UL 310

STANDARD FOR SAFETY

Electrical Quick-Connect Terminals

UL Standard for Safety for Electrical Quick-Connect Terminals, UL 310

Ninth Edition, Dated October 17, 2014

Summary of Topics

This revision of ANSI/UL 310 dated May 10, 2019 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.

As noted in the Commitment for Amendments statement located on the back side of the title page, UL and CSA are committed to updating this harmonized standard jointly. However, the revision pages dated May 10, 2019 will not be jointly issued by UL and CSA as these revision pages address UL ANSI approval dates only.

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 are substantially in accordance with Proposal(s) on this subject dated March 8, 2019.

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Third Edition

Underwriters Laboratories Inc.
UL 310
Ninth Edition

Electrical Quick-Connect Terminals

October 17, 2014

(Title Page Reprinted: May 10, 2019)

Approved American National Standard

ANSI/UL 310-2014 (R2019)

Commitment for Amendments

This standard is issued jointly by 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 CSA Group or UL at any time. Revisions to this standard will be made only after processing according to the standards development procedures of 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.

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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 inquires@csagroup. org and include "Proposal for change" in the subject line: Standard designation (number); relevant clause, table, and/or figure number; wording of the proposed change; and rationale for the change.

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This ANSI/UL Standard for Safety consists of the Ninth Edition including revisions through May 10, 2019.

The most recent designation of ANSI/UL 310 as a Reaffirmed American National Standard (ANS) occurred on May 10, 2019. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

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

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CONTENTS

No Text on This Page

Preface

This is the harmonized CSA Group and UL standard for Electrical Quick-Connect Terminals. It is the Third edition of CSA-C22.2 No. 153 and the Ninth edition of UL 310. This edition of CSA C22.2 No. 153 supersedes the previous edition published in 2009. This edition of UL 310 supersedes the previous edition published May 27, 2009.

This harmonized standard was prepared by the CSA Group and Underwriters Laboratories Inc. (UL). The efforts and support of the CANENA Technical Harmonization Subcommittee 99, Electrical Quick-Connect Terminals, are gratefully acknowledged.

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

This Standard was reviewed by the CSA 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 was reviewed by UL's Standards Technical Panel (STP) for Electrical Quick-Connect Terminals, STP 310.

This standard has been approved by the American National Standards Institute (ANSI) as an American National Standard.

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

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

Level of harmonization

This standard uses the IEC format but is not based on, nor is it considered equivalent to, an IEC standard.

This standard is published as an identical standard for CSA Group and UL.

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.

Reasons for differences from IEC

This standard provides requirements for electrical quick-connect terminals for use in accordance with the electrical installation codes of Canada and the United States. At present there is no IEC Standard for electrical quick-connect terminals for use in accordance with these codes. Therefore, this standard does not employ any IEC Standard for base requirements.

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 quick-connect terminals, both connectors and tabs, having nominal widths of 2.8, 3.2, 4.8, 5.2, and 6.3 mm (0.110, 0.125, 0.187, 0.205, and 0.250 in). They are intended for internal wiring connections in electrical equipment and for the field termination of conductors to electrical equipment in accordance with Part I of the *Canadian Electrical Code*, C22.1, in Canada, and the *National Electrical Code,*NFPA 70, in the United States of America.

1.2 These requirements apply to quick-connect terminals intended for use with one or two 26 – 10 AWG (0.13 - 5.3 mm^2) copper conductors.

1.3 These requirements do not apply to terminals for use with aluminum conductors.

1.4 These requirements do not apply to multi-pole devices. Multi-pole devices are covered by UL 1977 and CSA C22.2 No. 182.3.

1.5 In Canada, general requirements applicable to this standard are given in CAN/CSA-C22.2 No. 0.

2 Definitions

For the purpose of this standard the following definitions apply.

2.1 BURR – An extraneous protrusion in the stock, not considered an integral functional part of the connector or tab.

2.2 CONNECTOR (female connector) – That portion of a quick-connect termination which is pushed onto the male tab.

2.3 C26000 ALLOY – A copper-zinc alloy consisting of approximately 70 percent copper and 30 percent zinc (cartridge brass) as specified by the *Copper Development Association's Copper Development Alloy (CDA) Standards Handbook, Wrought Copper and Copper Alloy Mill Products, Part 2 – Alloy Data*.

2.4 DETENT – A dimple (depression) or hole in the male tab that engages a raised portion on the female connector, thus providing a latch for the mating parts.

2.5 PRODUCTION TAB (male tab) – That portion of a quick-connect termination which receives the female connector.

2.6 QUICK-CONNECT TERMINATION – An electrical connection consisting of a male tab and female connector that can be readily inserted or withdrawn without the use of a tool.

2.7 REFERENCE POINT – A specially marked point on a connector or tab that is used when making electrical test measurements.

2.8 TERMINAL – An electrical connecting device; may be either a female connector or male tab.

2.9 TEST TAB (male test tab) – A male tab, manufactured to close tolerances and with specific materials, used for the purpose of conducting tests with production female connectors.

3 Units of measurement

3.1 The values given in SI (metric) units as well as AWG conductor sizes shall be normative. Any other values given are for information purpose only.

3.2 Unless otherwise stated, all alternating-current (ac) electrical measurements are in root-mean-square (rms) units.

4 Normative references

4.1 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.

CSA Group

C22.1-12
Canadian Electrical Code, Part I, (CE Code)

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

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

CSA-C22.2 No. 182.3-M1987 (R2009)
Special Use Attachment Plugs, Receptacles, and Connectors

UL (Underwriters Laboratories Inc.)

