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Standard for Safety for Splicing Wire Connectors

Fifth Edition, Dated June 30, 2023

Summary of Topics

This Fifth Edition dated June 30, 2023 includes clarification regarding insulating covers during stress corrosion tests, the addition of Annex G – Conductor Stranding and testing with metric and non-standard size conductors.

Commitment for Amendments

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This ANSI/UL Standard for Safety consists of the Eighth Edition. The most recent designation of ANSI/UL 486C as an American National Standard (ANSI) occurred on June 30, 2023. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

The Department of Defense (DoD) has adopted UL 486C on January 28, 1992. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

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Preface

This is the harmonized ANCE, CSA Group, and ULSE standard for Splicing Wire Connectors. It is the fifth edition of NMX-J-548-ANCE, the fifth edition of CSA C22.2 No. 188, and the eighth edition of UL 486C. This edition of NMX-J-548-ANCE supersedes the previous edition published May 5, 2021. This edition of CSA C22.2 No. 188 supersedes the previous edition published on May 5, 2021. This edition of UL 486C supersedes the previous edition published May 5, 2021.

This harmonized standard was prepared by the Association of Standardization and Certification (ANCE), the CSA Group, and ULSE. The efforts and support of the Technical Harmonization Committee for Connectors, 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.

The present Mexican standard was developed by the SC 20D – Conectores part of the CT 20 – Conductores from the Comité de Normalización de la Asociación de Normalización y Certificación, A.C., CONANCE, with the collaboration of the connectors manufacturers and users.

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

Application of Standard

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

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

Level of harmonization

This standard uses the IEC format but is not based on, nor is it to be considered equivalent to, an IEC standard. This standard is published as an equivalent standard for ANCE, CSA Group, and ULSE.

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

Reasons for differences from IEC

The Technical Harmonization Committee identified several IEC standards that address electrical wire connectors included in the scope of this standard. The IEC standards for electrical wire connectors are recognized as being generally system-specific, containing the requirements for the relevant wire connectors and cables in many discrete IEC standards.

The THC determined the safe use of electrical wire connectors is dependent on the design and performance of the wire connectors in relation to the North American electrical codes with which they are intended to be installed. The THC agreed such future investigation would be facilitated by the harmonization of the North American electrical codes for wire connectors with IEC installation practices.

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 This Standard applies to single-polarity, hand-, or tool-applied splicing wire and cable connectors intended for use with all alloys of copper, aluminum conductors, or copper-clad aluminum conductors, or all three, in accordance with the Canadian Electrical Code Part I, CSA C22.1, in Canada, the National Electrical Code, NFPA-70, in the United States of America, or the Standard for Electrical Installations, NOM-001-SEDE, in Mexico, as follows:

Note: Copper-clad aluminum conductors are for use only in the United States in accordance with the National Electrical Code, NFPA 70.

- a) Connectors intended to hold two or more conductor(s);
- b) Connectors intended for use in appliances and equipment that comply with the requirements for such appliances and equipment;
- c) Connectors intended for use with 6 AWG (13.3 mm²) or smaller conductors;
- d) Uninsulated connectors that are used in circuits rated 8 000 V and less;
- e) Connectors intended for use in air-handling spaces; and
- f) Exothermically welded wire connectors.

Note: Examples of splicing wire connectors include twist-on connectors, insulation-piercing or displacement connectors, spring-action connectors, tool-applied crimp, mechanical set-screw connectors, etc.

1.2 This Standard is intended for splicing wire connectors suitable for use with conductors in the size ranges as follows:

- a) Aluminum:
 - 1) 12 AWG (3.3 mm²) and 10 AWG (5.3 mm²) solid;
 - 2) 12 AWG (3.3 mm²) to 6 AWG (13.3 mm²) stranded, Class B concentric, compressed, and compact; and
 - 3) 12 AWG (3.3 mm²) to 6 AWG (13.3 mm²) stranded single input wire (SIW).

