

UL 486C

0-7629-0600-6

Splicing Wire Connectors

Underwriters Laboratories Inc. (UL)
333 Pfingsten Road
Northbrook, IL 60062-2096

UL Standard for Safety for Splicing Wire Connectors, UL 486C

Fourth Edition, Dated September 28, 2000

Revisions: This Standard contains revisions through and including October 10, 2001.

Text that has been changed in any manner is marked with a vertical line in the margin. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

A change in an effective date is indicated by a note following the affected item, and giving both the previous effective date and the new date the requirement becomes effective.

The following table lists the future effective dates with the corresponding reference. The future effective dates for paragraphs 4.9, 7.2.7, 7.2.9, 25.7, 25.8, Tables 7.2, 9.1, 11.1 and 25.1, Section 24, were added/changed according to the bulletin dated December 18, 2000.

Future Effective Dates	References
October 10, 2006	Paragraphs 4.9, 7.2.7, 7.2.9, 25.7, 25.8, Tables 7.2, 9.1, 11.1, 25.1, and Section 24

The new and revised requirements are substantially in accordance with UL's Bulletin(s) on this subject dated December 18, 2000. The bulletin(s) is now obsolete and may be discarded.

The revisions dated October 10, 2001 include a reprinted title page (page1) for this Standard.

As indicated on the title page (page 1), this UL Standard for Safety is an American National Standard. Attention is directed to the note on the title page of this Standard outlining the procedures to be followed to retain the approved text of this ANSI/UL Standard.

As indicated on the title page (page1), this UL Standard for Safety has been adopted by the Department of Defense.

The master for this Standard at UL's Northbrook Office is the official document insofar as it relates to a UL service and the compliance of a product with respect to the requirements for that product and service, or if there are questions regarding the accuracy of this Standard.

UL's Standards for Safety are copyrighted by UL. Neither a printed copy of a Standard, nor the distribution diskette for a Standard-on-Diskette and the file for the Standard on the distribution diskette should be altered in any way. All of UL's Standards and all copyrights, ownerships, and rights regarding those Standards shall remain the sole and exclusive property of UL.

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 UL.

Revisions of UL Standards for Safety are issued from time to time. A UL Standard for Safety is current only if it incorporates the most recently adopted revisions.

UL 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 UL 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 UL or an authorized UL representative has been advised of the possibility of such damage. In no event shall UL's liability for any damage ever exceed the price paid for this Standard, regardless of the form of the claim.

UL will attempt to answer support requests concerning electronic versions of its Standards. However, this support service is offered on a reasonable efforts basis only, and UL may not be able to resolve every support request. UL supports the electronic versions of its Standards only if they are used under the conditions and operating systems for which it is intended. UL's support policies may change from time-to-time without notification.

UL reserves the right to change the format, presentation, file types and formats, delivery methods and formats, and the like of both its printed and electronic Standards without prior notice.

Purchasers of the electronic versions of UL's Standards for Safety agree to defend, indemnify, and hold UL harmless from and against any loss, expense, liability, damage, claim, or judgement (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.

If a single-user version electronic Standard was purchased, one copy of this Standard may be stored on the hard disk of a single personal computer, or on a single LAN file-server or the permanent storage device of a multiple-user computer in such a manner that this Standard may only be accessed by one user at a time and for which there is no possibility of multiple concurrent access.

If a multiple-user version electronic Standard was purchased, one copy of the Standard may be stored on a single LAN file-server, or on the permanent storage device of a multiple-user computer, or on an Intranet server. The number of concurrent users shall not exceed the number of users authorized.

Electronic Standards are intended for on-line use, such as for viewing the requirements of a Standard, conducting a word search, and the like. Only one copy of the Standard may be printed from each single-user version of an electronic Standard. Only one copy of the Standard may be printed for each authorized user of a multiple-user version of an electronic Standard. Because of differences in the computer/software/printer setup used by UL and those of electronic Standards purchasers, the printed copy obtained by a purchaser may not look exactly like the on-line screen view or the printed Standard.

An employee of an organization purchasing a UL Standard can make a copy of the page or pages being viewed for their own fair and/or practical internal use.

The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if

the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

Copyright © 2001 Underwriters Laboratories Inc.

