

IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding

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**Substation Committee
of the
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Foreword

(This Foreword is not a part of IEEE Std 837-1989, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.)

This standard has been written to fill a need for standardization of terminology and test requirements for permanent grounding connections.

Many types of connectors are available that may be used as permanent grounding connections even though they were designed for use as power connectors. This standard has been written to provide a meaningful reproducible test program that will enable connector manufacturers to qualify their products as permanent grounding connections. The users can then be reasonably assured that the qualified permanent grounding connection will be capable of performing satisfactorily over the lifetime of the substation or other installation.

This standard addresses the parameters for testing grounding connections on aluminum, copper, steel, copper-clad steel, galvanized steel, stainless steel, and stainless-clad steel.

Comments, corrections, and suggestions for the next revision of this standard are welcome and should be submitted to the Secretary, IEEE Standards Board 345 East 47th Street New York, NY 10017.

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CLAUSE	PAGE
1. Scope and Purpose	1
1.1 Scope.....	1
1.2 Purpose.....	1
2. References.....	1
3. Definitions.....	2
4. Qualification Tests	3
5. Performance Criteria	3
5.1 General.....	3
5.2 Mechanical Tests.....	4
5.3 Sequential Tests	4
6. Test Procedures	5
6.1 General.....	5
6.2 Mechanical Test Samples.....	5
6.3 Sequential Test Samples	5
6.4 Connector Description	6
6.5 Test Conductors	6
6.6 Test Assembly Methods.....	6
6.7 Connection Preparation.....	6
6.8 Installation.....	6
7. Mechanical Tests.....	6
7.1 General.....	6
7.2 Mechanical Pullout Test.....	6
7.3 Electromagnetic Force Test	7
8. Current-Temperature Cycling Test	9
8.1 General.....	9
8.2 Current-Temperature Cycling Test.....	9
8.3 Ambient Conditions	10
8.4 Control Conductor.....	10
8.5 Current Cycling.....	10
8.6 Loop Configuration.....	10
8.7 Measurements	11
9. Freeze-Thaw Test.....	13
9.1 General.....	13
9.2 Freeze-Thaw Test.....	13
9.3 Test Samples and Their Configuration	13
9.4 Freeze-Thaw Equipment	14
9.5 Freezing and Thawing Cycle	14
9.6 Resistance Measurements	14

CLAUSE	PAGE
10. Corrosion Tests	14
10.1 General	14
10.2 Nitric Acid Test (HNO ₃).....	14
10.3 Salt Spray Test	17
11. Fault-Current Test	17
11.1 General	17
11.2 Fault-Current Test	17
11.3 Test Samples	18
11.4 Configuration	18
11.5 Fault Duration	18
11.6 Fault Current	18
11.7 Number of Surges	18
11.8 Resistance Measurements	18
11.9 Visual Evaluation.....	18
12. Bibliography.....	18
Annex A (informative) Nitric-Acid, Dilution	20
Annex B (informative) Conductor Ampacity Calculation [B4] and [B12]	21

IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding

1. Scope and Purpose

1.1 Scope

This standard provides direction and methods for qualifying permanent connections used for substation grounding. It particularly addresses the connectors used within the grid system, connectors used to join ground leads to the grid system, and connectors used to join the ground leads to equipment and structures.

1.2 Purpose

The purpose of this standard is to give assurance to the user that connectors meeting the requirements of this standard will perform in a satisfactory manner over the lifetime of the installation provided that the proper connectors are selected for the application and that the connectors are installed correctly.

2. References

This standard shall be used in conjunction with the following publications. When the following standards are superseded by an approved revision, the revision shall apply.

- [1] ANSI/IEEE Std 100-1988 IEEE Standard Dictionary of Electrical and Electronics Terms.¹
- [2] ASTM A363-83, Specification for Zinc-Coated (Galvanized) Steel Overhead Ground Wire Strand.²
- [3] ASTM A510-82, Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
- [4] ASTM A752-83, Specification for General Requirements for Wire Rods and Coarse Round Wire, Alloy Steel.
- [5] ASTM B1-85, Specification for Hard-Drawn Copper Wire.

¹ANSI/IEEE publications are available from the Sales Department of ANSI, 1430 Broadway, New York, NY 10018, or from the Service Center, IEEE, 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855-1331.