In Mexico, the use of aluminum conductors is permitted only with thermoset insulation and for sizes of 6 AWG (13.3 mm²) and higher.
- b) Copper-clad aluminum:
 - 1) In Canada, this construction is not allowed.
 - 2) In Mexico, this construction is not allowed.
 - 3) In the United States:
 - i) 12 AWG (3.3 mm²) and 10 AWG (5.3 mm²) solid; and
 - ii) 12 AWG (3.3 mm²) to 6 AWG (13.3 mm²) stranded, Class B concentric, compressed, and Class C concentric.
- c) Copper:
 - 1) 30 AWG (0.05 mm²) to 10 AWG (5.3 mm²) solid; and

2) 30 AWG (0.05 mm²) to 6 AWG (13.3 mm²) stranded, Class B concentric and compressed, and Class C concentric.

d) Compact-stranded copper conductors:

In Canada and Mexico, for 8 AWG (8.4 mm²) and 6 AWG (13.3 mm²).

In the United States this is not applicable.

e) Rigid (solid and stranded) metric wire sizes, Classes 1, 2, 5, and 6, in the range of 0.5 – 10 mm², in addition to AWG sizes, with AWG ratings mandatory and metric wire ratings optional.

Note 1: Metric wire sizes are based on the IEC Standard for Conductors of Insulated Cables, IEC 60228.

Note 2: For example, a connector rated for 6 AWG (13.3 mm²) – 14 AWG (2.1 mm²) may be additionally rated for 10 – 2.5 mm². See Annex C for example.

f) Other class and strand configurations as indicated by marking.

1.3 These requirements cover splicing wire connectors intended for:

- a) Copper-to-copper;
- b) Aluminum-to-aluminum;
- c) Copper-clad aluminum-to-copper-clad aluminum;
- d) Copper-to-aluminum or copper-clad aluminum and aluminum-to-copper-clad aluminum conductor combinations intended for intermixing of conductors and dry locations only; or
- e) All of the above.

1.4 This Standard is intended for splicing wire connectors suitable for currents not exceeding the ampacity of insulated conductors rated 75 °C or 90 °C, in accordance with the rating of the connector.

1.5 This Standard does not apply to:

- a) Insulated splicing wire connectors intended for use at voltage levels in excess of 2 000;
- b) Terminal wire connectors;
- c) Wire binding screw terminals;
- d) Built-in terminal connectors on devices rated less than 30 A and intended for outlet box mounting or having provision for stress relief;
- e) Built-in terminal connectors on devices having integral cable clamps;
- f) Flat quick connect terminals; and
- g) Soldering lugs.

2 Reference publications

2.1 Normative references

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.

2.1.1 ANCE Standards

NMX-J-192-ANCE, *Wires and Cables – Flame Test on Electrical Cables – Test Methods*

NMX-J-417-ANCE, *Wires and Cables – Forced-Convection Air Ovens for Evaluation of Polymeric Materials Used in Cables, Electrical Equipment and Devices – Specifications*

NMX-J-508-ANCE, *Wiring Devices – Safety Requirements – Specifications and Test Methods*

2.1.2 CSA Standards

C22.1, *Canadian Electrical Code, Part I(CE Code)*

C22.2 No. 0, *General-requirements – Canadian Electrical Code, Part II*

C22.2 No. 0.17, *Evaluation of Properties of Polymeric Materials*

2.1.3 IEC† Standards

IEC 60228, *Conductors of Insulated Cables*

† *International Electrotechnical Commission*

2.1.4 UL Standards

UL 746C, *Polymeric Materials – Use in Electrical Equipment Evaluations*

UL 2043, *Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces*

2.1.5 NFPA* Standards

ANSI/NFPA 70, *National Electrical Code (NEC)*

NFPA 90A, *Installation of Air-Conditioning and Ventilating Systems*

* *National Fire Protection Association*

2.1.6 NOM Standards – Mexican Secretary of Energy

NOM-001-SEDE, *Standard for Electrical Installations*

2.1.7 ULC Standards

ULC/ORD-C2043, *Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces*

2.1.8 Other Codes

International Mechanical Code

Uniform Mechanical Code

2.2 Informative references

2.2.1 See Annex [A](#) for a listing of supplemental standards.

3 Units of measure

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

3.2 For conductor sizes, AWG conductor sizes are noted with their metric equivalents in parenthesis, followed by the closest metric conductor size covered by the IEC Standard for Conductors of Insulated cables, IEC 60228.