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

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

CDA (Copper Development Association)

CDA Standards Handbook
Wrought Copper and Copper Alloy Mill Products, Part 2 – Alloy Data

IEC (International Electrotechnical Commission)

IEC 61210 Ed. 2.0
Connecting Devices – Flat Quick-Connect Terminations for Electrical Copper Conductors – Safety Requirements

NFPA (National Fire Protection Association)

ANSI/NFPA 70-2014
National Electrical Code® (NEC®)

5 Construction

5.1 General

5.1.1 Terminals shall be designed to provide a reliable electrical connection between wires and between wires and components in electrical equipment, when used in the intended manner. Additional requirements concerning certain features such as insulation added at the time of assembly in equipment,

spacings between terminals of opposite polarity and between terminals and non-current-carrying metal parts, and the support of wires adjacent to the terminals shall be the subject of consideration by the standard covering the specific equipment involved.

5.1.2 A connector shall comply with Clause 5.2, the dimensional requirements of Clause 5.3.1, and the applicable test requirements of Clause 6, when the connector is tested in conjunction with a test tab complying to Clause 5.2.2 and Clause 5.3.3.

5.1.3 A production tab shall comply with Clause 5.2, the dimensional requirements of Clause 5.3.2, and the applicable test requirements of Clause 6.

5.2 Materials

5.2.1 Connectors and production tabs (terminals)

5.2.1.1 A connector or a production tab shall be made of plain or plated copper alloy, nickel, or nickel alloy. If provided, the plating shall be an electrically conductive coating (e.g. tin, nickel, zinc, gold, or silver).

5.2.1.2 In reference to Clause 5.2.1.1, a connector or a production tab may be plated steel or unplated steel of a corrosion-resistant alloy if the connector or tab is intended for use in an appliance or equipment where such construction is permitted by the product standard.

5.2.1.3 After shearing or removal, a connector or a production tab that is provided on a feeder strip reel need not be plated on the edge of the connector or tab where it was originally attached to the strip.

5.2.2 Test tab

5.2.2.1 Test tabs for the insertion-withdrawal test described in Clause 6.4 shall be made of unplated brass, identified as CDA C26000 Alloy with a hardness of 62 ±7 on the Rockwell 30T scale.

5.2.2.2 Test tabs for the temperature and current cycling tests described in Clause 6.5 shall be made of tin-plated steel or corrosion resistant steel having a hardness of 68 ±5 on the Rockwell 30T scale.

5.2.2.3 In regard to Clause 5.2.2.2, for connectors intended exclusively for use with production tabs of copper alloy, an unplated brass test tab of C26000 Alloy with a hardness of 62 ±7 on the Rockwell 30T scale may be used.

5.3 Dimensions

5.3.1 Connector

5.3.1.1 A connector shall have the configuration illustrated in Figure 1 and the dimensions specified in Table 1.

5.3.2 Production tab

5.3.2.1 A production tab shall have the configuration shown in Figure 2 to Figure 4 and the dimensions specified in Table 2 to Table 3. Figure 3 illustrates dimple detents and Figure 4 illustrates hole detents.

5.3.2.2 In regard to Clause 5.3.2.1, a production tab may have other dimensions from those contained in Figure 2 to Figure 4 and Table 2 to Table 3 if the tab is intended for use within an appliance or equipment where such construction is permitted by the end product standard and is performance tested with a specific mating connector.

5.3.2.3 All portions of a production tab shall be flat, its surfaces not deviating more than 0.010 mm/mm (0.010 in/in), and free of burrs greater than 10 percent of the tab thickness, or raised plateaus.

5.3.2.4 In regard to Clause 5.3.2.3, in an area 1.3 mm (0.050 in) surrounding the detent, a raised plateau over the stock thickness of 0.03 mm (0.001 in) per side is acceptable.

5.3.2.5 For an optional shoulder, the minimum dimension shall be 1.14 mm (0.045 in). See dimension "K" of Figure 2. There shall not be any obstructions within 1.14 mm (0.045 in) of the "K" dimension end of the area defined by dimension "B."

5.3.2.6 The center of a hole or detent shall be within 0.08 mm (0.003 in) of the centerline of the tab. The depth of a dimple, dimension "G" on Figure 3 , shall not be less than 0.08 mm (0.003 in).

5.3.2.7 Bevel "H" shall be approximately 45 degrees. See Note 2 to Figure 2.

5.3.2.8 Dimensional measurements shall not include plating, burrs, or flatness tolerance.

5.3.3 Test tab

5.3.3.1 Single-ended test tabs for the insertion-withdrawal test shall have the configuration shown in Figure 2 to Figure 4 and the dimensions specified in Table 2 and Table 3. The "C" dimension tolerance shall be ±0.008 mm (0.0003 in) for brass and ±0.013 mm (0.0005 in) for steel, and raised plateaus around the detent shall be limited to a combined total of 0.03 mm (0.001 in) for both sides.

5.3.3.2 Double-ended test tabs for the temperature and current cycling tests shall be constructed in accordance with Clause 5.3.3.1 and have the configuration shown in Figure 5 .

5.4 Insulation

5.4.1 Insulation provided as a part of a terminal shall be constructed of one of the materials specified and have a maximum operating temperature (MOT) as specified in Table 4.

5.4.2 The insulating material may have a flammability classification as determined by tests described in UL 94 or CAN/CSA-C22.2 No. 0.17. See Clause 7.10.

