



UL 2459

# Underwriters Laboratories Inc. Standard for Safety

## Insulated Multi-Pole Splicing Wire Connectors



*UL COPYRIGHTED MATERIAL –  
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR  
DISTRIBUTION WITHOUT PERMISSION FROM UL*



**Documents**  
Document Sharing Hub

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

UL Standard for Safety for Insulated Multi-Pole Splicing Wire Connectors, UL 2459

First Edition, Dated August 22, 2008

### **Summary of Topics**

***This First edition of ANSI/UL 2459 harmonizes UL and CSA requirements for insulated multi-pole splicing wire connectors. These requirements cover insulated multi-pole mating or non-mating splicing wire connectors intended for field wiring and factory wiring for use in accordance with the Canadian Electrical Code, Part I, in Canada, and NFPA 70, National Electrical Code, in the United States.***

UL Standards for Safety are developed and maintained in the Standard Generalized Markup Language (SGML). SGML -- an international standard (ISO 8879-1986) -- is a descriptive markup language that describes a document's structure and purpose, rather than its physical appearance on a page. Due to formatting differences resulting from the use of UL's new electronic publishing system, please note that additional pages (on which no requirements have been changed) may be included in revision pages due to relocation of existing text and reformatting of the Standard.

The following table lists the future effective date with the corresponding item.

| Future Effective Date | References      |
|-----------------------|-----------------|
| February 22, 2010     | Entire standard |

The requirements are substantially in accordance with UL's Proposal(s) on this subject dated August 31, 2007 and April 25, 2008.

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.

The UL Foreword is no longer located within the UL Standard. For information concerning the use and application of the requirements contained in this Standard, the current version of the UL Foreword is located on ULStandardsInfoNet at: <http://ulstandardsinfo.net/ulforeword.html>

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 Recognition and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

Copyright © 2008 Underwriters Laboratories Inc.

UL COPYRIGHTED MATERIAL –  
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR  
DISTRIBUTION WITHOUT PERMISSION FROM



**Documents**

Document Sharing Hub

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

| Page       | Date            |
|------------|-----------------|
| 1-56 ..... | August 22, 2008 |



Canadian Standards Association  
CSA C22.2 No. 2459-08  
First Edition



Underwriters Laboratories Inc.  
UL 2459  
First Edition

## Insulated Multi-Pole Splicing Wire Connectors

August 22, 2008



ANSI/UL 2459-2008

UL COPYRIGHTED MATERIAL –  
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR  
DISTRIBUTION WITHOUT PERMISSION FROM UL



**Documents**

Document Sharing Hub

## Commitment for Amendments

This standard is issued jointly by the Canadian Standards Association (CSA) and Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the standard may be submitted to CSA or UL at any time. Revisions to this standard will be made only after processing according to the standards development procedures of CSA and UL. CSA and UL will issue revisions to this standard by means of a new edition or revised or additional pages bearing their date of issue.

---

**ISBN 1-55436-435-3**

**© 2008**

**Canadian Standards Association**

All rights reserved. No part of this publication may be reproduced in any form whatsoever without the prior permission of the publisher.

To purchase CSA Standards and related publications, visit CSA's Online Store at [www.ShopCSA.ca](http://www.ShopCSA.ca) or call toll-free 1-800-463-6727 or 416-747-4044.

---

## Copyright © 2008 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. 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 <http://csds.ul.com>.

The most recent designation of ANSI/UL 2459 as an American National Standard (ANSI) occurred on August 22, 2008.

This ANSI/UL Standard for Safety, which consists of the First edition is under continuous maintenance, whereby each revision is ANSI approved upon publication.

---

**UL COPYRIGHTED MATERIAL –  
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR  
DISTRIBUTION WITHOUT PERMISSION FROM UL**