Note 1: Specifications for conductor sizes for both AWG and metric are shown as follows: 12 – 6 AWG (3.31 – 13.3) / 4.0 – 10.0 mm².

Note 2: IEC 60228 covers conductors in the metric range of 0.5 – 2 500 mm². For requirements covering AWG wire ranges outside this scope, the specification for the metric conductor will be limited to the conductor range covered by IEC 60228.

4 Definitions

For the purpose of this Standard, the following terms and definitions apply.

4.1 Circular Mil (Cmil) – the area of a circle with a diameter of 0.001 in.

4.2 Control Conductor – an unbroken conductor that is included in the current-cycling test loop.

4.3 Crimping Die – that part of a crimping tool which forms the crimp(s) and usually incorporates the crimp anvil(s), the crimp indenter(s), and the positioner.

Note: Crimping dies may have a separate or integral section for compressing the insulation grip, if provided.

4.4 Equalizer – a busbar that provides for equipotential and uniform current flow in a stranded conductor without adversely affecting the temperature of the connector(s).

4.5 Packaging Container – the container in which the unit containers are packaged.

4.6 Single Input Wire (SIW) – a stranded conductor that varies the number of wires within a range of conductor sizes in order to permit that range of conductor sizes to be constructed from a single wire size.

4.7 Splicing Wire Connector – a connector that establishes a connection between two or more conductors by means of mechanical pressure and is not intended to be permanently mounted.

4.8 Stability Factor S – the measure of temperature stability of a connector during the current-cycling test.

4.9 Temperature Rating – the maximum temperature of an insulated connector assigned by the manufacturer.

4.10 Temperature Rise – the difference of the temperature of the connector, measured under load, and the ambient temperature.

4.11 Unit Container – the smallest container in which connectors are packaged.

4.12 Voltage Rating – the maximum voltage of an insulated connector.

5 Symbols and abbreviations

5.1 ° – Degree

5.2 A – Amps, Amperes

5.3 Al – Aluminum

5.4 AWG – American Wire Gage/gauge

5.5 C – Celsius

5.6 CC or CCA – Copper-clad aluminum

5.7 Cu – Copper

5.8 d – Days

5.9 f – Flexible

5.10 h – Hour

5.11 HgNO₃ – Mercurous nitrate

5.12 Hz – Hertz, cycles per second

5.13 in – Inches

5.14 m – Meter

5.15 mil – Thousandth of an inch

5.16 min – Minutes

5.17 ml – Milliliter

5.18 mm – Millimeter

5.19 mm² – Square millimeter

5.20 N – Newton – Kilogram meter/sec²

5.21 NH₄ – Ammonia

5.22 r – Rigid solid and rigid stranded

5.23 rpm – Revolutions per minute

5.24 s – Seconds

5.25 SAE – Society of Automotive Engineers

5.26 sol – Solid

5.27 str – Stranded

5.28 V – Volts

6 Construction requirements

6.1 General

6.1.1 For products intended for use in Canada, general requirements are given in CSA C22.2 No. 0.

6.1.2 The design and construction of a connector intended for use with stranded conductors shall be such that all strands of the conductor shall be contained within the connector.

6.1.3 The clamping or twist-on movement of a connector shall adapt it for use with conductors of different sizes, when such use is intended, without permanent removal or addition of parts. Examples of clamping means are:

- a) Direct-bearing screws with or without use of a pressure plate;
- b) Deformation of the connector barrel (crimping) using a special tool;
- c) Element for insulation piercing or insulation displacement;
- d) Spring-action clamp;
- e) Helical coiled spring; and
- f) Formed insulation cavity (no spring).