6 Tests

6.1 General

6.1.1 A connector or a production tab having a wire attachment means shall comply with the crimp pull-out test described in Clause 6.3. The wire(s) shall not separate from the connector or production tab when subjected to the specified force.

Note: This performance requirement applies to both connectors and tabs that have a crimp barrel or other means of attachment to wire(s). This requirement would not apply to other constructions where there is no means of wire attachment, for example, a male tab with mounting provisions on end equipment.

6.1.2 A connector shall comply with the requirements of the insertion-withdrawal test described in Clause 6.4. The forces required to insert and withdraw a connector shall be in accordance with Table 5. The withdrawal portion of the insertion-withdrawal test need not be performed on connectors that have a locking feature requiring use of a tool or other means to facilitate disconnection. This test shall be performed on female connectors using single-ended test tabs and is not performed on production male tabs.

6.1.3 A connector shall comply with the requirements of the temperature and current cycling tests, described in Clause 6.5. During the temperature test, the temperature rise of a connector shall not exceed 30°C. During the current cycling test, the temperature rise at the 500th cycle shall not be more than 15°C higher than the temperature rise at the 24th cycle, and neither rise shall be more than 85°C. These tests shall be performed in sequence using the same specimens. This test shall be performed on female connectors using double-ended test tabs and is not performed on production male tabs.

6.1.4 Insulated terminals, production tabs, and connectors shall additionally comply with the requirements of the dielectric withstand tests, described in Clause 6.6, without breakdown (puncture or flashover).

6.1.5 Insulated terminals, production tabs, and connectors shall additionally comply with the requirements of the secureness of insulation test, described in Clause 6.7. The insulation shall not be damaged and shall not become detached from the terminal.

6.1.6 The insulation of a terminal shall not crack or break when the terminal is assembled on the wire(s) as intended.

6.2 Preparation of specimens

6.2.1 Specimens of the terminal shall be assembled to lengths of wire(s) of the size(s) in the manner specified by the manufacturer; see Clauses 7.6 and 8.

6.2.2 For the crimp pull-out test described in Clause 6.3, and the insertion-withdrawal test described in Clause 6.4, ten new connectors and ten new single-ended test tabs shall be used for each test. For the temperature and current cycling tests, described in Clause 6.5, ten new connectors and five new double-ended test tabs shall be used.

Note: Additional connectors and tabs will in some cases be necessary to complete the test circuit illustrated in Figure 6.

6.2.3 Stranded wire, with separately tinned strands, as specified in Table 6 under the heading "internal wiring", shall be used for tests on a terminal intended for internal wiring connections. The wire shall have thermoplastic insulation not greater than 0.8 mm (1/32 in) thick.

6.2.4 A terminal intended for field termination of conductors shall be tested with insulated solid wire. See Table 7 for insulation type. When intended for field termination of stranded conductors, testing shall be performed using the stranded wire as specified in Table 6 under the heading "field terminations". See Clause 7.6 for markings.

6.2.5 A terminal that is intended for both field termination of conductors and internal wiring connections shall be tested using both types of wires specified in Clauses 6.2.3 and 6.2.4.

6.2.6 Prior to assembly, the wire shall be stripped in accordance with Clause 6.2.9 or 6.2.10, as appropriate, so that the wire remains intact. The wire may be reformed back to its original shape before assembly to the terminal.

6.2.7 A specific type of tool necessary to obtain a proper installation shall be used in assembling the terminal to the wire(s). When intended for assembly using multiple types of tools, the terminal shall perform acceptably when any intended tool or representative tool is used.

6.2.8 With reference to Clause 6.2.7, the tools used for assembly of a terminal to a conductor shall be selected on the basis of:

a) Profile, width, and depth of the crimp;

b) Crimping die geometry and profile;

c) Number of crimps; and

d) Similarity of crimp forces.

6.2.9 For an insulated terminal marked with a nominal strip length in accordance with Clause 7.7, the dielectric withstand tests shall be conducted with wires stripped to the maximum tolerance specified in Table 8.

6.2.10 For an insulated terminal marked with a maximum wire-strip length and a minimum wire-strip length in accordance with Clause 7.7, the dielectric withstand tests shall be conducted with the wires stripped to the maximum length specified by the manufacturer.

6.3 Crimp pull-out test

6.3.1 A connector or a production tab shall be subjected to a tensile force as specified in Table 9 for a period of 1 min.

6.3.2 A connector or tab that has an integral insulation crimp shall have it rendered mechanically inactive or removed for this test. Any insulation crimp, not to be confused with the wire crimp, shall not be relied upon during the performance of this test. In some cases special assembly techniques will be required where the insulation crimp tabs are not applied, removed, or are subsequently pried up and away from the wire crimp barrel.

6.3.3 A terminal intended for use with wires of more than one size or a range of sizes shall be subjected to the test specified in Clause 6.3.1 using each size of wire within the wire range.

6.3.4 A terminal intended for simultaneously crimping two or more conductors shall be tested with the conductor combination constituting the minimum circular cross-sectional area and the conductor combination constituting the maximum circular cross-sectional area.

6.3.5 When a terminal is intended to simultaneously secure two or more wires of different or same AWG sizes, the terminal shall be suspended in the top of the test setup and the specified force shall be applied first to the largest-size wire and then in turn to the other wire(s) from the same tested sample. The value of the force shall be selected according to the size of the wire to which the force is applied.

