Association of Standardization and Certification
NMX-J-745-ANCE-2024
Second Edition

CSA Group
CSA C22.2 No. 355:24
Second Edition

ULSE Inc.
UL 486G
Second Edition

Sealed Twist-On Connecting Devices

July 22, 2024

ANSI/UL 486G-2024

Standard for Safety for Sealed Twist-On Connecting Devices

Second Edition, Dated July 22, 2024

Summary of Topics

This new Second Edition dated July 22, 2024 is issued to include editorial updates and corrections. Also included are changes in requirements to provide additional means of communicating information such as instructions, tooling, wire type(s), wire size(s), etc.

Commitment for Amendments

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

ISBN 978-1-4883-5067-2 © 2024 Canadian Standards Association

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

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This ANSI/UL Standard for Safety consists of the Second Edition.

The most recent designation of ANSI/UL 486G as an American National Standard (ANSI) occurred on July 22, 2024. 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 ULSE at any time. Proposals should be submitted via a Proposal Request in the Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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PREFACE

This is the harmonized ANCE, CSA Group, and ULSE standard for Sealed Twist-On Connecting Devices. It is the second edition of NMX-J-745-ANCE, the second edition of CSA C22.2 No. 355, and the second edition of UL 486G. This edition of NMX-J-745-ANCE, CSA C22.2 No. 355 supersedes the previous edition published on January 2018. This edition of UL 486G supersedes the previous edition published September 2022.

This harmonized standard was prepared by the Association of Standardization and Certification, (ANCE), CSA Group and ULSE. The efforts and support of the Technical Harmonization Committee, CANENA Technical Harmonization Committee 99 – Electrical Connectors on the Harmonization of Electrotechnical Standards of the Nations of the Americas (CANENA), are gratefully acknowledged. are gratefully appreciated.

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

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

An identical standard is a standard that is exactly the same in technical content except for national differences resulting from conflicts in codes and governmental regulations. Presentation is word for word except for editorial changes.

Interpretations

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

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Sealed Twist-On Connecting Devices

1 Scope

1.1 The wire connectors covered by these requirements are intended for use with copper conductor in accordance with installations covered by the National Electrical Code, NFPA 70; the Canadian Electrical Code, Part I, CSA C22.1; and NOM 001 SEDE, Standard for Electrical Installations. The requirements in this standard cover twist-on style splicing sealed wire connectors intended for installations for applications noted below:

a) In accordance with wiring methods where the connector is installed in enclosures rated for the environment and located in dry locations, damp locations, wet locations, below grade, or above grade.

b) In lighting systems operating at 30 volts or less (rated 25 amperes and 30 volts, 42.4 volts peak, maximum), and lighting equipment connected to a Class 2 power source; where the connector is located in dry locations, damp locations, wet locations, direct buried locations, below grade, or above grade where protected from direct exposure to sunlight.

NOTE: Sealed wire connectors used in these applications do not require the use of an enclosure.

c) In Canada, Class 2 circuits located in dry locations, damp locations, wet locations, direct buried locations, below grade, or above grade where protected from direct exposure to sunlight. In the United States and Mexico, Class 2 and Class 3 circuits located in dry locations, damp locations, wet locations, direct buried locations, below grade, or above grade where protected from direct exposure to sunlight.

NOTE: Sealed wire connectors used in these applications do not require the use of an enclosure.

1.2 Splicing sealed wire connectors covered by this standard are intended for use with single or multiple conductor underground feeder cable, golf course sprinkler cable, underground low energy cable, irrigation cable, or other cable with insulation acceptable for direct burial, below grade use, or wet locations.

1.3 Splicing sealed wire connectors covered by this standard are intended for use with copper conductor sizes 30 AWG (0.05 mm^2) through 6 AWG (13.3 mm^2) with currents not exceeding the ampacity of insulated conductors rated either 75 °C (167 °F) or 90 °C (194 °F) and intended for use at 600 V or less.

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

2 Reference Publications

2.1 Undated and dated references

2.1.1 For undated references to standards, such reference shall be considered to refer to the latest edition and all revisions to that edition up to the time when this standard was approved. For dated references to standards, such reference shall be considered to refer to the dated edition and all revisions published to that edition up to the time this standard was approved.

2.2 Normative references

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

ASTM G21, *Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi*

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

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

CSA C22.2 No. 188, *Splicing Wire Connectors*

NFPA 70, *National Electrical Code (NEC)*

NMX-J-548-ANCE, *Splicing Wire Connectors*

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

UL 486C, *Splicing Wire Connectors*

3 Units of Measurement

3.1 The dimensional values given in SI (metric) units shall be normative. Any other values provided in parenthesis are for information purposes only.

