



UL 486E

STANDARD FOR SAFETY

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

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

Sixth Edition, Dated January 31, 2024

Summary of Topics

This new Sixth edition of ANSI/UL 486E dated January 31, 2024 includes the following changes in requirements:

- ***Addition to the Scope to address use of ferrules and adapters; [1.4](#)***
- ***Remove reference to a “Dielectric-Withstand Test”; [8.1.2](#) and [9.1.6.2](#)***
- ***Clarify that aluminum test conductors can be compact, compressed, or concentric stranding; [7.1.13](#)***
- ***Use of busbar during static heating test; [9.3.1.1](#)***
- ***Time stabilization clarification; [9.2.1](#) and [9.2.4](#)***
- ***Remove “number of strands” from marking requirement; [10.12](#)***
- ***Sizing and lubricating bushings during secureness test; [9.3.2.1](#) and [Table 9.13](#)***
- ***Corrections to [Table 8.3](#)***
- ***Testing with metric and non-standard size conductors; [1.3](#), [2.1.3](#), [3.2](#), [7.1.7](#), [7.1.10](#), [8.1.6](#), [8.1.7](#), [9.1.5.2](#), [9.1.5.3](#), [9.1.5.5](#), [9.1.5.6](#), [9.1.9.4](#), [10.4](#), [10.7](#), [10.8](#), [10.10](#), [10.26](#), [10.30](#), [Table 7.5](#), [Table 7.6](#), [Table 8.3](#), [Table 9.1](#), [Table 9.2](#), [Table 7.4](#), [Table 9.3](#) – [Table 9.6](#), [Table 9.8](#), [Table 9.13](#), [Table 9.14](#), [Section B4](#), and [Annex E](#)***
- ***Testing with aluminum wire with AA-8000 alloy conductors; [7.2.2](#), [7.2.3](#), [7.3.1](#), [Table 7.4](#), and [Annex A](#)***
- ***Use of shear head bolts; [9.1.9.4](#), [9.1.9.5](#) and [9.1.9.6](#)***
- ***Insulating covers during stress corrosion tests; [9.6.1](#)***
- ***Addition of stranding table; [9.1.5.6](#) and [Annex F](#)***
- ***Thermal testing with insulation colors other than black; [9.1.5.8](#), [9.1.5.9](#) and [9.1.5.10](#)***
- ***Alternate information means; [10.32](#)***

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated September 29, 2023 and December 15, 2023.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form by any means, electronic, mechanical photocopying, recording, or otherwise without prior permission of ULSE Inc. (ULSE).

ULSE provides this Standard "as is" without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability or fitness for any purpose.

In no event will ULSE be liable for any special, incidental, consequential, indirect or similar damages, including loss of profits, lost savings, loss of data, or any other damages arising out of the use of or the inability to use this Standard, even if ULSE or an authorized ULSE representative has been advised of the possibility of such damage. In no event shall ULSE's liability for any damage ever exceed the price paid for this Standard, regardless of the form of the claim.

Users of the electronic versions of UL's Standards for Safety agree to defend, indemnify, and hold ULSE harmless from and against any loss, expense, liability, damage, claim, or judgment (including reasonable attorney's fees) resulting from any error or deviation introduced while purchaser is storing an electronic Standard on the purchaser's computer system.

JANUARY 31, 2024



ANSI/UL 486E-2024

1

UL 486E

Standard for Equipment Wiring Terminals for Use with Aluminum and/or

Copper Conductors

First Edition – August, 1984
Second Edition – May, 1988
Third Edition – December, 1994
Fourth Edition – May, 2009
Fifth Edition – September, 2015

Sixth Edition

January 31, 2024

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

The most recent designation of ANSI/UL 486E as an American National Standard (ANSI) occurred on January 31, 2024. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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 On-Line Collaborative Standards Development System (CSDS) at <https://csds.ul.com>.

Our Standards for Safety are copyrighted by ULSE Inc. Neither a printed nor electronic copy of a Standard should be altered in any way. All of our Standards and all copyrights, ownerships, and rights regarding those Standards shall remain the sole and exclusive property of ULSE Inc.

COPYRIGHT © 2024 ULSE INC.