6.3.6 The force shall be applied by means of a tensile testing machine. The head of the tensile testing machine shall be adjusted to travel at a speed of 25.4 mm/min (1 in/min) until the specified force is obtained. Dead weights may be used if applied gradually without sudden jerks or movement.

6.4 Insertion-withdrawal test

6.4.1 The connectors shall be inserted and withdrawn from test tabs for a total of six times. The forces required for the first insertion, first withdrawal, and sixth withdrawal shall be measured.

6.4.2 The force shall be measured with a testing device capable of holding the reading and providing accurate alignment, with slow and steady insertion and withdrawal of the connector to the test tab.

6.5 Temperature and current cycling tests

6.5.1 General

6.5.1.1 A connector designed for only one wire size shall be tested with wire of that size.

6.5.1.2 A connector designed for a range of wire sizes shall be tested with both the maximum and minimum sizes in the range.

6.5.1.3 New connectors shall be crimped in the intended manner on both ends of 165 mm (6-1/2 in) lengths of tin-plated copper wire of the size and type specified in Clause 6.2.3, 6.2.4, or 6.2.5, as applicable. The method of preparation shall be as described in Clauses 6.2.6 to 6.2.10. The assembly shall be arranged and connected as illustrated in Figure 6 and Figure 7. The wire size for the power-supply leads and circuit-continuation wire shall be the same as that specified for the test.

6.5.1.3.1 In regards to Clause 6.5.1.3, when the assembly involves simultaneously crimping two conductors between specimens, one of the conductors shall be subsequently cut midway between specimens so that the full current is carried by the single remaining intact conductor. When a combination of two conductors of the same size are simultaneously crimped, one conductor shall be cut so that the current only flows through the remaining uncut conductor.

6.5.1.3.2 The test current shall be based on the single conductor size. When a combination of two conductors of different sizes is simultaneously crimped, the smaller size conductor shall be cut so that the current only flows through the remaining uncut larger conductor. The test current shall be based on the larger single conductor size.

6.5.1.4 The tests described in Clauses 6.5.2 and 6.5.3 shall be conducted under the conditions described in Clauses 6.5.1.5 to 6.5.1.7 in a location where the air flow does not exceed 0.12 m/s (25 ft/min).

6.5.1.5 The test shall be conducted at an ambient temperature of 25 ±5°C. The temperature rises shall be the temperature of the connectors minus the ambient temperature.

6.5.1.6 Any 60 Hz voltage may be used that will result in an essentially sinusoidal current of the specified value flowing through the connector.

6.5.1.7 Temperature shall be measured with thermocouples consisting of 30 AWG iron and constantan wires. The thermocouples and related instruments shall be calibrated to take consistently accurate measurements. Each thermocouple shall make contact with the surface being tested and shall not be relocated during the tests. A temperature shall be considered to be stable when three successive readings taken at intervals of 5 minutes indicate no further rise above the ambient temperature. A terminal does not meet the intent of this requirement when any one of the measured connector temperatures shows a rise of more than those specified in Clause 6.1.3.

6.5.2 Temperature test

6.5.2.1 The test current specified in Table 10 or Table 11, as applicable, shall be passed through the connector assembly continuously until stable temperatures are attained.

6.5.3 Current cycling

6.5.3.1 After the continuous temperature test described in Clause 6.5.2, the same specimens shall be subjected to a 500 cycle test with a current as specified in Table 10 or Table 11, as applicable. Each cycle shall consist of full current application for 45 minutes, followed by a 15 minute period during which no current flows.

Note: The full current portion of the cycle, during which temperature measurements are made, may be extended longer than 45 minutes, when necessary, to enable the connector to attain thermal stabilization. In such cases, the testing period is not to be prolonged longer than necessary.

6.6 Dielectric withstand tests

6.6.1 General

6.6.1.1 No specimen shall be subjected to more than one dielectric withstand test.

6.6.1.2 For a terminal intended to secure combinations of conductors of different total cross-sectional area, or single conductors of different AWG sizes, the entire specified series of tests shall be performed on two sets of specimens. The first set of specimens of the terminal shall be secured to the combination of conductors of the smallest total cross-sectional area, or to the smallest conductor, if only one conductor is intended to be secured. The second set of specimens shall be secured to the combination of largest total cross-sectional area, or to the largest conductor, if only one wire is intended to be secured.

6.6.2 Insulation puncture test

6.6.2.1 The insulated terminals shall be subjected to the insulation puncture test in accordance with the requirements of Clauses 6.6.2.2 to 6.6.2.6.

6.6.2.2 The tests to be conducted and the number of specimens for each test shall be as specified in Table 12. The test potential shall be 2200 V for a terminal rated 300 V and 3400 V for a terminal rated 600 to 1000 V for signs and luminaires (lighting fixtures). Each specimen shall be assembled to a conductor(s) in the intended manner, and the test potential shall be applied for 1 minute between conductor or conductors and the outer electrode. Each specimen shall be embedded in No. 7-1/2 conductive shot that shall serve as the outer electrode. Only that portion of the outer insulating surface that covers live parts shall be covered by the outer electrode. An insulated terminal that has openings allowing for the entrance of shot shall have those openings closed with tape, petrolatum, epoxy, silicone, rubber, or other comparable material. The exposed tang of an insulated terminal shall be similarly treated. The supplementary insulating material shall not be applied so as to supplement the terminal insulation where it covers live parts. Puncture of the wire insulation during this test shall be judged as inconclusive, and the wire insulation repaired and the test repeated. When flashover between the electrode and the insulated terminal occurs, the supplementary insulation shall be repaired and the test shall be repeated.