6.1.4 Any rearrangement or adjustment of a connector that is necessary to adapt it to various sizes of conductors shall be obvious unless the connector is marked as described in [10.11](#).

6.1.5 There shall be no sharp edges or corners on the outer surface of a connector that result in damage to insulation that the connector contacts.

6.2 Intermixing

6.2.1 Intermixing (direct conductor contact) between conductors of different materials shall be permitted if the connector meets the performance requirements of this Standard and is marked in accordance with [10.5](#)(d).

6.3 Materials

6.3.1 The main current-carrying part of a connector shall be of aluminum, an aluminum alloy, copper, a copper alloy, or other material investigated and found to meet the performance requirements of this Standard.

6.3.2 Except as specified in [6.3.3](#), a connector body of a copper, copper alloy, aluminum, or aluminum alloy and intended for aluminum conductor shall be coated with an electrically conductive coating, such as tin, that will inhibit oxidation and corrosion.

Note: Other coatings may be used if investigated for the purpose and found suitable.

6.3.3 With reference to [6.3.2](#), the following need not be coated:

- a) A connector shipped prefilled with an oxide-inhibiting compound; and
- b) A connector of aluminum or aluminum alloy that is intended for aluminum conductor only.

6.3.4 Iron or steel, if protected against corrosion, may be used for screws, plates, yokes, springs, or other parts that are employed as a means of clamping the conductor, if such parts are not the primary current-carrying members.

6.3.5 Insulation employed as a part of the connector shall be suitable for its rated temperature in accordance with [Table 6.1](#).

Table 6.1
Operating temperature ratings of connector insulation materials

Material	Temperature, °C
Thermoplastic ^a	75
	90
	105
	125
	150
Phenolic ^b	150
Urea ^c	100
Melamine ^d	130
Melamine ^e	150
^a Assigned by the manufacturer.	
^b Composition may be filled or unfilled.	
^c Unless the compound has been found by test to be acceptable for use at a higher temperature.	
^d Composition with a specific gravity less than 1.55.	
^e Composition with a specific gravity 1.55 or more. Compound may have cellulosic filler material.	

6.3.6 Insulation employed as a part of the connector shall be suitable for the tested voltage rating of the connector in accordance with [Table 6.2](#).

Table 6.2
Insulation puncture and flashover test voltages, Tests A and B

Connector insulation voltage rating, V	Test voltage, Vac	
	Puncture (1 min)	Flashover (maximum)
300	2 200	4 000
600 (1 000 in signs and luminaires)	3 400	8 000
1 000	5 000	11 000
1 500	7 000	16 000
2 000	9 000	21 000

6.3.7 The insulating material shall have a minimum flammability classification of V-2 or VTM-2 as determined by tests described in Annex [B](#). The material thickness for determining the flammability shall be measured at points supporting live parts or within 3 mm (0.118 in) of live parts, whichever is less.

Note: Insulating tubing that has a VW1 rating is not considered equivalent. Tubing may be tested using bar samples to achieve a V-2 minimum rating or the glow wire test (see [6.3.8](#)) may be performed.

6.3.8 With reference to [6.3.7](#), a material other than V-2 or VTM-2 may be used when the insulation of the wire connector complies with the requirements for the glow-wire test as specified in UL 746C, or CSA C22.2 No. 0.17, or NMX-J-508-ANCE, with a glow wire at a temperature of 750 °C.

6.3.9 The insulation color of a twist-on or set-screw connector rated for aluminum conductor shall be purple or brown. The insulation color of a twist-on or set-screw connector rated for copper wire only shall be any color other than purple or brown.

6.3.10 Connectors intended to be installed in air-handling spaces and marked "Suitable for Use in Air-Handling Spaces," or equivalent, as indicated in [10.25](#), shall comply with System Flammability – Discrete Components Located In Air-Handling Spaces, [7.15](#).