No Text on This Page

CONTENTS

1	Scope	5
2	Reference Publications	6
2.1	Normative references	6
2.2	Informative references	6
3	Units of Measurement	6
4	Definitions	7
5	Symbols and Abbreviations	7
6	Construction Requirements	8
6.1	General	8
6.2	Materials	9
7	Test Requirements	10
7.1	General	10
7.2	Current-cycling	13
7.3	Static-heating sequence	17
7.4	Mechanical sequence	19
7.5	Stress corrosion/moist ammonia (NH ₄)	20
7.6	Stress corrosion/mercurous nitrate (HgNO ₃)	20
8	Sampling Requirements	20
8.1	General	20
8.2	Current-cycling	22
8.3	Static-heating sequence	24
8.4	Mechanical sequence	24
8.5	Stress corrosion/moist ammonia (NH ₄)	25
8.6	Stress corrosion/mercurous nitrate (HgNO ₃)	25
9	Test Methods	25
9.1	General	25
9.2	Current-cycling	41
9.3	Static-heating sequence	42
9.4	Mechanical sequence	48
9.5	Stress corrosion/moist ammonia (NH ₄)	48
9.6	Stress corrosion/mercurous nitrate (HgNO ₃)	48
10	Marking, Labeling, and Packaging	49

ANNEX A (Informative) – INFORMATIVE REFERENCES

ANNEX B (Informative) – EXAMPLES

B1	Examples from 7.1.4	55
B2	Example from 8.3.2 (ampere-rated, non-parallel)	55
B3	Example from 8.3.3 (ampere-rated, both parallel and non-parallel)	55
B4	Example from 1.3(e) and 7.1.7 (testing with both AWG/kcmil and metric conductors)	56

ANNEX C (Informative) – STABILITY FACTOR CALCULATION

ANNEX D (Informative) – MARKING LOCATIONS GUIDE

ANNEX E (Normative) – AWG/kcmil VS. METRIC CONDUCTORS

E1	General	60
----	---------------	----

ANNEX F (Informative) – CONDUCTOR STRANDING

1 Scope

1.1 This Standard applies to equipment wiring terminals for use with all alloys of copper, aluminum, or copper-clad aluminum conductors, in accordance with the National Electrical Code, NFPA 70, as follows:

- a) Equipment wiring terminals intended to hold one or more conductor(s);
- b) Equipment wiring terminals intended for use in appliances and equipment that comply with the requirements for such appliances and equipment;
- c) Ampere-rated equipment wiring terminals;
- d) Horsepower rated equipment wiring terminals; and
- e) Wire range rated equipment wiring terminals.

1.2 These requirements apply to field wired equipment wiring terminals which are an integral part of the equipment, or are intended for use in specific equipment.

1.3 This Standard is intended for equipment wiring terminals 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; and
- 2) 12 AWG (3.3 mm²) to 2 000 kcmil (1 010 mm²) stranded, Class B concentric, compressed, and compact.

b) Copper-Clad Aluminum:

- 1) 12 AWG (3.3 mm²) and 10 AWG (5.3 mm²) solid; and
- 2) 12 AWG (3.3 mm²) to 2 000 kcmil (1 010 mm²) stranded, Class B concentric.

c) Copper:

- 1) 30 AWG (0.05 mm²) to 10 AWG (5.3 mm²) solid; and
- 2) 30 AWG (0.05 mm²) to 2 000 kcmil (1 010 mm²) stranded, Class B concentric and compressed, and Class C concentric.

d) Compact-stranded copper conductors for 2 AWG (33.6 mm²) and larger.

e) Rigid (solid and stranded) metric wire sizes, Classes 1, 2, 5, and 6, in the range of 0.5 – 1 000 mm², in addition to AWG/kcmil sizes, with AWG/kcmil 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, an equipment wiring terminal rated for 6 AWG – 250 kcmil may be additionally rated for 16 – 120 mm². See Annex B for example.

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

1.4 Equipment wiring terminals covered by this Standard are also suitable for use with conductors that are prepared using ferrules evaluated in accordance with UL 486F, or wire connector adapters evaluated in accordance with UL 486A-486B, under the following conditions:

- a) Ferrules and adapters are applied in accordance with their ratings and installation instructions.
- b) The length of exposed conductive material maintains the strip lengths required by the connector manufacturer.

1.5 This Standard is intended for equipment wiring terminals suitable for currents not exceeding the ampacity of insulated conductors rated 75 °C or 90 °C in accordance with the rating of the equipment wiring terminal, if provided.

1.6 This Standard does not apply to:

- a) Insulated equipment wiring terminals; and
- b) Wire binding screw terminals.

2 Reference Publications

2.1 Normative 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 the Standard was approved.

2.1.2 NFPA* Standard

NFPA 70-2011, *National Electrical Code (NEC)*

* National Fire Protection Association

2.1.3 IEC† Standards

IEC 60228, *Conductors of Insulated Cables*

† International Electrotechnical Commission.

