

ANSI C119.1-2002

American National Standard

For Electric Connectors—

Sealed Insulated Underground Connector Systems
Rated 600 Volts

Secretariat:

National Electrical Manufacturers Association

Approved September 5, 2002

American National Standards Institute, Inc.

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Foreword (Neither this foreword nor any of the informative annexes is a part of American National Standard C119.1-2002.)

The standard covers electrical, mechanical, and sealing requirements of connectors rated 600 volts and installed underground.

This standard was initially developed by an EEI-NEMA Joint Committee on Underground Distribution Connectors and Connector Systems and published by the American National Standards Institute in 1974.

Suggestions for improvement of this standard will be welcome. They should be sent to the National Electrical Manufacturers Association, 1300 North 17th Street, Suite 1847, Rosslyn, VA 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:

Robert Gurniak, Chairperson
Vince Baclawski, Secretary

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Edison Electric Institute	Robert Gurniak James Harris Harry Hayes George Minukas David West
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AMERICAN NATIONAL STANDARD **ANSI C119.1-2002**

For Electric Connectors—
Sealed Insulated Underground Connector Systems Rated 600 Volts

1 Scope and Purpose

1.1 Scope

This standard covers sealed, insulated underground connector systems rated at 600 volts for utility applications and establishes electrical, mechanical, and sealing requirements for sealed underground connector systems.

1.2 Purpose

The purpose of this standard is to give reasonable assurance to the user that sealed insulated underground connector systems 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 recommendation.

1.3 Definitions

connector: A device which joins two or more conductors for the purpose of providing a continuous electrical path

underground connector system: A connector and its associated insulated and sealing components.

connector assembly: Combination of the connector system installed on the conductor(s).

seal: An interface preventing the ingress of moisture into the connector assembly.

underground: Below grade application including direct burial.

control cable: A conductor, identical to the hottest of the test conductors, used as a reference for the determination of the test current.

input conductor: Supply side of the connector assembly.

output conductor: Load side of the connector assembly.

2 Referenced American National Standard

This standard is intended to be used in conjunction with American National Standard for Electric Connectors for Use between Aluminum-to-Aluminum or Aluminum-to-Copper Bare Overhead Conductors, ANSI C119.4-1998. When this referenced standard is superseded by a revision approved by the American National Standards Institute, Inc. the referenced revision shall apply.

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3 Performance Criteria

3.1 General

The connector system shall meet the requirements specified in 3.2, 3.3, and 3.4.

3.2 Connector performance

The connector shall be tested in accordance with 4.1 on bare conductors, in accordance with 3.2 of ANSI C119.4-1998 for class A connectors and shall meet the performance requirements specified in 4.2 and 4.3 of ANSI C119.4-1998.

Exception: Copper bodied connectors, for use with copper cable only, do not require current cycling in air in accordance with ANSI C119.4.

3.3 Thermal performance of insulated system under load

Connectors shall be tested in accordance with 4.2 for 120 hours and shall remain stable between the 72nd hour and the 120th hour of test.

Stability is indicated if the change in connector temperature does not differ by more than 2°C, including allowance for measurement error, from the change in input conductor temperature as measured in 4.2.

The connector temperature shall not exceed the conductor temperature by more than 10°C throughout the entire test.

The insulation provided as part of the connector system shall show no visible evidence of deterioration when thermal stability is reached.

3.4 Integrity of seal and connector insulation

When tested in accordance with 4.3, this test determines the connector system's ability to withstand repeated handling during underground installation.

When tested in accordance with 4.3.2(2), the connector assemblies shall have an insulation resistance greater than 6 megohms.

The insulation resistance of the assemblies measured in 4.3.2(8), (13), and (15) shall be either greater than 90% of the value measured in 4.3.2(2) or greater than 1×10^3 megohms.

The assemblies shall withstand the dielectric withstand tests specified in 4.3.2(3) and (16) without breakdown and the leakage current shall not exceed 1 milliampere in 4.3.2(17).

4 Test Procedures

4.1 Current cycling in air

Each connector shall be tested with the combination of input and output bare conductors, representing in number, size, and arrangement the most severe heating condition for which the connector is designed.

The connectors shall be installed in their "as received" condition, which may include insulation. The connector may be tested with or without the seals, the choice shall be stated in the test report.

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4.2 Thermal stability of insulated system under load

This test shall be conducted in a space free of forced air currents or radiated heat striking (directly or indirectly) any portion of the test loop during the current ON period. The ambient temperature shall be held between 15ºC and 35ºC.