7 Test requirements

7.1 General

7.1.1 A connector shall meet the test requirements when separate specimen sets are subjected to the tests in [Table 7.1](#) and [Table 7.2](#), as applicable, for the design of the connector.

Table 7.1
Test sequences – all connectors

Clause	Test
9.2	Current cycling
9.3.1 9.3.2 9.3.3 9.3.4	Static-heating sequence – Static heating – Secureness – Repeated static heating – Pullout
9.4.1 9.4.2	Mechanical sequence – Secureness – Pullout
9.10	Stress corrosion/moist ammonia NH ₄
9.11	Stress corrosion/mercurous nitrate (HgNO ₃)
9.12.1 9.12.2 9.12.3	Spring-action clamp sequence – Conditioning – Temperature – Dielectric withstand
9.13	Over-torque

Table 7.2
Additional test sequences for insulated connectors or connectors employing insulating covers

Clause	Test
9.5	Dielectric withstand
9.6	Secureness of insulation
9.7	Flexing
9.8	Installation at low temperature
9.9	Moisture absorption

7.1.2 For a tool-applied crimp-on connector, when the conductors are secured by a single securing means, tests shall be conducted with the conductors pre-twisted according to the instructions provided by the manufacturer and according to [10.12](#)(d) and [10.18](#). The conductors shall not be required to be pre-twisted when the design of the connector does not lend itself to direct contact, such as a butt-end splice.

7.1.3 With reference to [7.1.2](#), at the manufacturer's option, tests of connectors intended for original equipment manufacturer (OEM) use may be conducted with the conductors not pre-twisted. However, instructions for pre-twisting the conductors shall be provided for field-wiring applications. Instructions for pre-twisting shall be optional for OEM wiring applications. If the connector can be crimped without providing direct contact between the conductors, then tests shall be conducted with the connector crimped so they are not in direct contact. Connectors tested with the conductors not pre-twisted shall be marked as specified in [10.19](#).

7.1.4 For the current-cycling, static-heating sequence, and mechanical sequence tests, when more than a single conductor is secured by a single securing means, tests on duplicate specimens shall be conducted to represent the most severe conductor position conditions that could result when conductors are assembled into the connector.

7.1.5 A connector of copper or copper alloy need not be subjected to the current-cycling test using copper conductors, unless the connector is dependent upon insulation piercing, insulation displacement, or spring action.

7.1.6 A twist-on connector provided with a metal insert need not be subjected to the current-cycling test using copper conductors. A twist-on connector not provided with a metal spring shall be subjected to the current-cycling test.

7.1.7 With reference to [7.1.5](#) and [7.1.6](#), a pre-filled twist-on connector, with or without a spring insert, shall also be subjected to the current-cycling test using copper conductors.

Note: Pre-filling usually consists of a gel, epoxy, anti-oxidant, or similar compound.

7.1.8 The initial static-heating test need not be conducted in the static-heating sequence using copper conductor.

7.1.9 Conductor-sizes 30 – 20 AWG (0.05 – 0.52 mm²) need not be subjected to the secureness test in the static-heating sequence or mechanical sequence.

7.1.10 Specimen sets shall be subjected to the test sequences using the conductor material specified in [Table 7.3](#) for the one or more conductor material combinations for which the connector is intended. The dielectric withstand, stress corrosion, secureness of insulation, flexing, and low temperature installation tests may be conducted using either copper or aluminum or copper-clad aluminum conductor. When a connector is rated for copper-to-copper, aluminum-to-aluminum, and copper-to-aluminum (intermixed), or copper-clad aluminum, the mechanical sequence with copper-to-aluminum conductors may be omitted.