2.2 Informative references

2.2.1 See Annex A for a listing of supplemental standards.

3 Units of Measurement

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

3.2 For conductor sizes, AWG/kcmil conductor sizes are noted with their metric equivalents in parenthesis, followed by the closest metric conductor size covered by IEC 60228.

Note 1: Specifications for conductor sizes for both AWG/kcmil and metric are shown as follows: 12 – 3 AWG (3.31 – 26.7) / 4.0 – 25.0 mm².

Note 2: IEC 60228 covers conductors in the metric range of 0.5 – 2 500 mm². For requirements covering AWG/kcmil wire ranges outside this scope, the specification for the metric conductor will be limited to the conductor range covered by IEC 60228. Metric wire sizes larger than 1 000 mm² are not covered by this standard.

4 Definitions

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

4.2 CIRCULAR MIL (cmil) – the area of a circle with a diameter of 0.001 inch.

4.3 CONTROL CONDUCTOR – an unbroken conductor, which is included in the current-cycling test loop.

4.4 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 separate or integral sections for compressing the insulation grip, if provided.

4.5 EQUALIZER – a busbar that provides a point of equipotential and uniform current flow in a stranded conductor without adversely affecting the temperature of the equipment wiring terminal(s).

4.6 EQUIPMENT WIRING TERMINAL – establishes a connection between one or more conductors to a terminal plate or stud, or to any similar device, by means of mechanical pressure.

4.7 PACKAGING CONTAINER – the container in which the unit containers are packaged.

4.8 RATED CURRENT (AMPERE RATING) – current assigned to the equipment wiring terminal by the manufacturer.

4.9 STABILITY FACTOR S – the measure of temperature stability of a equipment wiring terminal during the current-cycling test.

4.10 TEMPERATURE RISE – denotes the difference of the temperature of the equipment wiring terminal, measured under load, and the ambient temperature.

4.11 UNIT CONTAINER – the smallest container in which equipment wiring terminals are packaged.

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 – Copper-Clad Aluminum

5.7 Cu – Copper

5.8 d – Days

5.9 f – Flexible

- 5.10 h – Hours
- 5.11 HgNO_3 – Mercurous nitrate
- 5.12 Hz – Hertz, cycles per second
- 5.13 in – Inch, Inches
- 5.14 kcmil – Thousand circular mil
- 5.15 m – Meter
- 5.16 mil – Thousandth of an inch
- 5.17 min – Minutes
- 5.18 ml – Milliliter
- 5.19 mm – Millimeter
- 5.20 mm^2 – Square millimeter
- 5.21 N – Newton - kilogram meter/sec²
- 5.22 NH_4 – Ammonia
- 5.23 r – Rigid solid and rigid stranded
- 5.24 rpm – Revolutions per minute
- 5.25 s – Seconds
- 5.26 SAE – Society of Automotive Engineers
- 5.27 sol – Solid
- 5.28 str – Stranded
- 5.29 V – Volts

6 Construction Requirements

6.1 General

6.1.1 The design and construction of an equipment wiring terminal intended for use with stranded conductors shall be such that all strands of the conductor shall be contained within the equipment wiring terminal.

6.1.2 An equipment wiring terminal that is suitable for compact-stranded conductors shall also accept all strands of a Class B concentric-stranded conductor of the same size.

6.1.3 An equipment wiring terminal intended for use with conductors of different sizes shall have a clamping mechanism that adapts to conductors of different sizes without permanent removal or addition of parts. Some examples of clamping mechanisms are:

- a) Direct bearing screws with or without use of a pressure plate;
- b) A pressure plate or plates and a screw or screws;
- c) Deformation of the equipment wiring terminal barrel (crimping) using a special tool;
- d) A spring pressure terminal; and
- e) An element for insulation-piercing or displacement.

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

6.1.5 There shall be no sharp edges or corners on the outer surface of an equipment wiring terminal that result in damage to insulation that the equipment wiring terminal contacts.

6.1.6 The construction of an equipment wiring terminal intended to secure more than a single conductor shall be such that there will be no intermixing (direct conductor contact) between the conductors of different materials unless the equipment wiring terminal is investigated and found to meet the performance requirements of this Standard and is marked in accordance with [10.20](#).

6.1.7 If the method of mounting an equipment wiring terminal is such that the mounting means cannot be retightened after wires are installed, or after the equipment wiring terminal is mounted in equipment, the mounting means – by inherent features or manufacturer's specifications – shall limit rotation of the terminal around its mounting means to 30° or less.

6.2 Materials

6.2.1 The main current-carrying part of an equipment wiring terminal 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.

6.2.2 The main current-carrying part of an equipment wiring terminal may be of plated steel or unplated steel of a corrosion resistant alloy if the equipment wiring terminal complies with the requirements for the end product.