3.2 Conductor sizes expressed in AWG/kcmil units shall be normative. Conductor sizes expressed in mm^2 are for information only and represent a soft conversion of AWG/kcmil wire sizes. These wire sizes in mm^2 do not typically exist.

Note: 4 AWG (21.2 mm^2) – A typical commercially available wire size would be 25 mm^2, not 21.2 mm^2.

4 Definitions

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

4.2 SEALED WIRE CONNECTOR – a connector and its integral insulating and sealing components.

5 Symbols and Abbreviations

5.1 ° – Degree

5.2 A – Amps, Amperes

5.3 AWG – American Wire Gage

5.4 C – Celsius

5.5 Cu – Copper

5.6 h – Hour

5.7 Hz – Hertz, cycles per second

5.8 in – Inches

5.9 kcmil – Thousand circular mils

5.10 m – Meter

5.11 min – Minutes

5.12 mL – Milliliter

5.13 mm – Millimeter

5.14 mm^2 – Square millimeter

5.15 sol – Solid

5.16 str – Stranded

5.17 V – Volts

6 Construction

6.1 Wire connectors

6.1.1 Wire connectors shall comply with UL 486C, CSA C22.2 No. 188, or NMX-J-548-ANCE, as applicable.

6.2 Insulation

6.2.1 Material used in the outer cover to insulate a sealed wire connector system shall be resistant to fungi attack. Materials not known to be resistant to fungi shall comply with Level 0 or 1. A natural, organic fiber such as cotton, paper, jute, or hemp shall not be used. Materials known to be resistant to fungi, such as polypropylene, polyvinyl chloride, EPDM rubber, or glass, need not be investigated for fungi resistance.

In the United States and Canada, ASTM G21 shall be used to determine compliance with level 0 or 1. In Mexico, a national standard to evaluate the fungi attack does not exist. It is recommended that ASTM G21 be used as a supplemental document in performing the evaluation.

7 Test Requirements

7.1 General

7.1.1 A sealed wire connector shall comply with the current-cycling, static-heating sequence, and mechanical sequence tests, as appropriate, described in UL 486C, CSA C22.2 No. 188, or NMX-J-548-ANCE, as applicable.

7.2 Test sequence

7.2.1 Tests 7.3 – 7.10 shall be performed in a series.

7.3 Flex conditioning

7.3.1 The flex conditioning shall be performed in accordance with 9.3.

7.4 Immersion

7.4.1 The sample assemblies shall be immersed in water in accordance with 9.4.

7.5 Heat conditioning

7.5.1 The sample assemblies shall be heat conditioned in accordance with 9.5.

7.6 Cold conditioning

7.6.1 The sample assemblies shall be cold conditioned in accordance with 9.6.

7.7 Repeated immersion

7.7.1 The sample assemblies shall be re-immersed in water in accordance with 9.7.

7.8 Insulation resistance

7.8.1 The insulation resistance of a sealed wire connector system shall not be less than 6 MΩ in accordance with 9.8.

7.9 Dielectric withstand

7.9.1 A sealed wire connector system shall withstand the applied voltage without breakdown in accordance with 9.9.

7.10 Leakage current

7.10.1 The leakage current through a sealed wire connector system shall not exceed 1 mA in accordance with 9.10.

8 Sampling Requirements

8.1 General

8.1.1 Three samples each of the maximum fill conductors and the minimum fill conductors shall be tested. These samples shall be used for the series of tests in sequence as described.

8.1.2 The term "maximum size wire" refers to the maximum wire size for a range-taking connector and refers to the maximum circular mil area for a connector rated for multiple wire combinations.

8.1.3 The term "minimum size wire" refers to the minimum wire size for a range-taking connector and refers to the minimum circular mil area for a connector rated for multiple wire combinations.