Table 7.3
Conductor material to be used in test sequences

Conductor for which connector is intended	Conductor used in test sequences
Copper ^a	Copper
Aluminum ^a	Aluminum
Copper-clad aluminum	Copper-clad aluminum
Copper to copper ^b	Copper
Aluminum to aluminum ^b	Aluminum
Copper-clad aluminum to copper-clad aluminum ^b	Copper-clad aluminum
Copper to aluminum ^b , intermixed	Copper to aluminum
Copper to copper-clad aluminum, intermixed	Copper to copper-clad to aluminum
NOTES: 1) Any conductor material may be used for the dielectric voltage-withstand test sequence. 2) If a connector is rated for copper to copper, aluminum to aluminum, and copper to aluminum (intermixed), the mechanical sequence with copper to aluminum conductor may be omitted. 3) In all test sequences, aluminum conductor represents tests with copper-clad aluminum conductor.	
^a Single conductor in an opening.	
^b Two or more conductors in an opening.	

7.1.11 Testing may be conducted using AWG solid and stranded sized conductors or Class 1 (rigid solid) and Class 2 (rigid stranded) metric sized conductors as follows:

- a) AWG solid conductors is representative of Class 1 metric conductors.
- b) Class 1 metric conductors is representative of AWG solid conductors.
- c) AWG stranded conductors is representative of Class 2 metric conductors.
- d) Class 2 metric conductors is representative of AWG stranded conductors.

Representative testing covers conductor sizes within the cross-sectional area envelope, as determined by the circular mils of the conductor, of the conductor sizes used as test conductors. Reference [9.1.5.5](#) – [9.1.5.6](#) for AWG stranding classes. Reference Annex [H](#) for conductor area, in circular mils, for conductor stranding, and for conductor diameters, of both AWG and metric conductor sizes.

Note: See Annex [D](#) for example.

7.1.12 A connector rated for Class 5, Class 6, or both Class 5 and 6 metric conductors (flexible stranded) shall be subjected to all test sequences using the appropriate Class of flexible metric conductors based on the ratings specified by the manufacturer. See [9.1.5.6](#) for testing with specific stranding counts.

7.1.13 Tests conducted on a connector with compact-stranded copper conductors shall be considered representative of concentric and compressed stranded copper conductors of the same size. Tests conducted on a connector with compact, compressed, or concentric-stranded aluminum conductors shall represent tests with compact, concentric, and compressed stranded aluminum conductors of the same size. See [Table 9.1](#).

7.2 Current cycling

7.2.1 The specimen sets shall complete 500 continuous cycles of current-on and current-off operations, while carrying the 60 Hz test current corresponding to the conductor size as specified in [Table 7.4](#). Other than as noted in [9.2.3](#), each cycle of operation shall consist of 1 h on and 1 h off.

Note: A current source may be maintained at or above the required value by regulation or frequent adjustment.

Table 7.4
Test current^a, A

Conductor size			Copper		Aluminum/Copper-clad aluminum	
AWG	(mm ²)	mm ²	Static heating	Current cycling	Static heating	Current cycling
30	(0.05)	—	3.0	3.5	—	—
28	(0.08)	—	3.5	4	—	—
26	(0.13)	—	5.5	6	—	—
24	(0.20)	—	7	8	—	—
22	(0.32)	—	9	12	—	—
—	—	0.5	11.7	15.6	—	—
20	(0.52)	—	12	16	—	—
—	—	0.75	15.8	18.3	—	—
18	(0.82)	—	17	19	—	—
—	—	1	17.4	19.4	—	—
16	(1.3)	—	18	20	—	—
—	—	1.5	21	23.2	—	—
14	(2.1)	—	30	33	—	—
—	—	2.5	31.7	35	—	—
12	(3.3)	—	35	39	30	43
—	—	4	40.3	45	33.5	49
10	(5.3)	—	50	56	40	60
—	—	6	54.7	61.7	43.6	64
8	(8.4)	—	70	80	55	77
—	—	10	78.3	88.3	61.6	85.3
6	(13.3)	—	95	105	75	102

NOTES:
1) Values in the mm² column represent the common sizes for metric conductors, as specified in the IEC Standard for Conductors of Insulated Cables, IEC 60228. Corresponding ampacities and test currents are determined by interpolation of the values for AWG conductors, as permitted in ANSI/NFPA 70, Section 310.15(A).
2) Conductor sizes between values provided in the table may be used for testing and rating connectors. Test currents shall be determined by interpolation of adjacent conductors based on the conductor's area. Reference [Table F.1](#) for conductor area.
^a Test current shall be from a 60 Hz ac power source.