**Documents**

Document Sharing Hub

## CONTENTS

|                                                                    |    |
|--------------------------------------------------------------------|----|
| Preface .....                                                      | 5  |
| 1 Scope .....                                                      | 7  |
| 2 Reference publications and definitions .....                     | 8  |
| 2.1 Reference publications .....                                   | 8  |
| 2.2 Definitions .....                                              | 9  |
| 3 Units of measurement .....                                       | 11 |
| 4 Construction .....                                               | 11 |
| 4.1 General .....                                                  | 11 |
| 4.2 Materials .....                                                | 12 |
| 4.3 Accessibility of parts .....                                   | 14 |
| 4.4 Spacings .....                                                 | 15 |
| 4.5 Mating-type (separable-type) connectors .....                  | 16 |
| 4.6 Integral pigtail leads .....                                   | 16 |
| 5 Test requirements .....                                          | 16 |
| 5.1 General .....                                                  | 16 |
| 5.2 Grounding contact – Short-time withstand current .....         | 17 |
| 5.3 Latching mechanism .....                                       | 17 |
| 5.4 Abnormal overload .....                                        | 18 |
| 5.5 Temperature .....                                              | 18 |
| 5.6 Dielectric voltage withstand .....                             | 18 |
| 5.7 Dielectric withstand – Puncture .....                          | 19 |
| 5.8 Mold stress relief .....                                       | 19 |
| 5.9 Current cycling .....                                          | 20 |
| 5.10 Mechanical sequence .....                                     | 21 |
| 5.11 Stress corrosion/moist ammonia (NH <sub>4</sub> ) .....       | 21 |
| 5.12 Stress corrosion/mercurous nitrate (HgNO <sub>3</sub> ) ..... | 21 |
| 5.13 Spring action .....                                           | 21 |
| 6 Sampling requirements .....                                      | 21 |
| 7 Test methods .....                                               | 22 |
| 7.1 General .....                                                  | 22 |
| 7.2 Grounding contact – Short-time withstand current .....         | 28 |
| 7.3 Latching or locking mechanism .....                            | 29 |
| 7.4 Abnormal overload .....                                        | 29 |
| 7.5 Temperature rise .....                                         | 30 |
| 7.6 Dielectric voltage withstand .....                             | 31 |
| 7.7 Dielectric withstand – Puncture .....                          | 31 |
| 7.8 Mold stress relief .....                                       | 32 |
| 7.9 Current cycling .....                                          | 32 |
| 7.10 Mechanical sequence .....                                     | 33 |
| 7.11 Stress corrosion/moist ammonia (NH <sub>4</sub> ) .....       | 34 |
| 7.12 Stress corrosion/mercurous nitrate (HgNO <sub>3</sub> ) ..... | 35 |
| 7.13 Spring-action sequence .....                                  | 35 |
| 8 Marking, labelling, and packaging .....                          | 36 |
| TABLES .....                                                       | 39 |
| FIGURES .....                                                      | 47 |

UL COPYRIGHTED MATERIAL –  
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR  
DISTRIBUTION WITHOUT PERMISSION FROM UL



**Documents**  
Document Sharing Hub

**Annex A (Informative)**

|                                                     |    |
|-----------------------------------------------------|----|
| A.1 Example of a stability factor calculation ..... | 54 |
|-----------------------------------------------------|----|

**Annex B (Informative)**

|                                                     |    |
|-----------------------------------------------------|----|
| B.1 Example of application of Clause 7.10.2.4 ..... | 55 |
|-----------------------------------------------------|----|

**Annex C (Informative)**

|                                                            |    |
|------------------------------------------------------------|----|
| C.1 French translations and markings (See Clause 8.) ..... | 56 |
|------------------------------------------------------------|----|

## Preface

This is the harmonized CSA and UL standard for insulated multi-pole splicing wire connectors. It is the first edition of CSA C22.2 No. 2459 and the first edition of UL 2459. This edition of UL 2459 supersedes the previous outline of investigation published in 2005.

This common standard was prepared by the Canadian Standards Association (CSA) and Underwriters Laboratories Inc. (UL). The efforts and support of the Technical Harmonization Committee for Connectors, of the Council on the Harmonization of Electrotechnical Standards of the Nations of the Americas (CANENA), are gratefully acknowledged.

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

This standard was reviewed by the CSA Integrated Committee on Electrical Connectors, under the jurisdiction of the CSA Technical Committee on Wiring Products and the CSA Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee.

This standard has been 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 to be considered a minimum quantity.

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

## Level of harmonization

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

This standard is published as an equivalent standard for CSA and UL.

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

## Reasons for differences from IEC

At present there is no IEC standard for insulated multi-pole splicing wire connectors. 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.

UL COPYRIGHTED MATERIAL –  
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR  
DISTRIBUTION WITHOUT PERMISSION FROM  Documents  
Document Sharing Hub

**CSA Effective Date**

The effective date for CSA International will be announced through CSA Informs or a CSA certification notice.

**UL Effective Date**

As of February 22, 2010, all products Listed or Recognized by UL must comply with the requirements in this standard.

Until February 22, 2010, new product submittals to UL may be evaluated under all requirements in this standard or, if requested in writing, evaluated under presently effective requirements only. The presently effective requirements are contained in the first issue of the Outline of Investigation for Insulated Multi-Pole Splicing Wire Connectors, Subject 2459.

