Designation: F2715 – 19 (Reapproved 2024)

Standard Specification for Temporary Protective Equipotential Bond Mat To Be Used on De-Energized Equipment[1]

This standard is issued under the fixed designation F2715; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers the manufacture and testing of the temporary protective equipotential bond mat used on or around de-energized electrical equipment.

1.2 It is common practice for users of protective equipment to prepare complete instructions and regulations to govern in detail the correct use and maintenance of such equipment.

1.3 The use and maintenance of this equipment is beyond the scope of this specification.

1.4 It is recognized that the use of temporary protective equipotential bond mats requires additional equipment for installation and use, typically temporary connecting jumper assemblies.

1.5 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B33 Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes

D2261 Test Method for Tearing Strength of Fabrics by the Tongue (Single Rip) Procedure (Constant-Rate-of-Extension Tensile Testing Machine)

F855 Specifications for Temporary Protective Grounds to Be Used on De-energized Electric Power Lines and Equipment

F1267 Specification for Metal, Expanded, Steel

F2453 Specification for Welded Wire Mesh Fence Fabric (Metallic-Coated or Polymer Coated) for Meshes of 6 in.[2] [3871 mm^2] or Less, in Panels or Rolls, with Uniform Meshes

2.2 *Other Standards:*

Fed Std 191/5100 Strength and Elongation, Breaking of Woven Cloth; Grab Method[3]

Fed Std 191/5874 Temperature, Low; Effect on Coated Cloth[3]

Fed Std MVSS302 Flammability of Interior Materials[3]

A-A-59551 Wire, Electrical, Copper Un-insulated[3]

3. Terminology

3.1 *Definitions:*

3.1.1 *bonding, n*—the mechanical interconnection of conductive parts to maintain a common electrical potential.

3.1.2 *carrier, fabric, n*—the main body of the equipotential bond mat on which the flat braid conductor is sewn.

3.1.3 *carrier, non-fabric, n*—the main body of the equipotential bond mat on which a conductive metal mesh is attached by means other than sewing.

3.1.4 *equipotential grounding system, n*—temporary grounding system placed in such locations and arranged in such a manner as to minimize the likelihood of workers being exposed to hazardous differences in electrical potential.

4. Significance and Use

4.1 Protective equipotential bond mats in this specification shall not be considered Temporary Protective Grounds and are

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from U.S. Government Publishing Office (GPO), 732 N. Capitol St., NW, Washington, DC 20401, http://www.gpo.gov.

not designed nor intended to carry full rated fault current. Refer to Specifications F855 for specifications for Temporary Protective Grounds.

4.2 Non-fabric carrier protective equipotential bond mat systems have more stringent electrical current tests to verify structural and interconnection integrity. Test values in this specification shall be considered a minimum; end users may request testing to higher values.

5. Classification

5.1 Equipotential bond mats covered under this specification shall be designated as Type I or Type II; Style 1, Style 2, Style 3 or Style 4; Grid Conductor, flexible, 1 to 6, or Grid Conductor, metallic mesh; and Fabric Carrier Material I or II.

5.1.1 *Type I,* capable of being cascaded (joined together).

5.1.2 *Type II,* without capability of being cascaded.

5.1.3 *Style 1,* fabric carrier with exposed conductor termination.

5.1.4 *Style 2,* fabric carrier with jacketed conductor termination.

5.1.5 *Style 3,* non-fabric carrier with exposed conductor terminations for the metallic mesh.

5.1.6 *Style 4,* non-fabric carrier with jacketed conductor terminations for the metallic mesh.

5.1.6.1 *Grid Conductor,* flexible, 1 to 6, in accordance with the normal flat width, or equivalent, of the flat braid conductors combination that makes up the grid conductor and perimeter conductor of the fabric carrier, as shown in Table 1.

5.1.6.2 *Grid Conductor,* metallic mesh. Expanded metal sheet, or welded wire mesh, which makes up the grid conductor, as shown in Table 2. Mesh type, size and attachment to the perimeter conductive provisions shall be such that the equipotential bond mat meets all electrical test requirements of Section 11.

5.1.7 *Fabric Carrier Material I,* slip resistant.

5.1.8 *Fabric Carrier Material II,* without slip resistance.

6. Manufacture and Marking

6.1 Each equipotential bond mat shall be marked clearly and permanently with the name of the manufacturer or supplier, ASTM F2715-YYYY (where YYYY is the year of the standard), serial number, type, and style.