7.2.2 The current-cycling test shall be completed without any connector exceeding the following temperature rise for any recorded cycle:

- a) Tests conducted with aluminum wire with AA-1350 alloy conductors shall not exceed a 125°C temperature rise above the ambient temperature.
- b) Tests conducted with aluminum wire with AA-8000 alloy conductors shall not exceed a 115°C temperature rise above the ambient temperature.
- c) Tests conducted with copper wire shall not exceed a 125°C temperature rise above the ambient temperature.

7.2.3 The stability factor "S_i" (see [7.2.4](#)) shall not exceed the following for connector temperature measurements taken at approximately 25, 50, 75, 100, 125, 175, 225, 275, 350, 425, and 500 cycles:

- a) Tests conducted with aluminum wire with AA-1350 alloy conductors shall not exceed a stability factor of ± 10 .
- b) Tests conducted with aluminum wire with AA-8000 alloy conductors shall not exceed a stability factor of ± 8 .
- c) Tests conducted with copper wire shall not exceed a stability factor of ± 10 .

7.2.4 The stability factor " S_i " for each of the 11 temperature measurements shall be determined by applying the following equations:

$$S_i = d_i - D$$

$$D = [(d_1 + d_2 + \dots + d_{11}) / 11]$$

in which:

D is the average temperature deviation;

i is a number from 1 to 11 and signifies one of the 11 individual temperature measurements; and

d_i is a temperature deviation for an individual temperature measurement.

Note: The value for d_i is determined by subtracting the control-conductor temperature from the connector temperature. The value for d_i is a positive number when the connector temperature is more than that of the control conductor and a negative number when the connector temperature is less than that of the control conductor. The average of the 11 temperature deviations is then determined. See Annex C for example.

7.3 Static-heating sequence

7.3.1 The specimen sets shall carry continuously the value of 60 Hz test current specified in [Table 7.4](#) for the conductor size being tested until stable temperatures are reached without exceeding a 50 °C temperature rise above ambient temperature.

Note 1: A current source may be maintained at or above the required value by regulation or frequent adjustment.

Note 2: When testing with aluminum conductors, testing may be conducted with either AA-1350 or AA-8000 conductors, with the same allowed temperature rise.

7.3.2 The joint between a connector and the conductor shall be intact after being subjected for 30 min to the secureness test described in [9.3.2](#).

7.3.3 The joint between a connector and the conductor shall be intact after being subjected for 1 min to the pullout test described in [9.3.4](#).

7.3.4 As a result of the tests, there shall be no breakage of the conductor or any strand of a stranded conductor, stripping of threads, shearing of parts, or other damage to the connector. Breaking of the conductor or any strand of a stranded conductor shall be determined by examination of the complete connector assembly while still intact after the secureness or pullout tests. Breakage has occurred if the conductor or a strand of a stranded conductor becomes visibly unattached. Strand breakage of 5 % is allowed for all classes of conductors other than B and C.

7.4 Mechanical sequence

7.4.1 The joint between a connector and the conductor shall be intact after being subjected for 30 min to the test described in [9.4.1](#).

7.4.2 The joint between a connector and the conductor shall be intact after being subjected for 1 min to the test described in [9.4.2](#).

7.4.3 As a result of the tests, there shall be no breakage of the conductor or any strand of a stranded conductor, stripping of threads, shearing of parts, or other damage to the connector. Breaking of the conductor or any strand of a stranded conductor shall be determined by examination of the complete connector assembly while still intact after the secureness or pullout tests. Breakage has occurred if the conductor or a strand of a stranded conductor becomes visibly unattached. Strand breakage of 5 % is allowed for flexible and fine stranded conductors.