A minimum of two insulated connector systems shall be assembled in accordance with the recommendations of the connector manufacturer, on the combination of insulated input and output conductors that represents in number, size, and arrangement the most severe thermal condition for which the connector is designed.

The input current shall be adjusted to produce 90°C $\pm$ 5°C on the hottest conductor.

The temperature of the input conductor shall be measured under the conductor insulation at a point 305 mm (12 in.) from the connector. The temperature of the connector shall be measured under the connector insulation as close as possible to the midpoint of the current path between the input and output.

The temperature measurements shall be recorded a minimum of once every twelve hours (plus or minus two hours) beginning with the 72nd hour (plus or minus two hours) and continuing through the 120th hour.

4.3 Integrity of seal and connector insulation

4.3.1 Assemblies for test

Two connector assemblies with the largest insulation diameters and two connector assemblies with the smallest insulation diameters shall be tested in accordance with 4.3.2 through 4.3.11.

Each assembly shall be assembled in accordance with the manufacturer's recommendations.

4.3.2 Procedural sequence

Each connector assembly shall be subjected to the following in the order in which they are listed:

(1) Water immersion for 24 hours in accordance with 4.3.3.

(2) Insulation resistance measurement in accordance with 4.3.4.

(3) Dielectric withstand test in accordance with 4.3.5.

(4) Heat conditioning in accordance with 4.3.6.

(5) Flex in accordance with 4.3.7.

(6) Twist in accordance with 4.3.8.

(7) Water immersion for 24 hours in accordance with 4.3.3.

(8) Insulation resistance measurement in accordance with 4.3.4.

(9) Cold conditioning in accordance with 4.3.9.

(10) Flex in accordance with 4.3.7.

(11) Twist in accordance with 4.3.8.

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(12) Water immersion for 24 hours in accordance with 4.3.3

(13) Insulation resistance measurement in accordance with 4.3.4

(14) Current cycle and water submersion in accordance with 4.3.10

(15) Insulation resistance measurement in accordance with 4.3.4.

(16) Dielectric withstand test in accordance with 4.3.5.

(17) Leakage current test in accordance with 4.3.11.

4.3.3 Water immersion for 24 hours

All connector assemblies shall be immersed for 24 hours in a tank that contains tap water at room temperature of 25°C ± 5°C. All parts of the connector assemblies, except leads, shall be at least 305 mm (12 in.) below the surface of the water.

4.3.4 Insulation resistance measurement

While each connector assembly is immersed in accordance with 4.3.3, the insulation resistance shall be measured by applying a direct-current voltage of 500 or 1000 volts for 1 minute, keeping the length of the immersed conductor constant, and then determining the insulation resistance at the voltage used. The total length of the immersed conductor with each connector assembly shall not exceed 1.83 m (6 feet). The conductor polarity shall be positive.

If the tracking distance from the end of the conductor to the water surface is too short, a guarded circuit shall be employed.

4.3.5 Dielectric withstand test

While each connector assembly is immersed in accordance with 4.3.3, it shall be subjected to a 2.2-kilovolt 60-hertz test voltage for 1 minute, applied between the water and the conductor.

4.3.6 Heat conditioning

Each connector assembly shall be conditioned in an air-circulating oven at 90°C ± 5°C for 72 hours. After the conditioning period, the connector assemblies shall be allowed to cool to a room temperature of 25°C ± 5°C.

4.3.7 Flex

Each connector assembly shall be subjected to the following:

The insulated conductor shall be securely clamped at a distance from the joint as follows:

For conductors that are #4 AWG and larger, 15 times the diameter of the insulated conductor.

For conductors that are smaller than #4 AWG, 25 times the diameter of the insulated conductor.

The connectors shall be bent 90 degrees to one side, returned to the starting position, bent 90 degrees in the opposite direction, and returned to the starting position (see figure 1). Each seal shall be subjected to ten such flexing cycles.

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4.3.8 Twist

While clamped in accordance with 4.3.7, the connector shall be twisted around the conductor axis 15 degrees clockwise from the starting position, returned to the starting position, twisted 15 degrees counterclockwise, and returned to the starting position (see Figure 1). Each connector assembly shall be subjected to five such twisting cycles.

Some bending is tolerated to allow both seals on one connector assembly to be twisted simultaneously.

4.3.9 Cold conditioning

Each connector assembly shall be exposed for a minimum of 4 hours in air having a temperature of -18°C $\pm$ 5°C. Within 5 minutes after removal from the cold conditioning, the assemblies shall then be tested in accordance with 4.3.2 (10) and 4.3.2(11).