9 Test Methods

9.1 General

9.1.1 New assemblies shall be used for each test sequence.

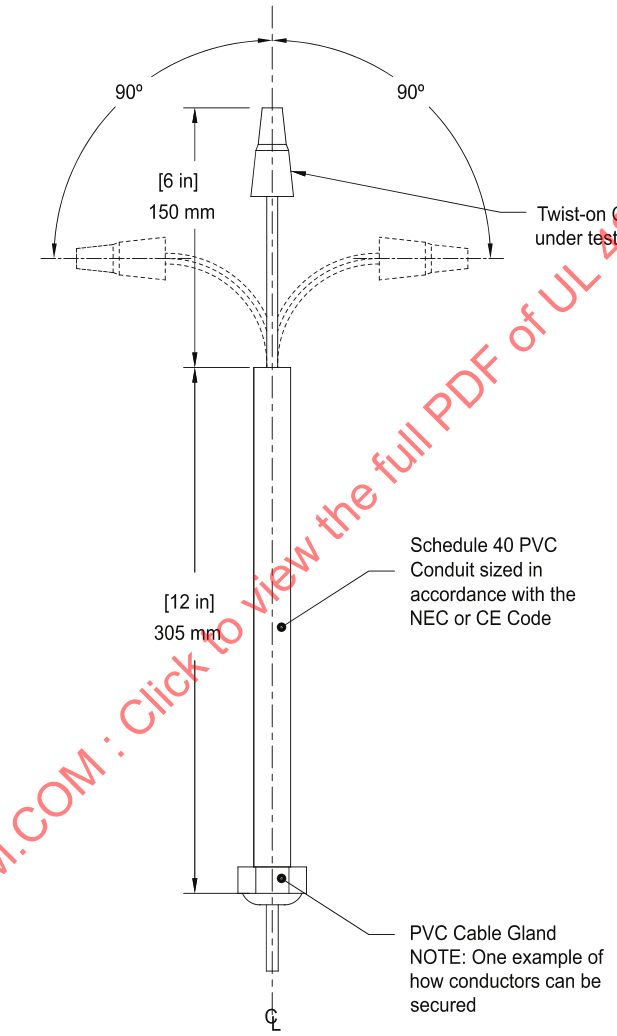
9.1.2 The preparation of the connector assemblies shall be as specified in Clause 8 and in accordance with UL 486C, CSA C22.2 No. 188, or NMX-J-548-ANCE, as applicable. The resulting bundle of conductors shall be routed through a section of conduit that is 305 mm (1 ft) in length and the free length of conductors shall extend beyond the opening of the conduit by 150 mm (6 in). The conduit shall be a Schedule 40 rigid PVC conduit with an inside diameter that results in a percentage fill as close to 40 % as

possible, but without exceeding that amount. The bundled conductors shall be secured at the opposite end of the conduit. See Figure 9.1.

NOTE: NEC Chapter 9, Table 4 may be referenced in determining wire fill calculations. (The smallest Schedule rigid PVC conduit is trade size 1/2 inch.)

Figure 9.1

Flex Conditioning



9.1.3 For conductors 14 AWG and larger, the conductors shall be Type RHW, USE, XHHW, RW90 EP, RW90 XLPE, or TWU or one of the types specified in 1.2. For conductors 16 AWG and smaller, the conductor insulation shall be thermoplastic at least 0.76 mm (0.030 in) thick.

9.2 Test sequence

9.2.1 Tests 9.3 – 9.10 shall be performed in series.

9.3 Flex conditioning

9.3.1 Each seal formed by the twist-on type connector and the conductor shall be subjected to this test. The free length of conductors that include the sealed connector shall be bent 90° to one side and returned to the starting position, and then bent 90° in the opposite direction and returned to the starting position. This cycle shall be repeated nine more times. Figure 9.1 illustrates a typical test assembly for a twist-on type connector. (At any point in the test sequence after the flex conditioning test, the bundle of conductors may be removed from the 305 mm (1 ft) length of conduit for the remaining tests.)

9.4 Immersion

9.4.1 The assemblies shall be immersed in a tank that contains tap water at a temperature of 25 ±5 °C (77 ±9 °F) for a duration of 24 h. All parts of the assemblies shall be immersed to a minimum depth of 305 mm (1 ft).

9.5 Heat conditioning

9.5.1 Following the immersion, the assemblies shall be removed from the water and conditioned in an air-circulating oven at a temperature of 65 ±5 °C (149 ±9 °F) for 48 h.

9.6 Cold conditioning

9.6.1 Immediately following heat conditioning, the assemblies shall be conditioned at a temperature of minus 18 ±2 °C (0 ±4 °F) for 4 h.

9.7 Repeated immersion

9.7.1 Immediately following the cold conditioning test, the assemblies shall be subjected to repeated immersion tests described in 9.4.1.

9.8 Insulation resistance

9.8.1 While still immersed, the assemblies shall be subjected to an insulation resistance test. The insulation resistance of each assembly shall be measured by applying a minimum direct-current voltage of 500 V for 1 min. The length of the immersed conductor shall be constant. The total length of the immersed conductors along with each connector assembly shall not exceed 2.4 m (8 ft). The conductor/assembly shall be connected to the positive side of the dc voltage and the electrode in the tap water connected to the negative side. If the tracking distance from the end of the conductor to the water surface is short, a guarded circuit may be used. See Annex A.

9.9 Dielectric withstand

9.9.1 Immediately after the insulation resistance test, and while still immersed, the assemblies shall be subjected to a dielectric withstand test. Each assembly shall be subjected to a 2200 V, 60 Hz potential for 1 min. The potential shall be applied between the conductor assembly and the water.