7.5 Dielectric-withstand test sequence

7.5.1 An insulated wire connector shall withstand, without breakdown, the dielectric-withstand tests specified in [Table 7.5](#).

Table 7.5
Dielectric-withstand test sequence

Connector	Required test
1. A connector having insulation in the form of a tubular sleeve and intended to accommodate only one conductor in each opening ^a and intended for use with: a) 10 AWG (5.3 mm ²) / 6 mm ² or smaller conductors; or b) 8 – 6 AWG (8.4 – 13.3 mm ²) / 10 mm ² conductors.	A, C A A, B
2. Connectors having insulation in other than a tubular form and for conductor size not covered in item 1 ^b .	
NOTES: A – Test A is described in 9.5.2 . B – Test B is described in 9.5.3 . C – Test C is described in 9.5.4 .	
^a These types of connectors included insulation-piercing and push-in types. ^b These types of connectors include twist-on types.	

7.5.2 The insulation of an insulated connector shall not crack or break when the connector is assembled as intended on the conductor.

7.5.3 The oven conditioning described in [9.5.2.2](#) and [9.5.2.3](#) shall not cause the connector insulation to harden, soften, crack, deform, loosen, or otherwise change so as to adversely affect the insulating properties of the conductor insulation or the connector insulation.

Note: Discoloration of the connector insulation is allowed.

7.6 Secureness of insulation

7.6.1 The insulation of a connector shall not be damaged and shall not become detached from the body of the connector when subjected to the secureness of insulation test in [9.6](#).

7.7 Flexing

7.7.1 An insulating cover employing a hinge, a latch, or a lock shall retain its resilience and shall not crack when subjected to the flexing test specified in [9.7](#).

7.8 Low temperature installation

7.8.1 In Canada, the thermoplastic or thermosetting insulation of a compression-type connector assembled by a tool shall not crack or fracture when installed and tested in accordance with [9.8](#). This test shall not apply to insulated wire connectors intended for factory installation only.

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

7.9 Moisture absorption

7.9.1 Porcelain or cold-molded composition used as insulation on connectors shall not absorb more than 3 % of its mass when subjected to the moisture-absorption test specified in [9.9](#).

7.10 Stress corrosion/moist ammonia (NH₄)

7.10.1 A copper alloy part of a connector shall be resistant to stress corrosion cracking.

Note: The moist ammonia test is considered an alternative to the mercurous nitrate test.

7.10.2 A copper alloy part containing more than 15 % zinc shall be tested for stress corrosion cracking.

7.10.3 A copper alloy part containing more than 15 % zinc shall show no evidence of cracking when examined using a 25X magnification after being subjected to the stress corrosion/moist ammonia (NH₄) test specified in [9.10](#).

7.11 Stress corrosion/mercurous nitrate (HgNO₃)

7.11.1 A copper alloy part of a connector shall be resistant to stress corrosion cracking.

Note: The mercurous nitrate test is considered an alternative to the moist ammonia test.

7.11.2 A brass part containing less than 80 % copper shall not crack when subjected to the stress corrosion/mercurous nitrate (HgNO₃) test specified in [9.11](#).

7.12 Spring action

7.12.1 After being subjected to the conditioning in [9.12.1](#), a spring-action connector shall not exceed a temperature rise of 50 °C above the ambient temperature when tested as specified in [9.12.2](#).

7.12.2 A spring-action connector shall withstand without dielectric breakdown the application of the test potential when tested as specified in [9.12.3](#).

7.13 Over-torque

7.13.1 A connector to which torque is applied by means of a blade-type screwdriver shall withstand the values of torque as specified in [9.13](#). There shall be no shearing of parts, stripping of threads, or other damage to the connector.

7.14 Separable part securement

7.14.1 Connector insulation consisting of separable parts, such as a body and cap, shall not separate or become detached after being subjected to the test described in [9.14](#).