Note: A smaller (higher-size number) shot may be used with concurrence of those concerned.

6.6.2.3 In regard to Clause 6.6.2.2, for an insulated terminal employing a separable cap that is applied after assembly of the terminal to the conductor and has openings that cannot be effectively closed to prevent entry of the shot, metal foil closely applied to the outer surface of the insulation may be used as the outer electrode.

6.6.2.4 Specimens assembled to a wire shall be conditioned in an air-circulating oven, in accordance with Table 13.

6.6.2.5 Specimens not assembled to conductors shall be conditioned for 168 h in an air-circulating oven at 100° C. The specimens shall be allowed to cool to room temperature. When the insulation is of a hygroscopic material such as nylon, the specimens shall be subjected to conditioning at a relative humidity of 85 ±5% at 30 ±2° C for 24 h. After conditioning, the specimens shall be assembled or crimped to a conductor in the intended manner.

6.6.2.6 The oven-conditioning described in Clauses 6.6.2.4 and 6.6.2.5 and Table 13 shall not cause the insulation on a terminal to harden, soften, crack, deform, loosen, or otherwise change so as to adversely affect the insulating properties.

Note: Discoloration of the insulation is allowed.

6.6.3 Flashover

6.6.3.1 Six specimens shall be tested in the as-received condition. Each specimen not assembled to a wire or wires shall be placed on a flat metal plate in a position having the highest probability to result in breakdown to the open end when the test voltage is applied between the metal plate and all insulated metal parts of the terminal. A test voltage of 1600 V for a terminal rated 300 V and 3000 V for a terminal rated 600 V [1000 V in signs and luminaries] shall be applied for 1 minute. A breakdown (flashover) does not meet the intent of this requirement.

6.7 Secureness of insulation test

6.7.1 A temporary distortion of flexible insulating material during the tests is allowed. Tearing or breaking of the insulation meets the intent of this standard when the terminal complies with the dielectric withstand test. The variety of designs of terminals is such that it is not practicable to specify in detail how the force is to be applied. The arrangement shall be such that the tendency for the insulation to be damaged or to be separated from the body is greatest. Flexible insulation, when installed on a terminal after assembly to a wire or wires, shall be allowed to regain its normal shape before the test.

6.7.2 Insulation on terminals intended for use with 10 AWG (5.3 mm^2) or smaller conductors shall not be damaged and shall not become detached from the terminal when a force is applied for 1 minute between the insulation and the terminal.

6.7.3 To determine compliance with Clause 6.7.2:

a) A 4.4 N (1 lb) force shall be applied to the following:

1) An unassembled, as-received specimen; and

2) A specimen that has been unassembled from the conductor after oven conditioning in accordance with Table 13; and

b) A 22 N (5 lb) force shall be applied to the following:

1) An assembled, as-received specimen;

2) A specimen that has been assembled to the conductor before oven conditioning in accordance with Table 13; and

3) A specimen that has been assembled to the conductor after conditioning for 7 days at 100 ±1° C in an air-circulating oven, then cooling to room temperature, and when the insulation is of a hygroscopic material, such as nylon, conditioning for 24 hours at a relative humidity of 85 ±5% at a temperature of 30 ±2°C.

7 Markings

7.1 Each terminal shall be marked with the name, trademark, or other descriptive marking by which the organization responsible for the product is identified.

7.2 The smallest container, reel, or packaging carton containing terminals shall be legibly and permanently marked with:

a) The name, trade name, trademark, or other descriptive marking by which the organization responsible for the product is identified;

b) A distinctive catalog, model number, or the equivalent;

c) The wire size or sizes rated for single-wire application and the minimum and maximum wire sizes rated for two-wire application for which the terminal has been found to be suitable;

d) A statement referring to the installation instructions;

e) A statement indicating that the terminals are intended for internal wiring of electrical equipment, for field termination of conductors, or for both; and

f) A statement indicating that the terminals are intended for termination of copper wire only, for example, "copper wire only " or an equivalent wording. For terminals not capable of terminating a wire, such as printed circuit mounted devices, the container, reel, or packaging carton need not be marked that the terminals are suitable for termination of copper wire only.

7.3 The voltage rating for which an insulated terminal has been found acceptable shall be marked on the terminal or the smallest unit container. The marked voltage rating, shall be: "300 V maximum", 600 V maximum", or "600 V maximum building wiring; 1000 V maximum signs or luminaires", or the equivalent, whichever is appropriate.

7.4 The maximum operating temperature in accordance with Table 4 for which an insulated terminal is suitable shall be marked on the terminal or the smallest unit container.

7.5 When a terminal intended for field termination of conductors is tested with stranded wire as specified in Clause 6.2.4, the wire size (see Clause 7.2(c)) shall be followed by "STRANDED" or "STR".

7.6 When it is not obvious, the method of rearrangement or adjustment of a terminal to adapt it to various sizes of wire shall be clearly indicated by size markings or other instructions appearing on the terminal or the appropriate packaging unit.

7.7 The minimum and maximum wire strip length marking for an insulated terminal is specifiable as a single (nominal) value as indicated in Clause 6.2.9. The marking shall appear:

a) On or in the smallest unit container in which the terminal is packed;

b) On the terminal; or

c) On an insulating cover.

7.8 In respect to Clause 7.7, the marking is not required when the end opposite the wire insertion end is open, and the end of the wire is visible after it is connected.

7.9 In respect to Clause 7.7, the minimum strip length marking is not required when a terminal is provided with an inspection hole opposite the wire insertion end through which the end of the wire is visible after it is connected.