6.2.3 An equipment wiring terminal intended for use with aluminum conductor(s) or an equipment wiring terminal body of aluminum or aluminum alloy shall be coated with an electrically conductive coating, such as tin, that will inhibit oxidation and corrosion. The following need not be coated:

- a) The wire-securing (barrel) portion of an equipment wiring terminal that is shipped prefilled with an oxide-inhibiting compound;
- b) The top cap of a lay-in equipment wiring terminal not in contact with the wire; and
- c) The stamped mounting hole in an equipment wiring terminal that is intended to be secured by a bolt, nut, and washer.

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

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

6.2.5 In regards to [6.2.4](#), an equipment wiring terminal intended for use in an appliance or equipment that complies with the requirements for such appliance or equipment may be plated steel or unplated steel of a corrosion-resistant alloy.

7 Test Requirements

7.1 General

7.1.1 An equipment wiring terminal shall meet the test requirements when separate sets of specimens are subjected to the applicable tests for the design of the equipment wiring terminal as specified in [Table 7.1](#) – [Table 7.2](#) and in [7.5](#) – [7.6](#).

Table 7.1
Test Sequences for All Connectors

Sequence			
1	2 ^a	3 ^b	4 ^c
Current-cycling	Static-heating Secureness Static-heating (repeated) Pullout	Secureness Pullout	Stress Corrosion
Note – Table 1 applies to equipment wiring terminals for non-parallel applications, in which case Table 7.2 would not be applicable. However, some equipment wiring terminals may have dual functionality, both parallel and non-parallel, in which case both Tables are applicable.			
^a This series of tests is referred to as static-heating sequence.			
^b This series of tests is referred to as mechanical sequence.			
^c The stress corrosion test, either moist ammonia or mercurous nitrate, need only be conducted for copper alloy parts not conforming to the copper requirements in 7.5 and 7.6 .			

Table 7.2
Test Sequences for All Equipment Wiring Terminals Intended for Parallel Conductors

Sequence			
1	2	3 ^a	4 ^b
Current-cycling	Static-heating	Secureness Pullout	Stress Corrosion
Note – Table 2 applies to equipment wiring terminals for parallel applications, in which case Table 7.1 would not be applicable. However, some equipment wiring terminals may have dual functionality, both parallel and non-parallel, in which case both Tables are applicable.			
^a This series of tests is referred to as mechanical sequence.			
^b The stress corrosion test, either moist ammonia or mercurous nitrate, need only be conducted for copper alloy parts not conforming to the copper requirements in 7.5 and 7.6 .			

7.1.2 With reference to [7.1.1](#), an equipment wiring terminal of copper or copper alloy need not be subjected to the current-cycling sequence using copper conductor, unless the equipment wiring terminal is dependent upon insulation piercing, insulation displacement, or spring action.

7.1.3 With reference to [7.1.1](#), the initial static-heating test need not be conducted in the static-heating sequence using copper conductor.

7.1.4 With reference to [7.1.1](#), for other than a tool-applied crimp type equipment wiring terminal, the current-cycling test using a copper conductor need not be performed when the equipment wiring terminal has been current-cycling tested with an aluminum conductor of a size not smaller than the size of the copper conductor required for the current-cycling test.

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

7.1.5 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.

7.1.6 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 equipment wiring terminal is intended. The stress corrosion tests shall be permitted to be conducted using either copper or aluminum conductor. When an equipment wiring terminal is rated for copper-to-copper, aluminum-to-aluminum, and copper-to-aluminum (intermixed), the mechanical sequence with copper-to-aluminum conductors may be omitted.

Table 7.3
Conductor Materials to be Used in Test Sequences

Conductor for which connector is intended	Conductor used in test sequences
Copper ^a	Copper
Aluminum ^a	Aluminum
Copper to copper ^b	Copper
Copper-clad aluminum	Copper-clad aluminum
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 ^b , intermixed	Copper to copper-clad aluminum
Notes –	
1) If a equipment wiring terminal 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.	
2) 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.	

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

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

Testing covers conductor sizes that are within the cross-sectional area envelope of the size tested, as determined by the circular mils of the conductor. See [9.1.5.5](#) – [9.1.5.7](#) for AWG/kcmil stranding classes.

See Annex E for conductor area, in circular mils, for conductor stranding, and for conductor diameters, of both AWG/kcmil and metric conductor sizes.

Note: See Annex B for example.

