve Configurations

UL 1691
Single Pole Locking-Type Separable Connectors

UL 1977
Component Connectors for Use in Data, Signal, Control and Power Applications

UL 4248-1
Fuseholders – Part 1: General Requirements

UL 4248-4
Fuseholders – Part 4: Class CC

UL 4248-5
Fuseholders – Part 5: Class G

UL 4248-6
Fuseholders – Part 6: Class H

UL 4248-8
Fuseholders – Part 8: Class J

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Full document details: UL 1682 2022

UL 4248-9
Fuseholders – Part 9: Class K

UL 4248-11
Fuseholders – Part 11: Type C (Edison Base) and Type S Plug Fuse

UL 4248-12
Fuseholders – Part 12: Class R

UL 4248-15
Fuseholders – Part 15: Class T

ANSI[1] Standards

ANSI/NFPA 70-2011[2]
National Electrical Code

ANSI/IEEE C37.09-1999 (2007)[3]
Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis

ASTM[4] Standards

ASTM D 570-98 (2010)
Standard Test Method for Water Absorption of Plastics

ASTM E 28-99 (2009)
Standard Test Methods for Softening Point of Resins Derived from Naval Stores by Ring-and-Ball Apparatus

IEC[5] Standards

IEC 60664-1 (2007)
Insulation Coordination for Equipment within Low-Voltage Systems Part 1: Principles, Requirements and Tests

IEC 60695-2-10 (2013)
Fire Hazard Testing – Part 2-10: Glowing/Hot-Wire Based Test Methods – Glow-Wire Apparatus and Common Test Procedure

[1] American National Standards Institute.

[2] National Fire Protection Association.

[3] Institute of Electrical and Electronics Engineers, Inc.

[4] American Society for Testing and Materials.

[5] International Electrotechnical Commission.

3.3 Units of measurement

3.3.1 The values given in SI (metric) units shall be normative. Any other values given shall be for information purposes only.

Documents
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Full document details: UL 1682 2022

4 Construction

4.1 General

4.1.1 The ratings mentioned throughout this standard, including those mentioned in Clause 6.1.2, represent the maximum ampacity and voltage for a device. A device is considered to be for use with either alternating or direct current unless the rating includes a marking to restrict the use to alternating current. See Clause 7.1.6.1.

4.2 Configurations

4.2.1 Combinations of pin and sleeve attachment plugs and receptacles are covered by this standard. Standardized configurations of attachment plugs and receptacle combinations are located in UL 1686.

4.3 Insulating material

4.3.1 A base or body in or on which live parts are mounted shall be of ceramic or other insulating material meeting the requirements of this standard.

4.3.2 Vulcanized fiber or rubber may be used for insulating washers, separators, and barriers, but not as the sole support for live parts. The material shall be moisture resistant in accordance with Clause 5.7.

4.3.3 A polymeric material used for electrical insulation, an internal barrier necessary to maintain electrical clearances and creepage distances, or enclosure of live parts shall have a flame class rating of HB, V-2, V-1, V-0, VTM-2, VTM-1, VTM-0, 5VA, or 5VB in accordance with the requirements of UL 94, CAN/CSA-C22.2 No. 0.17, or NMX-J-565/3-ANCE. The flammability classification shall be judged at the actual minimum thickness employed within 0.8 mm (1/32 inch) of live parts within the device.

4.3.4 In Canada, insulating materials in contact with current-carrying parts of devices that are intended for permanent installation shall have a minimum flammability classification of V-2 in accordance with CAN/CSA-C22.2 No. 0.17, in a thickness of 1.6 mm or in the minimum thickness in contact with that current-carrying part, whichever thickness is greater.

In Mexico and the United States, this requirement does not apply.

4.3.5 In Canada, insulating materials in contact with current-carrying parts of devices not intended for permanent installation shall have a minimum flammability classification of HB in accordance with CAN/CSA-C22.2 No. 0.17.

In Mexico and the United States, this requirement does not apply.