²ASTM publications are available from the Sales Department of American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

- [6] ASTM B2-85, Specification for Medium-Hard-Drawn Copper Wire.
- [7] ASTM B3-74 (1985), Specification for Soft or Annealed Copper Wire.
- [8] ASTM B8-86, Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
- [9] ASTM B49-78 (1983), Standard Specification for Hot-Rolled Copper Rods for Electrical Purposes.
- [10] ASTM B105-88, Specification for Hard-Drawn Copper Alloy Wires for Electrical Conductors.
- [11] ASTM B117-85, Method of Salt Spray (Fog) Testing.
- [12] ASTM B172-71 (1985), Specification for Rope-Lay-Stranded Copper Conductors Having Bunch-Stranded Members, for Electrical Conductors.
- [13] ASTM B173-71 (1985), Specification for Rope-Lay-Stranded Copper Conductors Having Concentric-Stranded Members, for Electrical Conductors.
- [14] ASTM B174-71 (1985), Specification for Bunch-Stranded Copper Conductors for Electrical Conductors.
- [15] ASTM B193-87, Test Method for Resistivity of Electrical Conductor Materials.
- [16] ASTM B227-70 (1980), Specification for Hard-Drawn Copper-Clad Steel Wire.
- [17] ASTM B228-88, Specification for Concentric-Lay-Stranded Copper-Clad Steel Conductors.
- [18] ASTM B229-85, Concentric-Lay-Stranded Copper and Copper-Clad Steel Composite Conductors.
- [19] ASTM B230-85, Specification for Aluminum 1350-H19 Wire, for Electrical Purposes.
- [20] ASTM B233-85, Specification for Aluminum 1350 Drawing Stock for Electrical Purposes.
- [21] ASTM B236-88, Specification for Aluminum Bars for Electrical Purposes (Bus Bars).
- [22] ASTM B258-81 (1986), Specification for Standard Nominal Diameters and Cross-Sectional Areas of AWG Sizes of Solid Round Wires Used as Electrical Conductors.
- [23] ASTM B317-88, Specification for Aluminum-Alloy Extruded Bar, Rod, Pipe, and Structural Shapes for Electrical Purposes (Bus Conductors).
- [24] ASTM B396-87, Specification for Aluminum-Alloy 5005-H19 Wire for Electrical Purposes.
- [25] ASTM B397-85, Specification for Concentric-Lay-Stranded Aluminum-Alloy 5005-H19 Conductors.
- [26] ASTM B398-85, Specification for Aluminum-Alloy 6201-T81 Wire for Electrical Purposes.
- [27] ASTM B399-86, Specification for Concentric-Lay-Stranded Aluminum-Alloy 6201-T81 Conductors.
- [28] ASTM B416-88, Specification for Concentric-Lay-Stranded Aluminum-Clad Steel Conductors.
- [29] ASTM B609-85, Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical Purposes.

3. Definitions

General definitions of words or terms of a technical nature not listed in this standard shall be as defined in ANSI/IEEE Std 100-1988 [1].³

³The numbers in brackets correspond to those of the references listed in Section 2.

conductor: A metallic substance that allows a current of electricity to pass continuously along it. As used in this standard, a conductor includes cable (wire), rods (electrodes), and metallic structures.

conductor combination: The various conductors that may be joined by a connector.

connector: A metallic device of suitable electric conductance and mechanical strength used to connect conductors.

connector thermal capacity: The ability of a connector to withstand the amount of current required to produce a specified temperature on the control conductor without increasing the resistance of the connector beyond that specified in this standard.

control conductor: The conductor that is utilized to measure equivalent changes in temperature, size, etc., that are occurring in at least one of the conductors joined by the connector under test.

current cycle loop: The combination of conductors and connectors that carries the current of the circuit under test.

equalizer: A device to provide equipotential planes for resistance measurements.

grid system: A system consisting of interconnected bare conductors buried in the earth or in concrete to provide a common ground for electrical devices and metallic structures.

permanent connection: A grounding connector that will retain its electrical and mechanical integrity for the design life of the conductor within limits established by this standard.

4. Qualification Tests

A listing of the tests to be performed for all types of connectors is given in Table 1. They shall be tested individually and sequentially, as shown in Table 1.

Table 1— Qualification Test Sequence and Quantities

Test	Section	Minimum Number of Samples
		Per Test*
Individual test group-mechanical Mechanical pullout	7.2	4
Individual test group-electromagnetic Electromagnetic force	7.3	4
Sequential test groups-acidic Current-temperature cycling	8.1 through 8.8	4
Freeze-thaw	9.1 through 9.6	
Corrosion-nitric acid	10.2	
Fault current	11.1 through 11.9	
Sequential test groups-alkaline Current-temperature cycling	8.1 through 8.8	4
Freeze-thaw	9.1 through 9.6	
Corrosion-salt spray	10.3	
Fault current	11.1 through 11.9	

*These are the minimum number of connector samples of each connector design and conductor combination tested.

5. Performance Criteria

5.1 General

When installed and tested in accordance with this standard, all connections shall conform to the performance criteria given in 5.2 and 5.3.