7.10 The manufacturer may mark the flammability classification of the insulating material on the connector, smallest unit container, or an information sheet place in the smallest unit container. See Clause 5.4.2.

8 Installation instructions

8.1 Installation instructions shall be provided and shall include the following features, as applicable to the procedure for assembly of a terminal to one or two wires:

a) For a terminal intended to be assembled to a wire or wires by means of a specific type of tool, the tool designation or the designation of a removable tool part, such as a pressing die, shall be

marked on or in the container in which the terminal is packed and shall be identified by the catalog designation, color coding, die index number, or other equivalent means;

b) Instructions for preparation of the wires, such as twisting strands together before assembly, shall appear on or in the container in which the terminal is packed; and

c) The minimum and maximum wire strip length marking for an insulated terminal shall appear as specified in Clause 7.7.

TABLES

Table 1
Dimensions of connectors

(See Clause 5.3.1)

Dimensions, mm (in)			
Tab width, nominal	B3 Maximum	L2 Maximum	Q Maximum
6.3 (0.250)	8.13 (0.320)	3.56 (0.140)	9.40 (0.370)
5.2 (0.205)	6.86 (0.270)	3.56 (0.140)	8.00 (0.315)
4.8 (0.187)	6.86 (0.270)	3.56 (0.140)	8.00 (0.315)
3.2 (0.125)	4.57 (0.180)	3.56 (0.140)	7.37 (0.290)
2.8 (0.110)	4.57 (0.180)	3.56 (0.140)	7.37 (0.290)

Table 2
Dimensions of production and test tabs in inches

(See note to Figure 5)

Nominal size	A	B(min)	C	D	E	F	J	M	N	P	Q(min)
0.110 x 0.020 with dimple	0.024 0.012	0.275	0.021 0.019	0.114 0.106	0.071 0.051	0.051 0.043	12° 8°	0.067 0.055	0.055 0.039	0.055 0.012	0.319
0.110 x 0.020 with hole	0.024 0.012	0.275	0.021 0.019	0.114 0.106	0.071 0.051	0.051 0.043	12° 8°			0.055 0.012	0.319
0.110 x 0.032 with dimple	0.024 0.012	0.275	0.033 0.030	0.114 0.106	0.071 0.051	0.051 0.043	12° 8°	0.067 0.055	0.055 0.039	0.055 0.012	0.319
0.110 x 0.032 with hole	0.024 0.012	0.275	0.033 0.030	0.114 0.106	0.071 0.051	0.051 0.043	12° 8°			0.055 0.012	0.319
0.125 x 0.032 with dimple	0.025 0.015	0.275	0.033 0.031	0.128 0.122	0.070 0.056	0.051 0.045	12° 8°	0.067 0.057	0.053 0.043	0.055 0.015	0.320
0.125 x 0.032 with hole	0.025 0.015	0.275	0.033 0.031	0.128 0.122	0.070 0.056	0.051 0.045	12° 8°			0.055 0.015	0.320
0.125 x 0.020 with dimple	0.025 0.015	0.275	0.021 0.019	0.128 0.122	0.070 0.056	0.051 0.045	12° 8°	0.067 0.057	0.053 0.043	0.055 0.015	0.320
0.125 x 0.020 with hole	0.025 0.015	0.275	0.021 0.019	0.128 0.122	0.070 0.056	0.051 0.045	12° 8°			0.055 0.015	0.320
0.187 x 0.020	0.035	0.244	0.021	0.190	0.110	0.060	12°	0.067	0.059	0.067	0.287

Table 2 Continued on Next Page

Table 2 Continued

Nominal size	A	B(min)	C	D	E	F	J	M	N	P	Q(min)
with dimple	0.024		0.019	0.181	0.091	0.050	8°	0.055	0.047	0.024	
0.187 x 0.020 with hole	0.035		0.021	0.193	0.134	0.060	12°			0.067	
	0.024	0.244	0.019	0.184	0.117	0.050	8°			0.024	0.287
0.187 x 0.032 with dimple	0.040		0.033	0.190	0.110	0.060	12°	0.067	0.059	0.071	
	0.027	0.244	0.030	0.181	0.091	0.050	8°	0.055	0.047	0.027	0.287
0.187 x 0.032 with hole	0.040		0.033	0.193	0.134	0.060	12°			0.071	
	0.024	0.244	0.030	0.184	0.117	0.050	8°			0.027	0.287
0.205 x 0.020 with dimple	0.040		0.021	0.210	0.110	0.075	12°	0.098	0.080	0.067	
	0.027	0.244	0.019	0.201	0.091	0.063	8°	0.086	0.070	0.024	0.287
0.205 x 0.020 with hole	0.040		0.021	0.210	0.134	0.075	12°			0.067	
	0.027	0.244	0.019	0.201	0.117	0.063	8°			0.024	0.287
0.205 x 0.032 with dimple	0.040		0.033	0.210	0.110	0.075	12°	0.098	0.080	0.071	
	0.027	0.244	0.030	0.201	0.091	0.063	8°	0.086	0.070	0.027	0.287
0.205 x 0.032 with hole	0.040		0.033	0.210	0.134	0.075	12°			0.071	
	0.027	0.244	0.030	0.201	0.117	0.063	8°			0.027	0.287
0.250 x 0.032 with dimple	0.040		0.033	0.253	0.161	0.080	12°	0.098	0.080	0.071	
	0.027	0.307	0.030	0.244	0.142	0.063	8°	0.086	0.070	0.027	0.350
0.250 x 0.032 with hole	0.040		0.033	0.253	0.186	0.080	12°			0.071	
	0.020	0.307	0.030	0.244	0.169	0.063	8°			0.027	0.350

Notes: 1. Included are dimensions for those nominal sizes corresponding with those found in IEC 61210.
2. In the table where two values are provided, the lesser value is the minimum permitted value and the larger is the maximum permitted value.