7.1.8 For an equipment wiring terminal intended to be used with aluminum, copper-clad aluminum, and copper wire (marked "AL-CU" on the equipment wiring terminal or the end use equipment), sample sets with aluminum wire and copper wire are to be subjected to the test sequence in [Table 7.1](#) or [Table 7.2](#). For an equipment wiring terminal intended to be used with copper-clad aluminum wire and copper wire (marked "CC-CU" on the equipment wiring terminal or the end use equipment), sample sets with copper-clad aluminum wire and copper wire are to be subjected to the test sequence in [Table 7.1](#) or [Table 7.2](#). For a terminal intended to be used with copper wire only, sample sets with copper wire are to be subjected to the test sequence in [Table 7.1](#) or [Table 7.2](#).

7.1.9 Tests with aluminum wire are representative of tests with copper-clad aluminum wire.

7.1.10 An equipment wiring terminal 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 [9.1.5.7](#) for testing with specific stranding counts.

7.1.11 For an equipment wiring terminal intended to be used with aluminum and copper conductor, specimens with aluminum conductor and copper conductor shall be subjected to the current-cycling, static-heating sequence, and mechanical sequence tests.

7.1.12 For an aluminum-bodied equipment wiring terminal intended to be used with copper conductor only, specimens with copper conductor shall be subjected to the current-cycling, static-heating sequence, and mechanical sequence tests.

7.1.13 Tests conducted on an equipment wiring terminal with compact-stranded copper conductors shall represent tests with 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 7.4](#).

Table 7.4
Conductor Materials

		AWG or kcmil (mm ²)	Test and control conductors shall be as follows:
Aluminum	Solid	12 (3.31) / 4.0 mm ² and larger	Aluminum wire stock for use as an electrical conductor
	Stranded	12 – 3 (3.31 – 26.7) / 4.0 – 25.0 mm ²	AA-1350 or AA-8000 conductors. The stranding shall be Class B, SIW, or IEC Class 2 with compact, compressed or concentric stranding
		2 AWG – 1 000 (33.6 – 507) / 35 – 500 mm ²	AA-1350 or AA-8000 conductors. The stranding shall be Class B, SIW, or IEC Class 2 with compact, compressed or concentric stranding
		Larger than 1 000 (507) / 500 mm ²	AA-1350 or AA-8000 conductors. The stranding shall be Class B, SIW, or IEC Class

Table 7.4 Continued on Next Page

Table 7.4 Continued

		AWG or kcmil (mm ²)	Test and control conductors shall be as follows:
			2 with compact, compressed or concentric stranding
Copper	Solid	30 – 16 (0.05 – 1.31) / 0.5 – 1.5 mm ²	Soft annealed, tinned or untinned
		14 (2.08) / 2.5 mm ² and larger	Soft annealed and untinned
	Stranded	30 – 16 (0.05 – 1.31) / 0.5 – 1.5 mm ²	Soft annealed, tinned or untinned
		14 (2.08) / 2.5 mm ² and larger	Soft annealed, tinned or untinned. The stranding shall be concentric or compressed Class B, concentric Class C, or IEC Class 2.

7.1.14 The mechanical sequence and static sequence tests are to be conducted on the equipment wiring terminals in the end use equipment of which they are an integral part. The static heating test of the static sequence tests may be conducted on a sample not subjected to the Secureness Test. See [7.3.2](#).

7.1.15 In regards to [7.1.14](#), with the concurrence of those concerned, all test sequences may be conducted on samples prepared in accordance with [9.1.8](#) if such preparation is representative of the final use of the equipment wiring terminals in the end use equipment. See [9.1.8.8](#) for additional requirements for tangless type equipment wiring terminals.

7.1.16 In regards to [7.1.14](#), equipment wiring terminals may be removed from the end use equipment if interference from molded parts, or the enclosure walls, or both, may occur.

7.1.17 In regards to [7.1.14](#), equipment wiring terminals that are intended for use in specific end use equipment but are not integral to the end use equipment may be tested in free air outside the end use equipment.

7.1.18 The current-cycling tests are to be conducted on equipment wiring terminals that have been assembled utilizing the enclosure in the end use equipment or a reasonable facsimile and then removed and tested in open air.

7.2 Current-cycling

7.2.1 The specimen sets shall complete 500 cycles of equal current-on and current-off operations for the periods of time specified in [Table 7.5](#), other than as noted in [9.2.1](#) and [9.2.4](#), while carrying the current specified for the equipment wiring terminal temperature rating and conductor size being tested.