This Standard consists of pages dated as shown in the following checklist:

Page	Date
1	October 10, 2001
2-5	September 28, 2000
6	October 10, 2001
7	September 28, 2000
8-10B	October 10, 2001
11-17	September 28, 2000
18-20	October 10, 2001
21-27	September 28, 2000
28	October 10, 2001
29-31	September 28, 2000
32	October 10, 2001
33-40	September 28, 2000
41-43	October 10, 2001
44	September 28, 2000
45-46	October 10, 2001
47	September 28, 2000
48-50	October 10, 2001
SR1-SR6	October 10, 2001

No Text on This Page

SEPTEMBER 28, 2000
(Title Page Reprinted: October 10, 2001)



1

UL 486C

Standard for Splicing Wire Connections

First Edition – December, 1983
Second Edition – October, 1991
Third Edition – February, 1997

Fourth Edition

September 28, 2000

The most recent designation of ANSI/UL 486C as an American National Standard occurred on September 7, 2001.

This ANSI/UL Standard for Safety, which consists of the Fourth edition with revisions through October 10, 2001, is under continuous maintenance, whereby each revision is ANSI approved upon publication. Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Written comments are to be sent to UL-RTP Standards Department, 12 Laboratory Dr., P.O. Box 13995, Research Triangle Park, NC 27709-3995.

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

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

0-7629-0600-6

COPYRIGHT © 1983, 2001 UNDERWRITERS LABORATORIES INC.

No Text on This Page

CONTENTS

FOREWORD	6
----------------	---

INTRODUCTION

1 Scope	7
2 Units of Measurement	8
2A Undated References	8

CONSTRUCTION

3 General	8
4 Materials	9

PERFORMANCE

5 General	10
6 Selection of Samples	13
6.1 General	13
6.2 Heat cycling	13
6.3 Static-heating sequence	15
6.4 Mechanical sequence	15
6.5 Maximum fill	16
6.6 Spring-action sequence	17
6.7 Over torque	17
6.8 All other tests	17
7 Preparation of Samples	17
7.1 General	17
7.2 Test and control conductors	18
7.3 Conductor stripping	21
7.4 Tightening torque	22
7.5 Equalizer	23
8 Temperature Measurements	24
9 Heat-Cycling Test	27
9.1 General	27
9.2 Sample test assembly	28
10 Static-Heating Test	30
11 Secureness Test	31
12 Repeated Static-Heating Test	33
13 Pullout Test	33
14 Over-Torque Test	34
15 Conditioning	34
16 Temperature Test	35
17 Dielectric Voltage-Withstand Test for Spring-Action Connections	35
18 Dielectric Voltage-Withstand Test	36
18.1 General	36
18.2 Test A, insulation puncture	37
18.3 Test B, flashover	38
18.4 Test C, flashover	39
19 Secureness-of-Insulation Test	39
20 Reserved	40

21 Flexing Test 40

22 Moisture-Absorption Test 40

23 10-Day Moist Ammonia-Air Stress Cracking Test 40

24 Installation at Low Temperature 41

MARKING

25 Details 41

No Text on This Page

FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 These requirements apply to hand- or tool-applied pressure splicing wire and cable connectors intended for use with copper, aluminum, or copper-clad aluminum insulated conductors in accordance with the National Electrical Code, ANSI/NFPA 70.

1.2 These requirements apply to splicing wire and cable connectors intended for use with any combination of the following conductors: Nos. 30 – 8 AWG (0.05 – 8.4 mm²) solid and stranded copper, No. 6 AWG (13.3 mm²) stranded copper, Nos. 12 – 8 AWG (3.3 – 8.4 mm²) solid and stranded aluminum, No. 6 AWG stranded aluminum, Nos. 12 – 8 AWG solid and stranded copper-clad aluminum, and No. 6 stranded copper-clad aluminum.

1.3 These requirements also cover connectors of the types specified in 1.4 intended for use with metric conductors that have cross sectional area within the range of the rated AWG/kcmil conductors. For example a connector rated for 6 AWG – 250 kcmil may additionally be rated for 16 – 120 mm². See 6.1.4, 7.2.3, 25.22, and 25.23.

1.4 For connectors intended for use with stranded conductors, the following conductor strand configurations are intended:

- a) Aluminum – Class B concentric, compressed, and unidirectional lay compact.
- b) Copper – Class B concentric and compressed. Class C concentric, other stranding as indicated by marking.
- c) Copper-Clad Aluminum – Class B concentric.

Other class and strand configurations may also be covered as indicated by marking.

1.5 These requirements also apply to uninsulated splicing connectors for use in general use circuits rated 2000 volts nominal or less and for use in specific applications rated 8000 volts nominal or less when the splicing connectors are installed according to the National Electrical Code.

