American National Standard for Electric Connectors—Insulation Piercing Connector Systems, Rated 600 Volts or Less (Low-Voltage Aerial Bundled Cables and Insulated and Non-Insulated Line Wires)

Secretariat:

National Electrical Manufacturers Association

Approved August 21, 2018

American National Standards Institute, Inc.
NOTICE AND DISCLAIMER

The information in this publication was considered technically sound by the consensus of persons engaged in the development and approval of the document at the time it was developed. Consensus does not necessarily mean that there is unanimous agreement among every person participating in the development of this document.

NEMA Standards and guideline publications, of which the document contained herein is one, are developed through a voluntary consensus Standards development process. This process brings together volunteers and/or seeks out the views of persons who have an interest in the topic covered by this publication. While NEMA administers the process and establishes rules to promote fairness in the development of consensus, it does not write the document and it does not independently test, evaluate, or verify the accuracy or completeness of any information or the soundness of any judgments contained in its Standards and guideline publications. NEMA disclaims liability for any personal injury, property, or other damages of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, application, or reliance on this document.

NEMA disclaims and makes no guaranty or warranty, express or implied, as to the accuracy or completeness of any information published herein, and disclaims and makes no warranty that the information in this document will fulfill any of your particular purposes or needs. NEMA does not undertake to guarantee the performance of any individual manufacturer or seller’s products or services by virtue of this Standard or guide.

In publishing and making this document available, NEMA is not undertaking to render professional or other services for or on behalf of any person or entity, nor is NEMA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances. Information and other Standards on the topic covered by this publication may be available from other sources, which the user may wish to consult for additional views or information not covered by this publication.

NEMA has no power, nor does it undertake to police or enforce compliance with the contents of this document. NEMA does not certify, test, or inspect products, designs, or installations for safety or health purposes. Any certification or other statement of compliance with any health or safety–related information in this document shall not be attributable to NEMA and is solely the responsibility of the certifier or maker of the statement.
Approval of an American National Standard requires verification by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by the Standards developer.

Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

The use of American National Standards is completely voluntary; their existence does not in any respect preclude anyone, whether he has approved the Standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the Standards.

The American National Standards Institute does not develop Standards and will in no circumstances give an interpretation of any American National Standard. Moreover, no person shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute. Requests for interpretations should be addressed to the secretariat or sponsor whose name appears on the title page of this Standard.

Caution Notice: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken periodically to reaffirm, revise, or withdraw this Standard. Purchasers of American National Standards may receive current information on all Standards by calling or writing the American National Standards Institute.
CONTENTS

Foreword ......................................................................................................................... iv

1 Scope and Purpose ............................................................................................................. 1
  1.1 Scope .............................................................................................................................. 1
  1.2 Purpose ........................................................................................................................... 1

2 Referenced Standards ....................................................................................................... 1

3 Definitions ......................................................................................................................... 1

4 Performance Requirements ............................................................................................ 2
  4.1 General ............................................................................................................................. 2
  4.2 Mechanical Tests .............................................................................................................. 3
  4.3 Electrical Tests ............................................................................................................... 3

5 Sampling ............................................................................................................................. 4
  5.1 General ............................................................................................................................. 4
  5.2 Mechanical Tests .............................................................................................................. 4
  5.3 Electrical Tests ............................................................................................................... 5

6 Test Methods ..................................................................................................................... 6
  6.1 General ............................................................................................................................. 6
  6.2 Mechanical Tests .............................................................................................................. 6
  6.3 Electrical Tests ............................................................................................................... 8

7 Test Report .......................................................................................................................... 12

8 Marking ............................................................................................................................... 12
  8.1 Connector Marking .......................................................................................................... 12
  8.2 Assembly Instructions ..................................................................................................... 13

Annexes

A Standards that are Applicable to C119.5 .......................................................................... 25
B Heat Cycle Data Sheet ........................................................................................................ 26
C Loop Construction ............................................................................................................. 27
D Thermocouple Location .................................................................................................... 28