4.3.6 In Canada, as an alternative to the requirements of Clause 4.3.4, a thermosetting material may be used as an insulating material in contact with current-carrying parts of devices intended for permanent installation, provided that such material has the characteristics specified in (a) and (b) below:

a) A minimum flammability classification of HB in accordance with CAN/CSA-C22.2 No. 0.17; and

b) The continuous use temperature index (mechanical without impact) is a minimum of 100°C, in accordance with CAN/CSA-C22.2 No. 0.17.

In Mexico and the United States, this requirement does not apply.

4.3.7 The internal insulating systems of components for which component requirements exist need not have a flame class rating.

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Full document details: UL 1682 2022

4.3.8 A small part meeting all the following criteria need not have a flame class rating:

a) Its volume does not exceed 2 cm^3 (0.122 cubic inch);

b) Its maximum dimension does not exceed 3 cm (1.18 inches); and

c) Its location is such that it cannot propagate flame from one area to another or act as a bridge between a possible source of ignition and other ignitable parts.

4.3.9 Fiber and similar material that is equal to or less than 0.25 mm (0.010 inch) thick need not have a flame class rating.

4.3.10 A polymeric material used for electrical insulation, an internal barrier necessary to maintain electrical clearances and creepage distances, or enclosure of live parts shall comply with the requirements in Clauses 5.3 – 5.10.

4.3.11 A polymeric material having a maximum comparative tracking index (CTI) performance level class of 3 or a minimum CTI value of 175 need not comply with Clause 5.3.

4.3.12 A polymeric material having hot wire ignition (HWI) corresponding to the values shown in Table 1 for the applicable flammability classification need not comply with Clause 5.4.

4.3.13 A polymeric material having high-current arc resistance to ignition (HAI) corresponding to the values shown in Table 1 for the applicable flammability classification need not comply with Clause 5.5.

4.3.14 The internal insulating systems of components for which component requirements exist need not comply with the requirement in Clauses 5.3 – 5.5.

4.3.15 A small part meeting all the following criteria need not comply with the requirements in Clauses 5.3 – 5.5:

a) Its volume does not exceed 2 cm^3 (0.122 cubic inch);

b) Its maximum dimension does not exceed 3 cm (1.18 inches); and

c) Its location is such that it cannot propagate flame from one area to another or act as a bridge between a possible source of ignition and other ignitable parts.

4.3.16 Fiber and similar material that is equal to or less than 0.25 mm (0.010 inch) thick need not comply with the requirements in Clauses 5.3 – 5.5.

4.3.17 A polymeric material used for electrical insulation, an internal barrier necessary to maintain electrical clearances and creepage distances, or enclosure of live parts shall have the temperature index ratings shown in Table 2 for the specific application of the insulating material.

4.4 Resistance to corrosion

4.4.1 Parts of iron or steel other than stainless steel parts shall be protected against corrosion, in accordance with Clause 5.28.

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Full document details: UL 1682 2022

4.5 Enclosures

4.5.1 General

4.5.1.1 An enclosure shall be constructed to reduce the risk of unintentional contact with uninsulated live parts, as indicated in Clause 4.8.1, and to provide internal parts with protection from specified external conditions. Additional items used to form an enclosure, such as adapters, hoods, covers, and the like, may be permanently secured to the device. In Canada, elements of metallic enclosure systems such as outlet boxes and mounting panels shall be provided with a bonding terminal.

4.5.2 Mechanical strength

4.5.2.1 An enclosure shall have adequate strength and rigidity in accordance with Clauses 5.13 and 5.14.

4.5.3 Nonmetallic enclosures

4.5.3.1 A nonmetallic enclosure or a nonmetallic part of an enclosure shall comply with the applicable requirements in UL 746C, CAN/CSA-C22.2 No. 94, or NMX-J-/2-ANCE for Special Purpose Enclosures.

4.5.3.2 In Canada and the United States, if a nonmetallic enclosure is identified as being intended to be exposed to specific chemicals, oils, acids, solvents, cleaning agents, and the like, the performance of the enclosure material shall not be adversely affected by such substances as determined by applicable tests as described in UL 746A or CAN/CSA-C22.2 No. 0.17.