7. Chemical and Physical Requirements

7.1 Equipotential bond mats samples selected in accordance with Section 10 shall conform to the physical and chemical requirements as specified in this section.

7.2 *Fabric Carrier Strength:*

TABLE 1 Bond Mat Conductor Size

Grid Conductor	Grid, mm (in.)	Perimeter, mm (in.)
1	6.3 (¼)	6.3 (¼)
2	6.3 (¼)	12.6 (½)
3	6.3 (¼)	19 (¾)
4	12.6 (½)	12.6 (½)
5	12.6 (½)	19 (¾)
6	19 (¾)	19 (¾)

TABLE 2 Metallic Mesh Size

Expanded Mesh Style	Mesh Rigidity, D_mN*m (lb*i)
¾ #9	7738 (5707)
½ #13	1536 (1133)
Square Welded Wire Mesh Size, mm (in.)	
50 × 12 (2 × 0.25)	18297 (13495)
25 × 6 (1 × 0.12)	8435 (6221)

7.2.1 *Tensile (Grab)*—Fabric carrier material shall be capable of a tensile (grab) of 1828 N to 2037 N (411 lbf to 458 lbf) in accordance with Fed Std 191/5100.

7.2.2 *Tongue Tear*—Fabric carrier material shall be capable of tongue tear of 485 N to 516 N (109 lbf to 116 lbf) in accordance with Test Methods D2261.

7.2.3 *Cold Flexure*—Fabric carrier material shall be capable of a low cold crack of –40 °C (–40 °F) in accordance with Fed Std 191/5874-1978

7.3 Flat braid conductor shall comply with A-A-59551 and Specification B33 requirements and have the properties contained in Table 3 or greater.

7.4 Metallic mesh conductor shall comply with Specifications F1267 or F2453. The maximum opening size shall not exceed 50 mm by 50 mm (2 in. by 2 in.).

7.5 Non-fabric carriers shall have a minimum plate flexural rigidity of 5 times that of the metallic mesh that they carry. Mesh rigidity values, D_m, are given in Table 2. Non-fabric carrier isotropic plate flexural rigidity, D_c, may be calculated by: $D_c = Et^3/12(1 - \nu^2)$, where E is Young's Modulus, t is the effective thickness, and ν is Poisson's ratio.

7.6 *Carrier Fire Resistance*—The flame resistance of the carrier shall be performed in accordance with Fed Std MVSS302 and shall be self extinguishing.

8. Dimensions and Permissible Variations

8.1 Equipotential bond mat size is the combination of grid spacing and perimeter dimensional configurations.

8.2 The maximum length and width of grid spacing for fabric carrier mats shall be 200 mm by 200 mm (8 in. by 8 in.), with a permissible variation of ±25 mm (±1 in.). Mesh sizes for non-fabric carrier mats shall be accordance with Table 2.

8.3 Fabric carrier mat thread stitch spacing shall be 6 stitches or more per 25.4 mm (6 stitches or more per 1 in.).

8.4 A minimum adequate area must be provided for footing surface of 0.37 m^2 (4 ft^2) and a minimum of 0.6 m linear (2 ft) in any direction, with a permissible variation of ±25 mm (±1 in.).

TABLE 3 Flat Braid Minimum Specifications

Nominal Braid Width, mm (in.)	Nominal Thickness, mm (in.)	Strand AWG	No. of Strands	No. Wires Per Strand
6.35 (¼)	0.76 (0.03)	36	24	7
12.7 (½)	0.76 (0.03)	36	48	8
19 (¾)	1.0 (0.04)	36	48	18

9. Workmanship and Finish

9.1 Components shall be free of structural defects that affect handling or performance, or both.

9.2 Cosmetic and other surface irregularities which do not affect strength, performance, or handling, or combination thereof, are not cause for rejection.

10. Sampling

10.1 A product model represents a manufacturer's design specification standard according to which the production lot is manufactured.

10.2 A production lot shall consist of all equipotential bond mats of one product model produced at one time.

10.3 A test sample consists of two specimens, selected at random, for each different test specified. When a failure occurs in one specimen from the first sample, a second sample from the same lot shall be selected and tested. If the second sample (two specimens) passes, the lot shall be accepted. If the one specimen from the second sample fails, the lot shall be rejected.

11. Electrical Test

11.1 *Design Test*—The design test that follows shall be made on test samples of each product model to verify that the requirements of this specification are met.