Tables

Table 1 One (1) Minute Load Test Values ............................................................................. 14
Table 2 Tightening Torque .................................................................................................... 15
Table 3 Minimum Number of Samples ................................................................................ 15
Table 4 Length of Exposed Conductor ................................................................................ 15
Table 5 Oven-Conditioning Temperatures ........................................................................... 16
Table 6 Insulation Puncture and Flashover Test Voltage, Test A and B ................................. 16
Table 7 Conductor Lengths for Current Cycle Tests, AWG Sizes .......................................... 16
Table 8 Conductor Lengths for Current Cycle Tests, Square Millimeter Sizes ..................... 16
Table 9 Suggested Initial Test Current to Raise AWG Control Conductor Temperature 100°C Above Ambient ............................................................................................................. 17
Table 10 Suggested Initial Test Current To Raise Square Millimeter Control Conductor Temperature 100°C Above Ambient ............................................................................................................. 17
Table 11 Current Cycle Periods for AWG Control Conductors ............................................. 17
Table 12 Current Cycle Periods for Square Millimeter Control Conductors .......................... 18
Table 13 Resistance and Temperature Measurement Intervals .............................................. 18

© 2018 National Electrical Manufacturers Association
### Figures

1. Pullout Test Configuration ................................................................. 20
2. Set-up for Installation of Connector Mounting at Low Temperature Closing Circuit Indicator (Continuity) .................................................. 20
3. An Example of a Vertical Test Configuration ..................................... 21
4. Dielectric Withstand Test ................................................................. 22
5. Water Penetration Test ................................................................... 23
6. Connector Markings ........................................................................ 24

### Worksheet

ANSI C119.5 Worksheet ........................................................................ 26
Foreword (This foreword is not part of American National Standard C119.5.)

This Standard describes current cycle, mechanical, and environmental tests used to establish performance characteristics of insulation piercing connectors used to join insulated and non-insulated overhead conductors.

The qualification tests may be made before supplying, on a commercial basis, connectors covered by this Standard, in order to demonstrate satisfactory performance characteristics to meet the intended application. Qualification tests, once successfully completed, need not be repeated, unless changes are made in the materials, design, or manufacturing process that might change the connector’s performance characteristics.

The Subcommittee on Insulation Piercing Connectors of the Accredited Standards Committee on Connectors for Electric Utility applications, C119, in its constant review of the publication, continues to seek out the views of responsible users that will contribute to the development of better Standards.

Suggestions for improvement of this Standard will be welcome. They should be sent to the National Electrical Manufacturers Association, 1300 North 17th Street, Suite 1752, Rosslyn, Virginia 22209.

This Standard was processed and approved for submittal to ANSI by the Accredited Standards Committee on Connectors for Electrical Utility Applications, C119. Committee approval of this Standard does not necessarily imply that all committee members voted for its approval. At the time it approved this Standard, the ANSI ASC C119 Committee had the following members:

Michael Zaffina, Chairman
Michael Dyer, Vice Chairman
Paul Orr, Secretary

Organizations Represented

Electric Utility Industry
Michael Dyer
Arthur Maitland
Cory Morgan
Wilson Peppard
Angelo Rodriguez
Curt Schultz
Ryan Stargel
Giovanni Velazquez
Gerald Wasielewski
William Winge
Larry Witteck
Mike Zafinna

National Electrical Manufacturers Association
Matt Cawood
Peter Chan
David Coulombe
Seydou Diop
Matt Gaertner
Waymon Goch
Luke Hill
David Hughes
Kevin Jenkins
Barry Johnson
Eyass Khansa
Ron Kmieicik
Colin McCullough
Jonathon Olszewski
Alejandro Pineda

Kevin Puccini
Wayne Quesnel
Joe Renowden
Walter Romanko
Gary Schrader
David Shibilia
Gary Sibilant
Ben Sparks
Dan Stanton
Ryan Stough
Carl Tamm
Robert Westbrook
Andrew Zwit

© 2018 National Electrical Manufacturers Association
The C119.5 Subcommittee on Insulation Piercing Connector Systems, Rated 600 Volts or Less (Low-Voltage Aerial Bundled Cables and Insulated and Non-Insulated Line Wires) which developed this Standard, had the following members:

**NEMA Subcommittee Secretary, Paul Orr**  
Chairman, Ben Sparks, CMC  
Vice Chairman, Andy Zwit, ILSCO

<table>
<thead>
<tr>
<th>Member</th>
<th>Company/Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zachary Anderson</td>
<td>CenterPoint Energy</td>
</tr>
<tr>
<td>Matt Cawood</td>
<td>Thomas &amp; Betts, A Member of the ABB Group</td>
</tr>
<tr>
<td>Jeff Door</td>
<td>H-J Family of Companies</td>
</tr>
<tr>
<td>Michael Dyer</td>
<td>Salt River Project</td>
</tr>
<tr>
<td>Luke Hill</td>
<td>Polaris Electrical Connectors</td>
</tr>
<tr>
<td>Trung Hiu</td>
<td>USDA Rural Development Utilities Programs</td>
</tr>
<tr>
<td>David Hughes</td>
<td>Cooper Power Systems by Eaton</td>
</tr>
<tr>
<td>Barry Johnson</td>
<td>TE Connectivity</td>
</tr>
<tr>
<td>Alan Kasanow</td>
<td>Southern California Edison</td>
</tr>
<tr>
<td>Arthur Maitland</td>
<td>Eversource Energy</td>
</tr>
<tr>
<td>Colin McCullough</td>
<td>3M</td>
</tr>
<tr>
<td>Richard Morin</td>
<td>Hydro-Quebec Research Institute</td>
</tr>
<tr>
<td>Jonathon Olszewski</td>
<td>Preformed Line Products</td>
</tr>
<tr>
<td>Robert Osborne</td>
<td>UL LLC</td>
</tr>
<tr>
<td>Angelo Rodriguez</td>
<td>Florida Power &amp; Light Company</td>
</tr>
<tr>
<td>Gary Schrader</td>
<td>BURNDY LLC</td>
</tr>
<tr>
<td>Curt Schultz</td>
<td>ComEd</td>
</tr>
<tr>
<td>David Shibilia</td>
<td>Hubbell Power Systems</td>
</tr>
<tr>
<td>Carl Tamm</td>
<td>Classic Connectors Inc.</td>
</tr>
<tr>
<td>Giovanni Velazquez</td>
<td>CFE LAPEM</td>
</tr>
<tr>
<td>Michael Zaffina</td>
<td>United Illuminating Co.</td>
</tr>
</tbody>
</table>

© 2018 National Electrical Manufacturers Association
<This page left blank intentionally.>
1 Scope and Purpose

1.1 Scope
This Standard covers insulation piercing connectors used for making electrical connections between insulated, insulated-to-bare, and bare-to-bare conductors rated 600 V or less and 90°C (low-voltage aerial bundled cables and bare and insulated line wires) on overhead distribution lines for electric utilities. Underground insulation piercing connector systems rated at 600 V are covered by ANSI C119.1.

Since cable and insulation types exist in very different types and configurations, insulation piercing connectors cannot be designed for the full range of cable and insulation possibilities (cable cross-section and material, insulation material and thickness). The manufacturer is to indicate the cable and insulation types the connector is designed for, and conformity to this Standard shall be established by testing with these cable and insulation types.

This Standard establishes the electrical, mechanical, and environmental test requirements for electrical insulation piercing connectors. This Standard is not intended to recommend operating conditions or temperatures.

1.2 Purpose
The purpose of this Standard is to give reasonable assurance to the user that connectors meeting the requirements of this Standard will perform in a satisfactory manner, provided they have been properly selected for the intended application and are installed in accordance with the manufacturer's recommendations. The service operating conditions and the selection of the connector class is the responsibility of the user.

2 Referenced Standards
This Standard is intended to be used in conjunction with the following Standards. When the referenced Standard is superseded by a new revision, the latest referenced revision shall apply. Standards that are referenced by inference are shown in Annex A.

ASTM E4 Practices for Force Verification of Testing Machines

IEEE 837-2002 Standard for Qualifying Permanent Connections Used in Substation Grounding

ANSI C119.0-2015 Testing Methods and Equipment Common to the ANSI C119 Family of Standards

3 Definitions
bolted connector: A tap connector that makes an electrical connection utilizing bolting (or a bolt and nut combination) to apply contact pressure to the conductor.

Class W: A connector designated "Class W" has met the requirements of the Dielectric Withstand/Leakage Current and Water Penetration Tests.

connector: A device joining two or more conductors to provide a continuous electrical path.

control cable: A conductor of the same type and size as the conductor in the current cycle loop that serves as a reference for setting test current and monitoring temperature.

equalizer: A device installed in the test loop to ensure a point of equipotential in a stranded conductor.

input conductor: Conductor on the supply side of the connector.