In Mexico, this requirement does not apply.

4.5.3.3 Pliable, molded natural or synthetic rubber, or a combination thereof, or a pliable composition, the basic constituent of which is vinyl chloride or a copolymer of vinyl chloride and vinyl acetate, in the finished device that complies with Clause 5.2, may be employed as an insulating material for the enclosure of an attachment plug or a cord connector.

4.5.3.4 In Mexico, a product with a nonmetallic enclosure or a nonmetallic part of an enclosure shall comply with the applicable tests of this standard.

4.5.4 Metallic enclosures

4.5.4.1 In Canada and the United States, an enclosure may be constructed of iron, steel, copper, brass, zinc, aluminum, or their alloys. Aluminum alloys containing less than 80 percent aluminum shall not be used. Magnesium and its alloys shall not be used.

In Mexico, an enclosure may be constructed of iron, steel, copper, brass, zinc, aluminum, or their alloys. Magnesium and its alloys shall not be used. Aluminum alloys containing less than 80 percent aluminum shall not be used - this shall be determined by manufacturer's declaration.

4.5.4.2 Zinc or a zinc-based alloy shall not be used for an enclosure or parts of an enclosure which are in the primary grounding/bonding path.

4.5.5 Attachment plugs

4.5.5.1 An attachment plug shall not be provided with more than one multiconductor cord-outlet hole.

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Full document details: UL 1682 2022

4.5.6 Specific enclosures

4.5.6.1 An enclosure marked with one or more environmental enclosure type designations shall comply with the applicable requirements in Clauses 5.30 and 7.1.14.

4.6 Current-carrying parts

4.6.1 A current-carrying part shall be of silver, copper, a copper alloy, or other material acceptable for the application. Plated iron or steel shall not be used for parts that are depended upon to carry current.

4.6.2 Stainless steel may be employed for a part not subject to arcing.

4.6.3 Pressure wire terminal screws and wire binding screws may be made of plated iron or steel.

4.6.4 Iron or steel, if protected against corrosion by zinc, tin, or equivalent plating, may be used for screws, plates, yokes, or other parts that are employed as a means of clamping the conductor, provided that such parts are not the primary current-carrying members.

4.6.5 Suitable means shall be provided for retaining live parts within such limits of alignment as to ensure that plugs will enter receptacles, connectors, and the like in the intended manner.

4.6.6 Uninsulated live parts shall be secured in place to ensure the clearances and creepage distances required in Clauses 4.7.1 and 4.7.3 are maintained.

4.6.7 A current-carrying part shall be prevented from turning relative to the surface on which it is mounted if such turning would result in a reduction of spacings below the minimum acceptable values.

4.7 Clearances and creepage distances

4.7.1 The clearances and creepage distances shall be not less than 6.4 mm (1/4 inch) between:

a) Field wiring terminals of opposite polarity; and

b) A field wiring terminal and any other uninsulated metal part of a different polarity.

4.7.2 For field wiring terminals intended for solder connections using solid or tin dipped stranded wire only, the minimum clearances and creepage distances between the terminals shall be as specified in UL 840, CSA C22.2 No. 0.2, or NMX-J-597/1-ANCE. See Clause 7.1.12.2.

4.7.3 In all circuits other than at field wiring terminals, the acceptability of the clearances and creepage distances between an uninsulated live part and any other uninsulated metal part not of the same polarity shall be as specified in UL 840 or IEC 60664-1 or CSA C22.2 No. 0.2 or NMX-J-597/1-ANCE.

4.7.4 The dead metal mentioned in Clause 4.7.3 includes a metal surface on which the device is mounted in the intended manner. A dead-metal screw head, rivet, or the like, shall not be considered to be exposed to contact by persons after the device is installed in the intended manner if it cannot be contacted by the probe illustrated in Figure 1.