Table 3
Dimensions of metric production and test tabs in millimeters

(See note to Figure 5)

Nominal size	A	B(min)	C	D	E	F	J	M	N	P	Q(min)
2.8 x 0.5 with dimple	0.6		0.54	2.90	1.8	1.3	12°	1.7	1.4	1.4	
	0.3	7.0	0.47	2.70	1.3	1.1	8°	1.4	1.0	0.3	8.1
2.8 x 0.5 with hole	0.6		0.54	2.90	1.8	1.3	12°			1.4	
	0.3	7.0	0.47	2.70	1.3	1.1	8°			0.3	8.1
2.8 x 0.8 with dimple	0.6		0.84	2.90	1.8	1.3	12°	1.7	1.4	1.4	
	0.3	7.0	0.77	2.70	1.3	1.1	8°	1.4	1.0	0.3	8.1
2.8 x 0.8 with hole	0.6		0.84	2.90	1.8	1.3	12°			1.4	
	0.3	7.0	0.77	2.70	1.3	1.1	8°			0.3	8.1
3.2 x 0.8 with dimple	0.6		0.84	3.25	1.8	1.3	12°	1.7	1.4	1.4	
	0.3	7.0	0.79	3.10	1.4	1.1	8°	1.4	1.1	0.3	8.1
3.2 x 0.8 with hole	0.6		0.84	3.25	1.8	1.3	12°			1.4	
	0.3	7.0	0.79	3.10	1.4	1.1	8°			0.3	8.1
3.2 x 0.5 with dimple	0.6		0.54	3.25	1.8	1.3	12°	1.7	1.4	1.4	
	0.3	7.0	0.48	3.10	1.4	1.1	8°	1.4	1.1	0.3	8.1
3.2 x 0.5	0.6	7.0	0.54	3.25	1.8	1.3	12°			1.4	8.1

Table 3 Continued on Next Page

Table 3 Continued

Nominal size	A	B(min)	C	D	E	F	J	M	N	P	Q(min)
with hole	0.3		0.48	3.10	1.4	1.1	8°			0.3	
4.8 x 0.5 with dimple	0.9		0.54	4.80	2.8	1.5	12°	1.7	1.5	1.7	
	0.6	6.2	0.47	4.60	2.3	1.3	8°	1.4	1.2	0.6	7.3
4.8 x 0.5 with hole	0.9		0.54	4.90	3.4	1.5	12°			1.7	
	0.6	6.2	0.47	4.67	3.0	1.3	8°			0.6	7.3
4.8 x 0.8 with dimple	1.0		0.84	4.80	2.8	1.5	12°	1.7	1.5	1.8	
	0.7	6.2	0.77	4.60	2.3	1.3	8°	1.4	1.2	0.7	7.3
4.8 x 0.8 with hole	1.0		0.84	4.90	3.4	1.5	12°			1.8	
	0.6	6.2	0.77	4.67	3.0	1.3	8°			0.7	7.3
5.2 x 0.5 with dimple	1.0		0.54	5.30	2.8	1.9	12°	2.5	2.0	1.7	
	0.7	6.2	0.47	5.10	2.3	1.6	8°	2.2	1.8	0.6	7.3
5.2 x 0.5 with hole	1.0		0.54	5.30	3.4	1.9	12°			1.7	
	0.7	6.2	0.47	5.10	3.0	1.6	8°			0.6	7.3
5.2 x 0.8 with dimple	1.0		0.84	5.30	2.8	1.9	12°	2.5	2.0	1.8	
	0.7	6.2	0.77	5.10	2.3	1.6	8°	2.2	1.8	0.7	7.3
5.2 x 0.8 with hole	1.0		0.84	5.30	3.4	1.9	12°			1.8	
	0.7	6.2	0.77	5.10	3.0	1.6	8°			0.7	7.3
6.3 x 0.8 with dimple	1.0		0.84	6.40	4.1	2.0	12°	2.5	2.0	1.8	
	0.7	7.8	0.77	6.20	3.6	1.6	8°	2.2	1.8	0.7	8.9
6.3 x 0.8 with hole	1.0		0.84	6.40	4.7	2.0	12°			1.8	
	0.5	7.8	0.77	6.20	4.3	1.6	8°			0.7	8.9

Notes: 1. Included are dimensions for those nominal sizes corresponding with those found in IEC 61210.
2. In the table where two values are provided, the lesser value is the minimum permitted value and the larger is the maximum permitted value.

Table 4
Maximum operating temperature for insulating material

(See Clauses 5.4.1 and 7.4)

Material	Temperature, °C
Thermoplastic[a]	60
	75
	90
	105
	125
	150
Phenolic[b]	150
Urea[c]	100
Melamine[d]	130
Melamine[e]	150

[a] Temperature rating is the Relative Thermal Index (RTI) as rated by the insulation manufacturer or a rating as assigned by the connector manufacturer.

[b] Composition may be filled or unfilled.

[c] Unless the compound has been tested 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. The compound may have cellulosic filler material.