Table 7.5
Test Current for Connectors Intended for a Single Conductor, A

Conductor size			Copper						Aluminum and copper-clad aluminum						On (and off) times for current-cycling hours ^f
			As-signed maximum ampere rating ^b	Static-heating ^{a,c,g}		Current-cycling connector temperature rating ^a				As-signed maximum ampere rating ^b	Static-heating ^{a,c,g}		Current-cycling connector temperature rating ^a		
AWG or kcmil	(mm ²)	mm ^{2 h}				75 °C ^{d,g}	90 °C ^{e,g}	75 °C ^{d,g}	90 °C ^{e,g}						
30	(0.05)	—	0.5	3	3.5	4	—	—	—	—	—	—	1		
28	(0.08)	—	0.8	3.5	4	5	—	—	—	—	—	—	1		
26	(0.13)	—	1	5.5	6	8	—	—	—	—	—	—	1		
24	(0.20)	—	2	7	8	10	—	—	—	—	—	—	1		
22	(0.32)	—	3	9	12	13	—	—	—	—	—	—	1		
—	—	0.5	4.8	11.7	15.6	16.6	—	—	—	—	—	—	1		
20	(0.52)	—	5	12	16	17	—	—	—	—	—	—	1		
—	—	0.75	6.5	15.8	18.3	22.4	—	—	—	—	—	—	1		
18	(0.82)	—	7	17	19	24	—	—	—	—	—	—	1		
—	—	1	8	17.4	19.4	26.6	—	—	—	—	—	—	1		
16	(1.31)	—	10	18	20	31	—	—	—	—	—	—	1		
—	—	1.5	11.2	21	23.2	33.2	—	—	—	—	—	—	1		
14	(2.08)	—	15	[20] 30	[22] 33	[27] 40	—	—	—	—	—	—	1		
—	—	2.5	16.7	[21.7] 31.7	[24] 35	[31.4] 44.8	—	—	—	—	—	—	1		
12	(3.31)	—	20	[25] 35	[28] 39	[40] 54	15	[20] 30	[22] 33	[29] 43	—	—	1		
—	—	4	23.5	[30.3] 40.3	[34] 45	[47] 61.4	18.5	[23.5] 33.5	[26.2] 37.2	[35] 49	—	—	1		
10	(5.26)	—	30	[40] 50	[45] 56	[60] 75	25	[30] 40	[34] 45	[46] 60	—	—	1		
—	—	6	34.7	54.7	61.7	81	28.5	43.6	48.6	64	—	—	1		
8	(8.37)	—	50	70	80	100	40	55	60	77	—	—	1		
—	—	10	55	78.3	88.3	110	43.3	61.6	68.3	85.3	—	—	1		
6	(13.3)	—	65	95	105	131	50	75	85	102	—	—	1		
—	—	16	71.8	105	117	146	55.1	83.5	93.5	115	—	—	1		
4	(21.2)	—	85	125	140	175	65	100	110	140	—	—	1		
—	—	25	105	132	149	185	68.4	105	115	147	—	—	1		

Table 7.5 Continued on Next Page

Table 7.5 Continued

Conductor size			Copper				Aluminum and copper-clad aluminum				On (and off) times for current-cycling hours ^f
			As-signed maximum ampere rating ^b	Static-heating ^{a,c,g}	Current-cycling connector temperature rating ^a		As-signed maximum ampere rating ^b	Static-heating ^{a,c,g}	Current-cycling connector temperature rating ^a		
AWG or kcmil	(mm ²)	mm ² ^h			75 °C ^{d,g}	90 °C ^{e,g}			75 °C ^{d,g}	90 °C ^{e,g}	
3	(26.7)	—	100	145	165	205	75	115	125	160	1
2	(33.6)	—	115	170	190	240	90	135	150	190	1
—	—	35	117	174	195	246	91.6	138	154	194	1
1	(42.4)	—	130	195	220	275	100	155	175	215	1
—	—	50	144	219	244	306	114	172	192	239	1
1/0	(53.5)	—	150	230	255	320	120	180	200	250	1
2/0	(67.4)	—	175	265	300	370	135	210	230	295	1
—	—	70	179	272	307	380	138	214	236	301	1
3/0	(85.0)	—	200	310	345	435	155	240	270	335	1
—	—	95	214	333	372	467	166	258	290	360	1
4/0	(107)	—	230	360	405	505	180	280	315	390	1-1/2
—	—	120	246	389	431	544	196	303	338	423	1-1/2
250	(127)	—	255	405	445	565	205	315	350	440	1-1/2
—	—	150	283	442	496	620	228	347	387	486	1-1/2
300	(152)	—	285	445	500	625	230	350	390	490	1-1/2
350	(177)	—	310	505	555	708	250	395	435	555	1-1/2
—	—	185	318	517	570	726	256	404	446	567	1-1/2
400	(203)	—	335	545	605	765	270	425	470	595	1-1/2
—	—	240	368	601	668	843	300	470	522	658	2
500	(253)	—	380	620	690	870	310	485	540	680	2
—	—	300	417	685	768	960	338	536	595	754	2
600	(304)	—	420	690	775	968	340	540	600	760	2
700	(355)	—	460	755	850	1 055	375	595	675	835	2
750	(380)	—	475	785	885	1 100	385	620	700	870	2
—	—	400	487	809	913	1 132	393	640	720	898	2