4.7.5 Clearances and creepage distances shall be measured in accordance with UL 840 or IEC 60664-1 or CSA C22.2 No. 0.2 or NMX-J-597/1-ANCE. In determining the pollution degree and overvoltage category, the end-use application may be considered for a higher pollution degree and may modify those characteristics given in Clauses 4.7.8 and 4.7.9.

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Full document details: UL 1682 2022

4.7.6 Clearances and creepage distances shall be measured in all conditions of use, both with and without mating devices of the intended configuration installed and any movable parts displaced to the position of a minimum spacing.

4.7.7 The clearances and creepage distances required in Clause 4.7.1 shall be measured through air and over insulating and conductive surfaces with the device wired as intended with the maximum anticipated conductor size. They shall be measured from any point on the terminal that can contact the clamped conductor as in the case of a wire-binding-screw terminal, or from any point on the perimeter of an opening to receive a conductor in the case of an enclosed terminal.

4.7.8 Indoor use equipment shall comply with the requirements for pollution degree 3. Outdoor use equipment shall comply with the requirements for pollution degree 4, unless protection is afforded by a suitable enclosure appropriate for the installation in which case a lower pollution degree can be achieved. The interior of equipment with enclosure Types 3, 3S, 4, 4X, 6 and 6P or Marine Type shall comply with the requirements for pollution degree 3. Hermetically sealed or encapsulated enclosures shall comply with the requirements for pollution degree 1.

4.7.9 Plugs, connectors, inlets, and other cord connected devices shall be rated overvoltage Category II and receptacles and other devices connected to fixed wiring shall be rated overvoltage Category III as defined in UL 840 or IEC 60664-1 or CSA C22.2 No. 0.2 or NMX-J-597/1-ANCE.

4.8 Accessibility of live parts

4.8.1 To reduce the likelihood of unintentional contact that can involve a risk of electric shock from uninsulated live parts, a live part shall not be contacted by the probe illustrated in Figure 1. See Clause 4.8.6.

4.8.2 The contacts of an outlet device need not be evaluated for accessibility.

4.8.3 The probe illustrated in Figure 1 shall be applied to any depth that the recessing will permit, and shall be rotated, changed in configuration or angled before, during, and after application to any position that is necessary to examine the device.

4.8.4 The probe mentioned in Clause 4.8.1 shall be used as a measuring instrument to judge the accessibility provided by the recessing and not as an instrument to judge the strength of a material. The probe shall be applied with a force of 13 N (3 lbf) to determine accessibility.

4.8.5 During the examination of a product to determine whether it complies with the requirements in Clause 4.8.1, the device shall be wired and assembled in accordance with the manufacturer's instructions. Any other part that can be opened or removed by the user without using a tool shall be opened or removed.

4.8.6 Mating devices shall not have exposed live contacts when fully mated or during engagement or withdrawal.

4.8.7 Compliance with Clause 4.8.6 shall be determined with the use of the probe shown in Figure 1 in every possible position. See Clause 4.8.3.

4.8.8 The probe shall not be applied to holes in the shroud provided for locking if they do not exceed 10.2 mm (0.400 inch) in diameter.

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Full document details: UL 1682 2022

4.9 Grounding/bonding and dead-metal parts

4.9.1 A grounding/bonding type device shall have a separate contact for interconnection of the grounding/bonding conductor. In Canada, the means for providing bonding shall comply with CAN/CSA C22.2 No. 0.4.

4.9.2 The grounding/bonding terminal or lead and its corresponding contact of a male inlet or equipment outlet intended for permanent installation shall be conductively connected to the mounting means, housing, hood, shell or other dead-metal parts of a device that can come into contact with the equipment enclosure.

4.9.3 In the United States and Mexico, the conductive connection need not be provided if the mounting means, housing, hood, or shell is constructed of an insulating material and the lack of ground continuity to the equipment enclosure is readily apparent.

In Canada, this requirement does not apply.

4.9.4 In the United States and Mexico, the conductive connection need not be provided if the device is marked in accordance with Clause 7.1.3.1.

In Canada, this requirement does not apply.