Table 5
Forces for insertion-withdrawal test

(See Clause 6.1.2)

Tab size, mm (in)	Force, N (lbs)					
	First insertion, maximum individual	First withdrawal			Sixth withdrawal	
			Minimum		Minimum	
		Maximum	Average	Individual	Average	Individu-al
Unplated connector with test tab						
6.3 (0.250)	80 (18)	80 (18)	27 (6)	18 (4)	22 (5)	18 (4)
5.2 (0.205) and 4.8 (0.187)	67 (15)	89 (20)	22 (5)	13 (3)	13 (3)	9 (2)
3.2 (0.125) and 2.8 (0.110)	53 (12)	62 (14)	13 (3)	9 (2)	9 (2)	4 (1)
Plated connector with test tab						
6.3 (0.250)	76 (17)	76 (17)	22 (5)	13 (3)	18 (4)	13 (3)
5.2 (0.205) and 4.8 (0.187)	67 (15)	89 (20)	22 (5)	13 (3)	13 (3)	9 (2)
3.2 (0.125) and 2.8 (0.110)	53 (12)	62 (14)	13 (3)	9 (2)	9 (2)	4 (1)

Table 6
Number of strands for test wire

(See Clauses 6.2.3 and 6.2.4)

AWG (mm^2)	Number of strands	
	Internal wiring[a]	Field terminations[b]
24 – 26 (0.20 - 0.13)	Number of strands may vary	Number of strands may vary
22 (0.32)	7	7
20 (0.52)	10	10
18 (0.82)	16	16
16 (1.3)	26	26
14 (2.1)	41	7
12 (3.3)	65	7
10 (5.3)	105	7

[a] See Clause 6.2.3.
[b] See Clause 6.2.4.

Table 7
Test wire stranding and insulation type

(See Clause 6.2.4)

Wire size, AWG (mm^2)	Solid	Stranded
14 – 10 (2.1 – 5.3)	Soft annealed-untinned type XHHW, USE, THW, TW, THHN, TW75, TWN75, T90 Nylon, or RW90.	Concentric or compressed Class B stranding, soft annealed-untinned, Type XHHW, USE, THW, TW THHN, TW75, TWN75, T90 Nylon, or RW90.
18 – 16 (0.82 – 1.3)	Tinned or untinned, thermoplastic insulation not greater than 0.8 mm (1/32 in) thick	Tinned or untinned, thermoplastic insulation not greater than 0.8 mm (1/32 in) thick
26 – 20 (0.13 - 0.52)	Tinned or untinned, thermoplastic insulation	Tinned or untinned, thermoplastic insulation

Table 8
Strip-length tolerances

(See Clause 6.2.9)

Wire size		Tolerance	
AWG	(mm^2)	mm	(in)
26 – 14	(0.13 – 2.1)	± 0.8	(1/32)
12 – 10	(3.3 – 5.3)	± 1.2	(3/64)

Table 9
Forces for crimp pull-out test

(See Clause 6.3.1)

Wire size		Force	
AWG	(mm^2)	N	(lbs)
26	(0.13)	13.4	(3)
24	(0.20)	22.3	(5)
22	(0.32)	36	(8)
20	(0.52)	58	(13)
18	(0.82)	89	(20)
16	(1.3)	133	(30)
14	(2.1)	223	(50)
12	(3.3)	311	(70)
10	(5.3)	356	(80)

Table 10
Test current for temperature and current cycling tests for connectors intended for internal wiring only

(See Clauses 6.5.2 and 6.5.3)

Wire size,		Test current, A			
		Temperature		Current cycling	
AWG	(mm^2)	2.8 mm (0.110 in) and 3.2 mm (0.125 in)	All others	2.8 mm (0.110 in) and 3.2 mm (0.125 in)	All others
26	(0.13)	2	2	4	4
24	(0.20)	2	2	4	4
22	(0.32)	2	3	4	6
20	(0.52)	3	4	6	8
18	(0.82)	4	7	8	14
16	(1.3)	5	10	10	20
14	(2.1)		15		30
12	(3.3)		20		40
10	(5.3)		24		48

Table 11
Test current for connectors intended for field termination of conductors

(See Clauses 6.5.2 and 6.5.3)

Wire size,		Test current, A	
AWG	(mm^2)	Temperature	Current cycling
26	(0.13)	2	4
24	(0.20)	3	6
22	(0.32)	3	6
20	(0.52)	5	10
18	(0.82)	7	14
16	(1.3)	10	20
14	(2.1)	15	30
12	(3.3)	20	40
10	(5.3)	30	60

Table 12
Specimens required for insulation puncture test

(See Clause 6.6.2.2)

Insulating material	Number of specimens[a]
Thermosetting, for example, porcelain, or cold-molded melamine, phenolic, or urea-compound:	
Test as received only	6
Thermoplastic, for example, vinyl or nylon:	
Test as received	6
Test after oven aging, with specimens assembled to wire before such aging[b]	6
Test after oven aging, with specimens assembled to wire after such aging[c]	6

[a] See Clause 6.6.1.2.
[b] See Clause 6.6.2.4.
[c] See Clause 6.6.2.5.

Table 13
Temperatures for oven conditioning

(See Clauses 6.6.2.4, 6.6.2.6 and 6.7.3)

Rated temperature of connector insulation, °C	Oven temperature, °C	
	7-day test	Alternate 60-day test
60	100	70
75	113	81
90	121	97
105	136	113
125	158	133
150	180	158

FIGURES

Figure 1
Envelope configuration of connectors

(See Clause 5.3.1)