1.6 These requirements cover splicing connectors intended for copper-to-copper or aluminum-to-aluminum conductor combinations, or both. Also covered are copper-to-aluminum or to copper-clad aluminum conductor combinations intended for intermixing of conductors and dry locations only.

1.7 These requirements do not cover:

- a) Connectors intended for direct burial;
- b) Insulated connectors intended for use at voltage levels in excess of 600 volts [1000 volts in a sign or lighting fixture (luminaire)];
- c) Pressure terminal wire connectors;
- d) Binding-screw terminals;
- e) Built-in terminal connectors on devices rated under 30 amperes and intended for outlet-box mounting or having provision for strain relief; or

- f) Built-in terminal connectors on devices having integral cable clamps.

1.8 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

2 Units of Measurement

2.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

2A Undated References

2A.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

CONSTRUCTION

3 General

3.1 A connector intended for use with stranded conductor shall be constructed such that all strands of the conductor can be contained within the connector.

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

- a) Direct-bearing screws with or without use of a pressure plate;
- b) A pressure plate or plates and a screw or screws;
- c) A special tool to form or crimp the connector barrel;
- d) A plate of an insulation-piercing connector; and
- e) A spring-action clamp connector.

Any rearrangement or adjustment of a connector that is necessary to adapt it to various sizes of conductor shall be obvious unless the connector is marked as described in 25.13.

3.2 revised October 10, 2001

3.3 There shall be no sharp edges or corners on the outer surface of a connector to result in damage to electrical insulation when contacted.

4 Materials

4.1 The main current-carrying part of a connector shall be of aluminum, an aluminum alloy, copper, a copper alloy, or equivalent material that is intended for the purpose.

4.2 The connector body of a copper, copper alloy, aluminum, or aluminum alloy connector intended for aluminum conductor shall be coated with an electrically conductive coating, such as tin, that will inhibit oxidation and corrosion. When the connector body is not coated with an electrically conductive coating, the connector shall either be shipped prefilled with an oxide-inhibiting compound, or be an aluminum-bodied connector intended for an aluminum conductor only.

4.2.3 The top cap of a lay-in lug or connector not in contact with the wire is not required to be plated.

4.3 A brass part of a connector shall be resistant to stress corrosion cracking. A brass part containing not more than 15 percent zinc is considered to be resistant to stress corrosion cracking.

4.4 A brass part, containing more than 15 percent zinc, shall comply with 10-Day Moist Ammonia-Air Stress Cracking Test, Section 23.

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

4.6 Insulation used as a part of a connector shall be material intended for the marked temperature rating of the connector. The temperature limits of some of the commonly used insulating materials shall not exceed the values specified in Table 25.3.

4.7 The insulating material shall be a minimum flammability classification of V-2 or VTM2 as determined by tests described in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

Exception: A material other than V-2 or VTM2 is able to be used when the wire connector complies with the requirements for the glow-wire test as specified in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C at a temperature of 850°C (1,562°F).

4.7 revised October 10, 2001

4.8 Deleted October 10, 2001

4.9 Insulated twist-on or set-screw connectors rated for aluminum shall have insulation colored purple or brown. An insulated twist-on or set-screw connector rated for copper wire only shall not be colored purple or brown.

Effective date for 4.9 changed from September 28, 2000 to October 10, 2006

4.10 Porcelain or cold-molded composition used as insulation shall additionally comply with Moisture Absorption Test, Section 22.

PERFORMANCE

5 General

5.1 A splicing connector shall perform as intended when separate sets of samples are subjected to the tests specified in Table 5.1 and 5.2. As a result of the tests, there shall be no breakage of the conductor or any strand of a stranded conductor, stripping of threads, unintentional shearing of parts, separation of the conductor from the connector, or other unintentional damage to the connector. The insulation of an insulated connector shall not crack or break when the connector is assembled as intended on the conductor.

5.2 With reference to 5.1, separation of a conductor from a connector is to be determined by examination of the assembly after the Secureness Test, Section 11, and the Pullout Test, Section 13.

5.3 With reference to 5.1, breaking of the conductor or any strand of a stranded conductor is to be determined by examination of the complete connector assembly while still intact after the secureness and pullout tests. When the conductor or a strand of a stranded conductor becomes detached at the point where it enters the connector, breakage is determined to have occurred.