A UL effective date is one established by Underwriters Laboratories Inc. and is not part of the ANSI approved standard.

# INSULATED MULTI-POLE SPLICING WIRE CONNECTORS

## 1 Scope

1.1 This Standard covers insulated multi-pole mating or non-mating splicing wire connectors intended for field wiring and factory wiring for use in accordance with the Canadian Electrical Code, Part I, in Canada, and NFPA 70, National Electrical Code, in the United States.

1.2 These wire connectors are intended to facilitate the connection of devices, such as prefabricated wiring assemblies, smoke detectors, and lighting products, to the branch circuit conductors of buildings.

1.3 These wire connectors may additionally be used internal to luminaries to facilitate replacement of the ballast and may not be directly attached to the branch circuit conductors. These wire connectors are suitable for one or more conductors per contact.

1.4 These wire connectors are suitable for use with 30 to 6 AWG (0.05 to 13.3 mm<sup>2</sup>) stranded copper conductors and 30 to 10 AWG (0.05 to 5.3 mm<sup>2</sup>) solid copper conductors.

1.5 These wire connectors are suitable for currents not exceeding the ampacity of insulated conductors or as rated by the manufacturer.

**Note:** The ampacity of insulated conductors 14 AWG (2.1 mm<sup>2</sup>) and larger is determined in accordance with the values in the "Assigned maximum ampere rating" column, under the heading "Copper", in Table 7 of CAN/CSA-C22.2 No. 65 or UL 486A-486B. In Canada, the maximum ampacity of insulated conductors 14 AWG (2.1 mm<sup>2</sup>) and smaller is determined in accordance with Table 12 of the Canadian Electrical Code, Part I.

1.6 These wire connectors are suitable for voltages not exceeding 600 V.

1.7 This Standard does not apply to

- (a) splicing wire connectors intended for direct burial;
- (b) insulated splicing wire connectors intended for use at voltage levels exceeding 600 V (1000 V in a sign or luminaire);
- (c) terminal wire connectors;
- (d) wire binding screw terminals;
- (e) built-in terminal connectors on devices having integral cable clamps;
- (f) flat quick-connect terminals;
- (g) devices, such as wire connectors and soldering lugs, that are covered by
  - (i) CAN/CSA-C22.2 No. 65 or UL 486A-486B;
  - (ii) CAN/CSA-C22.2 No. 188 or UL 486C; or
  - (iii) UL 486E;

(h) devices, such as quick-connect terminals, that are covered by CSA C22.2 No. 153 or UL 310;

(i) devices covered by CSA C22.2 No. 182.3 or UL 1977; and

(j) devices, such as pin and sleeve connectors, that are covered by CSA C22.2 No. 182.1 or UL 1682.

## 2 Reference publications and definitions

### 2.1 Reference publications

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.

#### CSA (Canadian Standards Association)

**Note:** For products intended for use in Canada, general requirements are given in CAN/CSA-C22.2 No. 0.

C22.1-06

*Canadian Electrical Code, Part I*

CAN/CSA-C22.2 No. 0-M91 (R2006)

*General requirements – Canadian Electrical Code, Part II*

CAN/CSA-C22.2 No. 0.17-00 (R2004)

*Evaluation of properties of polymeric materials*

CAN/CSA-C22.2 No. 65-03

*Wire connectors*

C22.2 No. 153 -M1981 (R2003)

*Quick-connect terminals*

C22.2 No. 182.1-07

*Plugs, receptacles, and cable connectors of the pin and sleeve type*

C22.2 No. 182.3-M1987 (R2004)

*Special use attachment plugs, receptacles, and connectors*

CAN/CSA-C22.2 No. 188-04

*Splicing wire connectors*

#### UL (Underwriters Laboratories Inc.)

UL 94

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

UL 310

*Standard for Electrical Quick-Connect Terminals*

UL COPYRIGHTED MATERIAL –  
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR  
DISTRIBUTION WITHOUT PERMISSION FROM  Documents  
Document Sharing Hub

UL 486A-486B  
*Standard for Wire Connectors*

UL 486C  
*Standard for Splicing Wire Connectors*

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

UL 746A  
*Standard for Polymeric Materials – Short Term Property Evaluations*

UL 746B  
*Standard for Polymeric Materials – Long Term Property Evaluations*

UL 1682  
*Standard for Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type*

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

## **NFPA (National Fire Protection Association)**

NFPA 70  
*National Electrical Code*

## **2.2 Definitions**

The following definitions apply in this Standard:

2.2.1 Connector (cable connector) – a receptacle that is intended to provide power with means for attachment to electrical conductors.