4.9.5 A device that has a metal shell used as the grounding/bonding contact member shall be as follows:

a) The surface of the shell that is depended upon for grounding/bonding continuity shall not have a non-conductive coating or otherwise be subjected to conditions that can result in loss of grounding/bonding continuity;

b) One or more separate spring type components shall be incorporated to provide grounding/bonding path continuity;

c) The grounding/bonding components shall be protected against damage; and

d) In the United States and Mexico, the shell shall comply with the requirements of Clause 5.16. In Canada, this requirement does not apply.

4.9.6 The grounding/bonding contact shall be located and formed so the path of electrical continuity to the grounding/bonding contact of the mating plug is completed before continuity is established between any other contact and its respective contact on the plug.

4.9.7 The grounding/bonding contact need not make contact before any other contact if the device is of the interlocked type, which requires disconnection of the supply circuit before the plug can be inserted or removed.

4.9.8 The grounding/bonding contact path, except for the metal housing or mounting, shall be of copper or a copper alloy or equivalent material. If a metal housing is a part of the primary grounding/bonding path, it shall not be of zinc or a zinc-based alloy.

4.9.9 A copper-base alloy rivet that is used to hold parts together in the grounding/bonding-contact path or forms a part of the grounding/bonding path shall not contain less than 80 percent copper.

4.9.10 A connection in the grounding/bonding-contact path shall be secured by riveting, bolting, clamping, or welding or by an equivalent mechanical means of securement, capable of complying with the requirements of Clause 5.16.

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Full document details: UL 1682 2022

4.9.11 In mating devices provided with a grounding/bonding contact, the grounding/bonding contact shall not be capable of touching a line-side phase contact, independent of any polarization feature of the enclosure. This requirement is applicable only to devices rated 100 A and less, with four or fewer power contacts, excluding grounding/bonding contacts. Such devices shall comply with the requirements of Clause 5.27.

4.9.12 All exposed non-current-carrying metal parts of a device that are likely to become energized shall be conductively connected to the ground/bond.

4.9.13 Grounding/bonding and other dead-metal parts shall be secured in place so that the spacings required in Clause 4.7 are maintained.

4.10 Grounding/bonding connections

4.10.1 The grounding/bonding conductors of a device shall not be smaller in size than as indicated in Table 3.

4.10.2 An integral grounding/bonding pigtail lead for field connection shall not be shorter than 150 mm (6 inches).

4.10.3 A terminal provided for the field connection of a grounding/bonding conductor shall:

a) Employ a mechanical clamping means that does not depend upon solder for the connection of the wire; and

b) Be capable of securing a conductor of the minimum size indicated in Table 3.

4.11 Terminal parts

4.11.1 Devices shall be provided with suitable terminals or leads for the connection of conductors having an ampacity not less than the current rating for which they are intended in accordance with NFPA 70, CEC C22.1, or NOM-001-SEDE, as applicable. See Clauses 7.1.1.2 – 7.1.1.5.

4.11.2 In the United States, pressure wire and set screw terminals used with single or multiple copper conductors for fixed wiring shall comply with the applicable requirements in UL 486E. In Canada, the terminals of a device shall comply with the applicable requirements of CSA C22.2 No. 158. In Mexico, the terminals of a device intended to accommodate 8 AWG or larger conductor shall comply with the requirements of Supplement SB, Equipment Wiring Terminals for Use with Copper Conductors.

4.11.3 The tightening torque for the field wiring terminals of the devices mentioned in Clause 4.11.2 shall be specified by the device manufacturer and shall be marked as described in Clause 7.1.12.1.

4.11.4 A terminal plate that has a tapped hole for a soldering lug or pressure-wire connector shall be at least 1.27 mm (0.050 inch) thick and shall have no fewer than two full threads in the metal for a terminal screw.

4.11.5 Wiring terminals of a receptacle or power inlet shall be located or protected such that they cannot be forced against the wiring in the terminal box or compartment during installation.

4.11.6 Crimp type terminals may be provided with an inspection hole at the end of the crimp well to assure the full insertion of the conductor. Devices with crimp terminals shall be provided with manufacturer's installation instructions and be used with stranded conductors only and marked in accordance with Clause 7.1.12.3.