5.4 For a tool-applied crimp-on connector, when the conductors are secured by a single securing means, tests are to be conducted with the conductors pretwisted according to the instructions provided by the manufacturer and according to 25.14(d) and 25.20. The conductors are not required to be pretwisted when the design of the connector does not lend itself to direct contact, such as a butt-end splice.

5.5 At the manufacturer's option, tests of connectors intended for original equipment manufacturer (OEM) use will be conducted with the conductors not pretwisted. However, instructions for pretwisting the conductors shall be provided for field wiring applications. Instructions for pretwisting are optional for OEM wiring applications. When the connector can be crimped without providing direct contact between the conductors, then tests are to be conducted with the connector crimped so they are not in direct contact. Connectors tested with the conductors not pretwisted shall be marked as specified in 25.21.

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

5.7 A connector of copper or copper alloy is not required to be subjected to the heat-cycling sequence using copper conductors, unless the connector is dependent upon an insulation piercing, insulation-displacement, or spring-action type clamp.

5.8 A twist-on connector provided with a metal insert is not required to be subjected to the heat-cycling sequence using copper conductors.

5.9 With respect to 5.7 and 5.8, a pre-filled twist-on connector (with or without a spring insert) shall also be subjected to the heat cycling sequence using copper conductors. Prefilling usually consists of a gel, epoxy, or similar compound.

No Text on This Page

5.10 The oven conditioning described in 18.2.2, 18.2.3, and Table 18.2 shall not cause the connector insulation to change so as to adversely affect the insulating properties of the conductor insulation and the wire connector. However, discoloration of the connector insulation is acceptable.

Table 5.1
Test sequences – all connectors

Section	Test sequences	Sample set
9	Heat cycling sequence	
	Heat cycling	4 connectors for each combination of conductors for which the connector is intended as required by 6.2.2 – 6.2.6.
10 11 12 13	Static heating sequence	
	Static heating	4 connectors for each combination of connector and test conductor or conductors required by 6.3.2.
	Secureness	4 connectors for each combination of connector and test conductor or conductors required by 6.3.2.
	Repeated static heating	Sample set previously subjected to the Static-Heating Test, Section 10, and the Secureness Test, Section 11.
	Pull out	Sample set previously subjected to the repeated Static-Heating Test, Section 12.
11 13 6.5 14	Mechanical sequence	
	Secureness	2 connectors for each combination of conductors for which the connector is intended as required by 6.4.1 and 6.4.2.
	Pull out	Sample set previously subjected to the Secureness Test, Section 11.
	Max fill	For twist-on connectors only, 2 connectors for each combination of conductors for which the connector is intended as required by 6.5.1 and 6.5.2.
	Over-torque	For connectors where the tightening torque is applied by means of a screwdriver only, 6 connectors. See Table 14.1.
15 16 17	Spring-action clamp sequence	
	Conditioning	6 connectors for each combination of conductors for which the connector is intended as required by 6.6.2.
	Temperature	Sample set previously subjected to the Conditioning of Section 15.
23	Dielectric-voltage withstand	Sample set previously subjected to the Temperature Test, Section 16.
	Other	
23	10-day moist ammonia-air stress cracking test	3 connectors assembled to a 6 inch length of the maximum rated conductor and torqued to the value specified in 7.4.3.

Table 5.2
Additional tests – insulated connectors^a

Section	Tests	Sample set
18	Dielectric voltage-withstand	For connectors employing thermosetting insulating material: 6 connectors in as-received condition. For connectors employing thermoplastic material: 6 connectors in as-received condition, 6 connectors assembled to conductors before oven conditioning, and 6 connectors assembled to conductors after oven conditioning.
19	Secureness of insulation	For connector insulation in the form other than a tubular sleeve and for use with 10 AWG or smaller conductors: 6 connectors. For connector insulation in the form of a tubular sleeve and for use with 10 AWG or smaller conductors: 6 connectors in as-received condition, 6 connectors after oven conditioning, 6 connectors assembled to conductors before oven conditioning, and 6 connectors assembled to conductors after oven conditioning.
21	Flexing	For connectors with insulating covers employing a hinge, latch, or lock: 6 connectors in as-received condition and assembled to conductors, 6 connectors assembled to conductors after oven conditioning, and 6 connectors assembled to conductors after "cold" conditioning.
22	Moisture-absorption	6 connectors
24	Installation at low-temperature	6 connectors
^a Insulated connectors shall also be subjected to the test sequences described in Table 5.1.		