Table 7.5 Continued on Next Page

Table 7.5 Continued

Conductor size			Copper				Aluminum and copper-clad aluminum				On (and off) times for current-cycling hours ^f
			As-signed maximum ampere rating ^b	Static-heating ^{a,c,g}	Current-cycling connector temperature rating ^a		As-signed maximum ampere rating ^b	Static-heating ^{a,c,g}	Current-cycling connector temperature rating ^a		
AWG or kcmil	(mm ²)	mm ^{2 h}			75 °C ^{d,g}	90 °C ^{e,g}			75 °C ^{d,g}	90 °C ^{e,g}	
800	(405)	—	490	815	920	1 140	395	645	725	905	2
900	(456)	—	520	870	980	1 220	425	700	785	980	2
—	—	500	542	926	1 036	1 298	442	743	832	1 040	2
1 000	(507)	—	545	935	1 045	1 310	445	750	840	1 050	2
—	—	630	589	1 062	1 182	1 486	484	853	947	1 192	3
1 250	(633)	—	590	1 065	1 185	1 490	485	855	950	1 195	3
1 500	(760)	—	625	1 175	1 320	1 645	520	950	1 065	1 330	3
—	—	800	633	1 208	1 356	1 691	528	981	1 100	1 374	3
1 750	(887)	—	650	1 280	1 435	1 790	545	1 050	1 175	1 470	3
—	—	1 000	664	1 376	1 531	1 928	559	1 142	1 271	1 599	3
2 000	(1010)	—	665	1 385	1 540	1 940	560	1 150	1 280	1 610	3

Note – 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 conductors area. See [Table E.1](#) for conductor area.

^a See [7.2](#), [8.2](#), and [9.2](#).

^b Values are for 75 °C, not more than three conductors in raceway or cable ampacities, National Electrical Code, NFPA 70.

^c Values for 14 AWG (2.08 mm²) and larger are for 75 °C single conductor in free air ampacities, National Electrical Code, NFPA 70, Table 3 of the Canadian Electrical Code, C22.1, and Table 310-16 of the Standard for Electrical Installations, NOM-001-SEDE.

^d Values are approximately 112 percent of the static-heating test currents.

^e Values for 8 AWG (8.4 mm²) and larger conductors are approximately 140 percent of the static-heating test current.

^f See [9.2.5](#).

^g Values in brackets apply to connectors with assigned ampere ratings.

^h Values in the mm² column represent the common sizes for metric conductors, as specified in IEC 60228. Corresponding ampacities and test currents are determined by interpolation of the values for AWG/kcmil conductors, as permitted in NFPA 70, Section 310.15(A).

7.2.2 The current-cycling test shall be completed without any equipment wiring terminal 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 the equipment wiring terminal 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:

$$S_i = d_i - D$$

$$D = \left\lfloor \frac{(d1 + d2 + \dots + d11)}{11} \right\rfloor$$

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 equipment wiring terminal temperature. The value for d_i is a positive number when the equipment wiring terminal temperature is more than that of the control conductor and a negative number when the equipment wiring terminal 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 7.5](#) or [Table 7.6](#) for the conductor size being tested until stable temperatures are reached without exceeding a 50 °C temperature rise above ambient temperature.

Note 1: The temperature rise on an ampere-rated equipment wiring terminal may exceed 50 °C when the equipment wiring terminal, as used in the intended end use equipment application, does not exceed the maximum allowable temperature rise permitted for the end-use equipment application.

Note 2: A current source may be maintained at or above the required value by regulation or frequent adjustment.

Note 3: When testing with aluminum conductors, testing may be conducted with either AA-1350 or AA-8000 conductors, with the same allowed temperature rise.