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Full document details: UL 1682 2022

4.11.7 Wire binding screws used in making electrical connections shall not be smaller than as indicated in Table 4. Wiring terminal screws shall have no fewer than two threads of engagement into metal.

4.11.8 A No. 8 or larger binding screw that has more than the number of threads per inch indicated in Table 4, with a terminal plate formed from stock 0.76 mm (0.030 inch) thick, may have the metal extruded at the tapped hole to provide the two full threads of minimum engagement for the binding screw. To determine compliance with note b of Table 4, six devices shall be used. Solid 14 AWG (2.1 mm^2) copper wire shall be placed under the screw head and wrapped 2/3 – 3/4 turn around the screw. The screw shall then be tightened with a clutch-type torque screwdriver which has been calibrated and preset to release at 1.8 N·m (16 lbf in).

4.11.9 A wiring terminal that involves a wire-binding screw shall have upturned lugs, or the equivalent, to hold a wire under the head of the screw.

4.11.10 Terminal parts that are depended upon to carry current and that come into contact with branch circuit conductors other than the grounding/bonding conductor shall not have a coating of zinc or cadmium.

4.11.11 For a receptacle or an inlet, the integral supply leads shall not be shorter than 10 cm (4 inches).

4.12 Pin-type (insulation-piercing) or insulation-displacement terminals

4.12.1 In addition to the general performance requirements, an attachment plug or cord connector that employs either pin-type (insulation-piercing) or insulation-displacement terminals shall also comply with the requirements in Clause 5.31.

4.12.2 Attachment plugs or cord connectors that employ either pin-type (insulation-piercing) or insulation displacement terminals shall not be rated more than 30 amperes.

4.13 Assembly

4.13.1 General

4.13.1.1 A device incorporating two or more pieces shall be of such design that any intended grounding/bonding contact polarization will not be defeated by improper assembly during installation.

4.13.1.2 Means shall be provided for securely attaching the body of an inlet to the supporting base. When assembled, the body shall be prevented from turning with respect to the base.

4.13.1.3 Screws upon which the permanent assembly of a device depends shall not loosen under normal use.

4.13.1.4 A device shall be capable of being readily wired as intended and shall be capable of accepting a flexible cord, cable, or Appliance Wiring Material (AWM) having an ampacity at least equal to the rating of the device and of the type and size specified by the manufacturer.

4.13.1.5 Electrical contact shall be reliably maintained at any point at which a connection is made between current-carrying parts.

4.13.1.6 A sealing compound, if used, and in contact with live parts, shall be of an insulating, waterproof material that will not melt or flow at a temperature lower than the temperature rating of the conductors.

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Full document details: UL 1682 2022

4.13.1.7 In Canada and the United States, the determination of the softening point of a sealing compound shall be made in accordance with ASTM E 28. In Mexico, the determination of the softening point of a sealing compound shall be made in accordance with NMX-T-144-SCFI.

4.13.1.8 Sulphur shall not be not acceptable as a sealing compound.

4.13.2 Mating and intermateability

4.13.2.1 A device, including any configuration illustrated in Figures C1 – C5 of UL 1686, shall be constructed so that electrical continuity between respective and similarly marked terminals is established when the mating plug and outlet device are connected together.

4.13.2.2 An outlet device shall not permit an attachment plug other than one that is specifically intended for use with the outlet to be inserted to the extent that electrical contact is made.

4.13.2.3 Attachment plugs, cord connectors, power inlets, receptacles, and other devices that have different electrical ratings or are intended to be wired with conductors having different temperature ratings shall not be interchangeable with one another. See Clauses 5.24.2, 7.1.1.3, and 7.1.1.4.

4.14 Interlocks

4.14.1 An interlocked switch or circuit breaker employed in an outlet-plug combination shall be constructed so the plug cannot be withdrawn from the outlet while the contacts are alive, or be inserted when the switch or circuit breaker is in the “On” position.