2.2.2 Contact – a conductive element within a connector that is intended to mate with a corresponding element or conductor to provide an electrical path.

2.2.3 Control conductor – an unbroken conductor that is included in a current-cycling test loop.

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

2.2.5 Enclosure – the case or housing into which an insulator and contacts are assembled.

2.2.6 Equalizer – a bus bar that provides for equipotential and uniform current flow in a standard conductor without adversely affecting the temperature of the connector(s).

2.2.7 Insulation-piercing or insulation-displacement connector – a connector for the connection and possible disconnection of one conductor or the interconnection of two or more conductors, the connection being made by piercing, boring through, cutting through, removing, displacing, or making ineffective in some other manner the insulation of the conductor or conductors without previous stripping.

UL COPYRIGHTED MATERIAL –  
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR  
DISTRIBUTION WITHOUT PERMISSION FROM UL



**Documents**  
Document Sharing Hub

2.2.8 Insulator – a non-conductive portion of a device that provides for separation of and/or support of contacts. It may be combined with the enclosure.

2.2.9 Latch (latching) – a mechanical locking feature that provides for an intentional additional operation by the user to disengage mated connectors.

2.2.10 Luminaire disconnect – a mating wire connector (separable-type connector) intended to facilitate replacement of the ballast.

2.2.11 Mating wire connector (separable-type connector) – a connector consisting of two separable mating members (usually consisting of a male/female connection) that can be readily engaged or disengaged without the use of tools.

2.2.12 Non-mating wire connector (non-separable-type connector) – a device used to facilitate a direct connection to branch circuit conductors.

2.2.13 Plug (attachment plug) – a device that is intended to receive power when coupled with a mating device and establishes a connection between conductors of the two assemblies.

2.2.14 Receptacle (outlet) – a device intended to provide power to an inserted plug. It is usually installed as a fixed outlet.

2.2.15 Short-time withstand current – the specified root-mean-square value of current that a grounding conductor path is able to withstand for a short time under prescribed conditions of use and behavior.

2.2.16 Splicing wire connector – a connector that establishes a connection between two or more conductors by mechanical pressure and is not intended to be permanently mounted.

2.2.17 Spring-action-type connector – a connector that uses a spring action clamping mechanism for retaining a conductor.

2.2.18 Temperature rating – the maximum temperature of an insulated connector assigned by the manufacturer.

2.2.19 Temperature rise – the difference between the temperature of the connector, measured under load, and the ambient temperature.

2.2.20 Terminal – an accessible conductive part provided on a contact for connecting a conductor.

2.2.21 Thermoplastic – a plastic that can be repeatedly softened by heating and hardened by cooling through a temperature range characteristic of the plastic and, in the softened state, can be shaped into articles by molding or extrusion.

2.2.22 Thermoset – a material that is substantially infusible and insoluble after having been cured by heat or other means.

2.2.23 Unit container – the smallest container in which connectors are packaged.

2.2.24 Voltage rating – the maximum voltage of an insulated connector assigned by the manufacturer.

### 3 Units of measurement

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

### 4 Construction

#### 4.1 General

4.1.1 A multi-pole wire connector shall be provided with contacts of one of the following types:

- (a) splicing wire connectors;
- (b) insulation-piercing or insulation-displacement connectors;
- (c) tool-applied compression connectors; or
- (d) spring force connectors.

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

4.1.3 A connector that is suitable for compact-stranded conductors shall also accept all strands of a Class B concentric-stranded conductor of the same size.

4.1.4 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.

**Note:** *Examples of clamping means include*

- (a) direct-bearing screws, with or without use of a pressure plate;*
- (b) deformation of the connector barrel (crimping) using a special tool;*
- (c) an element for insulation piercing or insulation displacement;*
- (d) a spring-action clamp;*
- (e) a helical coiled spring; and*
- (f) a formed insulation cavity (no spring).*

4.1.5 Any rearrangement or adjustment of a connector that is necessary to adapt it to various sizes of conductors shall be obvious unless the connector is marked as described in Clause 8.8.

4.1.6 There shall be no sharp edges or corners on the outer surface of a connector that could damage the insulation that the connector contacts.

## 4.2 Materials

### 4.2.1 General

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

4.2.1.2 Except as specified in Clause 4.2.1.3, a connector body made of aluminum or aluminum alloy shall be coated with an electrically conductive coating, such as tin, that will inhibit oxidation and corrosion.

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

4.2.1.3 With reference to Clause 4.2.1.2, a connector shipped pre-filled with an oxide-inhibiting compound need not be coated.