11.1.1 Test set up configuration shall be as specified in Fig. 1.

11.1.2 Test shall be performed with the mat oriented in the position(s) in which it is intended to be utilized.

11.1.3 The equipotential bond mat is to be placed on the earth, laid out flat, with one corner connecting strap attached to the source conductor with a 3 m (10 ft) 1/0 ground cable, (R_j), with the same corner connected to a ground rod 1.22 m (4 ft) in the ground, with a 3 m (10 ft) 1/0 ground cable. The ground rod shall be spaced 3 m (10 ft) from the bond mat.

11.1.4 Connect a 1000 Ω resistor (±10 %) with one lead connected to a 0.3 m by 0.3 m by 11.34 kg (12 in. by 12 in. by 25 lb) steel plate in the center of the equipotential bond mat and another lead connected to the source conductor.

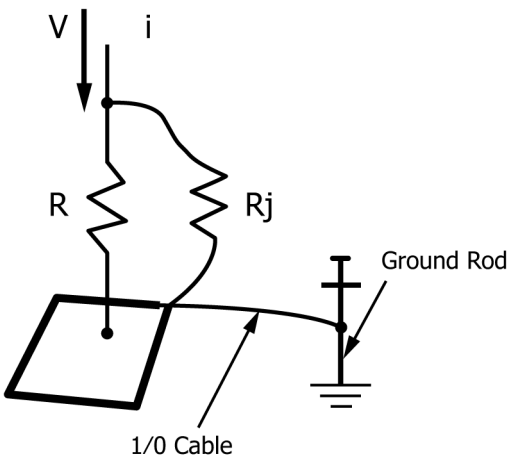

FIG. 1 Electrical Design Test

11.1.5 Energize the source conductor at 8 kV and measure the voltage across or current through, the 1000 Ω resistor, (R). The voltage across the resistor can be recorded by a digital oscillograph and the readings converted mathematically to current. The test current is to be measured to a precision of ±3 %.

11.1.6 Test duration shall be 14.5 cycles minimum.

11.1.7 The voltage across the resistor shall not exceed 5 V and the current shall not exceed 0.005 amps.

11.2 *Resistance Test:*

11.2.1 All resistance measurements shall be performed using a Kelvin bridge (four wire) resistance meter. For individual mats, measure the resistance, corner to corner diagonally; the resistance shall be less than 1 milliohm per foot of measured length. For cascadable assemblies of mats, the resistance tests shall be performed across the edges of adjacent mats and across the opposite corners of three or four mat configurations.

11.3 *Electrical Integrity Current Tests:*

11.3.1 The electrical integrity current tests consist of the *Continuous Current Test* and the *High Current Mechanical Test* and shall be performed on non-fabric carrier metallic mesh mats. These tests are required to ensure that the mat system does not overheat, that it maintains continuity, and that it provides equipotential protection means if exposed to a high current condition. The general test setup for both of these tests is shown in Fig. 2, Fig. 3, and Fig. 4. The tests shall be conducted on individual (un-cascaded) and on cascaded carrier assemblies (if cascadable). For cascaded assemblies, the tests shall be configured so as to represent an arrangement of the least number of multiple mats (typically two mats) in which the system is intended to be used. Before performing the Electrical Integrity Current Tests, the 11.2 Resistance Test shall be first performed.

NOTE 1—Manufacturers may test metallic mesh mats to current values that exceed the minimum requirements of 11.3.1.1 and 11.3.1.2. The test report shall document the conductor and lug size and the test levels applied.

11.3.1.1 *Continuous Current Test*—The continuous current test arrangement is shown in Fig. 3 for individual mats and Fig. 4 for cascadable assemblies. The test jumper conductor size shall be 4/0 AWG. The mat system shall be subjected to 250 A RMS for a duration of 4 h. The temperature rise shall be measured at the lugs and any system components in contact with the carrier. Lugs and connection jumpers shall have a lower operating temperature than that of the conductor rating. The temperature of components in contact with the carrier shall not exceed the lesser of the lug temperature or the temperature at which permanent damage to the carrier material would occur, but in no case shall the temperature exceed 75 °C.

11.3.1.2 *High Current Mechanical Test*—The high current mechanical test arrangement is shown in Fig. 3 for individual mats and Fig. 4 for cascadable assemblies. The testing facility station bus shall be attached to the mat lugs using test jumpers. The test jumpers and lugs shall be the same size as used for the continuous current test.

11.3.1.3 The mat system shall be subjected to the high current mechanical test level in Table 4 and shall be capable of