4.3.10 Current cycle and water submersion

The connector assembly shall be connected in series to a control cable identical to that used in the connector assembly and then subjected to the following sequence of operations for 50 cycles:

(1) Heating by current in air. The current ON period shall be 1 hour using sufficient current to raise the temperature of the conductor of the control cable to 90°C $\pm$ 5°C.

(2) The current shall then be turned off and, within 3 minutes, the connector shall be submersed in water having a temperature of 25°C $\pm$ 5°C for at least one half-hour.

4.3.11 Leakage current test

Following the dielectric withstand test mentioned in 4.3.2 (16) and while still immersed in the water, the connector assemblies are to be subjected to a 600-volt, 60-hertz potential between the water and conductor and the resulting leakage current measured.

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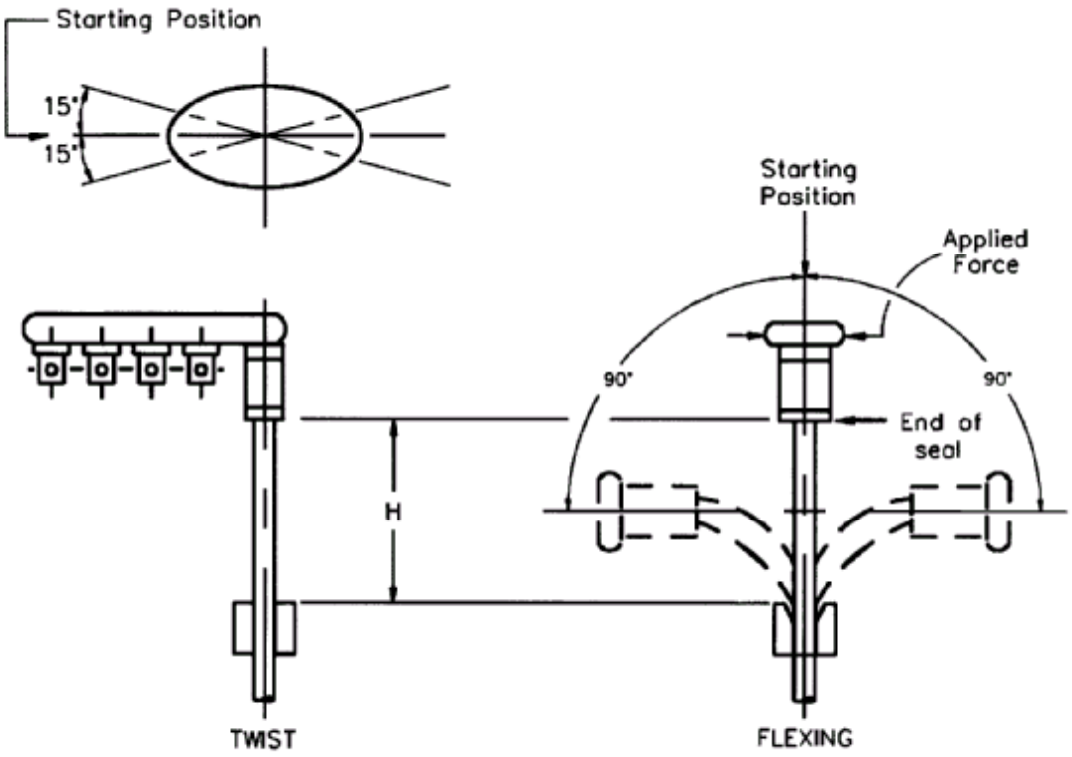

Figure 1—Flexing and twisting

5 Marking

5.1 Connector system marking

The principal component(s) of a connector system intended for direct burial or below grade use shall be marked with the manufacturer's name or trademark, the catalog number and wire range. The marking shall also be on the unit container (the smallest container in which the connector system is packaged).

5.2 Assembly instructions

Assembly instructions shall be provided with the connector system. The assembly instructions shall be marked on the unit container or on an instruction sheet provided in each unit container. The assembly instructions shall include, but are not limited to, the following:

1. Manufacturer’s name, part number, and wire range.
2. Wire connector assembly instructions (strip length, torque, tooling, etc.).
3. Connector system assembly instructions.

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Annex A
(informative)
This annex is not an official part of the body of this standard.
Optional Tests to Meet the Requirements of UL 486D

If concurrent testing is being run to UL 486D, test sequences B, C, and D of UL 486D must also be run.

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