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

### 4.2.2 Insulating materials

#### 4.2.2.1 General

4.2.2.1.1 Insulation employed as a part of a connector shall be suitable for the tested voltage rating of the connector in accordance with Table 1.

4.2.2.1.2 All parts that act as the electrical insulation shall comply with Clauses 4.2.2.2 to 4.2.2.5. Hard rubber shall not be employed.

#### 4.2.2.2 Regrind

4.2.2.2.1 Molded parts of thermoplastic containing up to 25% regrind dry blended with the same grade of virgin resin shall be accepted. Thermosetting materials shall not be used as regrind.

4.2.2.2.2 Thermoplastic molded parts containing more than 25% regrind by weight shall not be used unless their acceptability has been determined by a separate investigation. The parts and test samples for the investigation shall undergo a number of moldings until the percentage of regrind from the first molded part is less than 1% in the final molded part used for testing.

#### 4.2.2.3 Flammability

4.2.2.3.1 A polymeric material used for electrical insulation of live parts shall have a flame class rating of V-2, V-1, V-0, VTM-2, VTM-1, or VTM-0 in accordance with CAN/CSA-C22.2 No. 0.17 or UL 94. The flame class rating of the material shall be judged at the minimum thickness employed at the walls and barriers that are critical to the functioning of the insulation.

#### 4.2.2.4 Electrical properties

4.2.2.4.1 A polymeric material used for electrical insulation or enclosure of live parts shall have a comparative tracking index (CTI) rating of 175 V or greater or a performance level class (PLC) of at least 3. However, the following exceptions shall apply:

(a) polymeric material used for electrical insulation of live parts shall not be required to comply with this requirement when it complies with the comparative tracking index test described in CAN/CSA-C22.2 No. 0.17 or UL 746C; and

(b) polymeric material that is separated by air by more than 0.8 mm (1/32 in) from uninsulated live parts and more than 12.7 mm (1/2 in) from arcing parts shall not be required to comply with this requirement.

4.2.2.4.2 A polymeric material used for electrical insulation of live parts shall have hot wire ignition (HWI) and high-current arc resistance to ignition (HAI) ratings or performance level classes of at least those specified in Table 2 for the flame class rating determined in accordance with Clause 4.2.2.3. For materials with other than VTM flammability classifications, the HWI and HAI ratings of the material shall be evaluated using the specimen thickness employed in the connector. However, the following exceptions shall apply:

(a) polymeric material used for electrical insulation of live parts shall not be required to comply with the HWI requirements when it complies with the glow wire test described in CAN/CSA-C22.2 No. 0.17 and UL 746C;

(b) polymeric material used for electrical insulation of live parts shall not be required to comply with the HAI requirements when it complies with the high-current arc resistance to ignition test described in CAN/CSA-C22.2 No. 0.17 and UL 746C; and

(c) polymeric material that is separated by air by more than 0.8 mm (1/32 in) from uninsulated live parts and more than 12.7 mm (1/2 in) from arcing parts shall not be required to comply with the HWI and HAI requirements.

#### 4.2.2.5 Thermal properties

4.2.2.5.1 Polymeric materials used for electrical insulation of live parts shall have the applicable minimum relative thermal index temperature shown in Table 3. For materials with other than VTM flammability classifications, the material shall be evaluated using the specimen thickness. The thermal rating of the material shall be judged at the minimum thickness employed at the walls and barriers that are critical to the functioning of the insulation.

### 4.3 Accessibility of parts

4.3.1 A connector shall have live parts protected against contact

- (a) when fully assembled;
- (b) when installed in the intended manner;
- (c) while engaged; and
- (d) when disengaged.

The load side of a disengaged mating-type connector need not meet this requirement when marked "LOAD".

4.3.2 The probe shown in Figure 1 shall be applied with a force of not more than 13.3 N (3 lbf) to any depth that recessing will permit. The probe shall be rotated, changed in configuration, or angled before, during, and after application to any position that is necessary to examine the device. A live or dead metal part shall be determined to be accessible when

- (a) the part is contacted by the probe; or
- (b) the part is located in an opening larger than 7.1 mm (9/32 in) in diameter and recessed less than 4.8 mm (3/16 in).

4.3.3 In order to judge the accessibility of a live or dead metal part, the device shall be wired and assembled in accordance with the manufacturer's instructions, except that any parts that can be opened or removed by the user without a tool shall be opened or removed.

4.3.4 Accessible dead metal parts of a connector shall be conductively connected to the grounding conductor path.