4.14.2 The interlocked switch or circuit breaker shall break all ungrounded supply conductors.

4.14.3 The interlocking mechanism shall comply with the requirements of Clause 5.19.

4.14.4 A pilot contact switch shall comply with the applicable requirements for auxiliary devices in UL 508, CSA C22.2 No. 14, or NMX-J-515-ANCE.

4.14.5 A switch shall comply with the applicable requirements in the following:

a) NMX-J-162-ANCE/CSA-C22.2 No. 4/UL 98,

b) UL 508, CSA C22.2 No. 14, or NMX-J-515-ANCE, or

c) NMX-J-005-ANCE /CSA C22.2 No. 111/UL 20.

4.14.6 An interlock employing a circuit breaker shall comply with the applicable requirements in NMX-J-266-ANCE/CSA C22.2 No. 5/UL 489.

4.15 Devices intended to accommodate a fuse

4.15.1 Devices shall be constructed so that they will accommodate an enclosed fuse or fuses having a voltage rating not less than the voltage rating of the device.

4.15.2 The arrangement for holding the fuse shall comply with the requirements in NMX-J-009/4248/1-ANCE/CSA C22.2 No. 4248.1/UL 4248-1, in conjunction with any of the associated Standards tabulated below, as applicable for the class of fuseholder:

a) NMX-J-009/4248/4-ANCE/CSA C22.2 No. 4248.4/UL 4248-4,

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Full document details: UL 1682 2022

b) NMX-J-009/4248/5-ANCE/CSA C22.2 No. 4248.5/UL 4248-5,

c) NMX-J-009/4248/6-ANCE /CSA C22.2 No. 4248.6/UL 4248-6,

d) NMX-J-009/4248/8-ANCE/CSA C22.2 No. 4248.8/UL 4248-8,

e) NMX-J-009/4248/9-ANCE/CSA C22.2 No. 4248.9/UL 4248-9,

f) NMX-J-009/4248/11-ANCE/CSA C22.2 No. 4248.11/UL 4248-11,

g) NMX-J-009/4248/12-ANCE/CSA C22.2 No. 4248.12/UL 4248-12, or

h) NMX-J-009/4248/15-ANCE/CSA C22.2 No. 4248.15/UL 4248-15.

4.15.3 A device shall include provision for a fuse in each ungrounded conductor, but there shall not be any provision for a fuse in any other conductor.

4.15.4 The removal or replacement of a fuse shall not expose any live parts in a device to personal contact.

4.15.5 The construction of a plug shall ensure that a fuse or fuses will not be removable when the plug is engaged in an outlet.

4.15.6 An enclosure shall be provided for the fuse or fuses in a device intended to accommodate such components. An enclosure shall comply with all of the following:

a) It shall be of a moisture-resistant material in accordance with Clause 5.7.

1) Fiber and similar absorptive materials shall not be considered as having moisture-absorptive properties acceptable for use as the enclosure of a fuse.

2) Molded phenolic and similar thermosetting polymeric materials shall be considered as having moisture-absorptive properties acceptable for use as the enclosure of a fuse.

b) It shall reduce the likelihood of persons unintentionally contacting uninsulated live parts of the fuse and fuse holder.

c) It shall confine the effects of a fuse rupture to the interior of the enclosure.

d) It shall comply with the requirements for insulating materials in Clauses 4.3.3 – 4.3.5.

4.15.7 Polymeric materials used as the enclosure of a fuse shall have a flame class rating of V-0, V-1, V-2, 5VA, or 5VB in accordance with the requirements of UL 94, CAN/CSA-C22.2 No. 0.17, or NMX-J-565/3-ANCE.

4.16 Cord or cable grip

4.16.1 A cord or cable grip shall be provided on a plug or cord connector to:

a) Permit the flexible supply cord or cable to be readily replaced; and

b) Prevent a stress from being transmitted to the conductor connections within the terminal enclosure.

4.16.2 Devices provided with a suitable flexible conduit adapter or threaded inlet need not comply with the requirement of Clause 4.16.1.

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