Table 7.6
Static Test Currents for Connectors Intended for Paralleling Conductors, A

Conductor sizes			Number and material of conductors					
			Two		Three		Four	
AWG or kcmil	(mm ²)	mm ²	Copper	Aluminum and copper- clad aluminum	Copper	Aluminum and copper- clad aluminum	Copper	Aluminum and copper- clad aluminum
1/0	(53.5)	—	300	240	450	360	480	384
2/0	(67.4)	—	350	270	525	405	560	432
—	—	70	357	276	536	414	572	441
3/0	(85.0)	—	400	310	600	465	640	496
—	—	95	427	333	641	499	684	532
4/0	(107)	—	460	360	690	540	736	576
—	—	120	504	393	755	589	942	735
250	(127)	—	527	410	790	615	1 053	820
—	—	150	575	451	862	678	1 150	903
300	(152)	—	579	455	868	683	1 158	910
350	(177)	—	657	514	985	770	1 314	1 028
—	—	185	673	526	1 009	788	1 346	1 052
400	(203)	—	709	553	1 063	829	1 418	1 106
—	—	240	781	611	1 171	916	1 562	1 221
500	(253)	—	806	631	1 209	946	1 612	1 262
—	—	300	1 017	796	1 527	1 194	2 034	1 592
600	(304)	—	1 035	810	1 554	1 215	2 070	1 620
700	(355)	—	1 133	893	1 699	1 339	2 266	1 786
750	(380)	—	1 178	930	1 767	1 395	2 356	1 860
—	—	400	1 214	960	1 821	1 441	2 428	1 921
800	(405)	—	1 223	968	1 834	1 452	2 446	1 936
900	(456)	—	1 305	1 050	1 958	1 575	2 610	2 100
—	—	500	1 390	1 115	2 084	1 672	2 779	2 229
1 000	(507)	—	1 403	1 125	2 104	1 688	2 806	2 250
—	—	630	1 593	1 378	2 390	1 918	3 187	2 558
1 250	(633)	—	1 598	1 383	2 397	1 924	3 196	2 566
1 500	(760)	—	1 763	1 425	2 644	2 138	3 526	2 850
—	—	800	1 812	1 472	2 596	2 209	3 625	2 944
1 750	(887)	—	1 920	1 575	2 880	2 363	3 840	3 150
—	—	1000	2 065	1 713	3 098	2 570	4 130	3 426
2 000	(1 010)	—	2 078	1 725	3 117	2 588	4 156	3 450
NOTES —								

Table 7.6 Continued on Next Page

Table 7.6 Continued

Conductor sizes			Number and material of conductors		
			Two	Three	Four
AWG or kcmil	(mm ²)	mm ²	Aluminum and copper- clad aluminum Copper	Aluminum and copper- clad aluminum Copper	Aluminum and copper- clad aluminum Copper
1) The currents for conductor sizes 1/0 – 4/0 AWG (53.5 – 107 mm²) are based on the National Electrical Code (NEC), NFPA 70, Table 310-16, 75 °C column, multiplied by the number of conductors and de-rated by 80 percent. 2) The currents for conductor sizes 250 kcmil (127 mm²) and larger are in accordance with the NEC, NFPA 70, Sections 392.90(A)(2)(a) and 392.80(A)(2)(b) for Table 310.17 (free air ampacities), 75 °C column, multiplied by the number of conductors and de-rated as follows: 250 – 500 kcmil (127 – 253 mm²) – adjusted to 65 percent 600 kcmil (304 mm²) and larger – adjusted to 75 percent 3) Any number of conductors other than tabulated shall be adjusted in accordance with NEC, NFPA 70, Table 310.15(C)(1). 4) Values in the mm² column represent the common sizes for metric conductors, as specified in IEC 60228. Corresponding test currents are determined by interpolation of the values for AWG/kcmil conductors, as permitted in NFPA 70, Section 310.15(A). 5) 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 conductors area. See Table E.1 for conductor area.					

7.3.2 For equipment wiring terminals which are tested as part of the end use equipment, see [7.1.14](#), the samples shall carry the rated current of the end use equipment without exceeding the temperature limits for that particular equipment.

7.3.3 The joint between an equipment wiring terminal and the conductor shall be intact after being subjected for 15 min to the secureness test described in [9.3.2](#).

7.3.4 The joint between an equipment wiring terminal and the conductor of a specimen set shall be intact after being subjected for 1 min to the pullout test described in [9.3.4](#).

7.3.5 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 equipment wiring terminal. Breaking of the conductor or any strand of a stranded conductor shall be determined by examination of the complete equipment wiring terminal 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 percent is allowed for flexible and fine stranded conductors.

7.4 Mechanical sequence

7.4.1 The joint between an equipment wiring terminal and the conductor of a specimen set shall be intact after being subjected for 15 min to the secureness test described in [9.3.2](#).

7.4.2 The joint between an equipment wiring terminal and the conductor of a specimen set shall be intact after being subjected for 1 min to the pullout test described in [9.3.4](#).

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 equipment wiring terminal. Breaking of the conductor or any strand of a stranded conductor shall be determined by examination of the complete equipment wiring terminal 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 percent is allowed for flexible and fine stranded conductors.