Designation: B263/B263M – 14

Standard Test Method for Determination of Cross-Sectional Area of Stranded Conductors[1]

This standard is issued under the fixed designation B263/B263M; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This test method covers the procedure for determining the cross-sectional area of stranded conductors by the mass method.

1.2 The values stated in inch-pound or SI units are to be regarded separately as the standard. The values in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

1.3 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 The following documents form a part of this test method to the extent referenced herein.

2.2 *ASTM Standards:*[2]

B830 Specification for Uniform Test Methods and Frequency

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *lot, n*—a lot is any amount of stranded conductor of one type and size presented for acceptance at one time.

3.1.2 *sample, n*—a sample is a quantity of production units (reels, spools, coils, and so forth) selected at random from the lot for the purpose of determining conformance of the lot to the requirements of this test method.

3.1.3 *specimen, n*—a specimen is a length of stranded conductor removed for test purposes from any individual production unit of the sample.

4. Apparatus

4.1 *Balance, for measurement of mass,* accurate to 0.1 %.

4.2 *Steel Scale, for measurement of length,* with smallest divisions not greater than 1⁄32 in. [1 mm].

4.3 *Jig,* or equivalent equipment, for cutting the conductor to length and at right angles to its axis.

5. Sampling

5.1 Samples shall be taken from the outer end of reel or spool lengths, or from either end of coiled lengths.

5.2 Unless otherwise specified by the purchaser at the time of placing the order, a sample shall consist of the number of production units (reels or coils) shown in Table 1 or in accordance with Specification B830.

6. Test Specimens

6.1 The length of test specimens shall be as follows:

Nominal Size of Test Specimen, cmil [mm^2]	Length of Test Specimen min, ft [mm]
Up to 17 000 [9], incl	4 [1220]
Over 17 000 [9]	2 [610]

7. Procedure

7.1 Cut the test specimen, making sure that the ends are at the right angles to the axis of the conductor.

7.2 Measure the length of the specimen at room temperature (see Note) to the nearest 1⁄32 in. [1 mm], and measure the mass to within ±0.1 %, converting to pounds [grams] if weighed in other units.

NOTE 1—Correction for temperature variation need not be made, since the error introduced in the length measurement by the temperature variation is less than the required accuracy of the length measurement.

8. Calculation

8.1 Calculate the cross-sectional area of a stranded conductor, composed of only one type of conducting material, as follows:

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[1] This test method is under the jurisdiction of ASTM Committee B01 on Electrical Conductors and is the direct responsibility of Subcommittee B01.02 on Methods of Test and Sampling Procedure.

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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.

TABLE 1 Number of Production Units Required per Sample

Nominal Conductor Size, cmil [mm^2]	Number of Production Units in Sample: For first 100 000 ft [30 000 m]^A or fraction thereof	For each additional 100 000 ft [30 000 m]^A or fraction thereof
Up to 83 690 [50] incl	1	1
Over 83 690 to 211 600 [50 to 110], incl	2^B	1
Over 211 600 to 500 000 [110 to 260], incl	3^B	1
Over 500 000 [260]	4^B	1

^A Not more than one specimen per production unit shall be taken if the length in any one unit exceeds 100 000 ft [30 000 m].
^B If the number of units in the shipment is less than that indicated, one specimen shall be taken from each unit.

TABLE 2 Mass Factors, *f*

Metal	Mass Factor, *f*, lb/cmil·1000 ft [g/cm^3]
Copper—bare, tinned, lead-coated, or lead alloy-coated	0.0030270 [8.890]
Aluminum 1350	0.0009189 [2.705]
Aluminum alloy 6201	0.0009142 [2.690]
Aluminum alloys, 8000 series	0.0009236 [2.710]
Copper-clad steel, all grades	0.0027750 [8.150]
Zinc-coated (galvanized) steel, all grades	0.0026490 [7.780]
Zinc-5 % aluminum mischmetal alloy coated steel, all grades	0.0026490 [7.780]
Aluminim-clad steel	0.0022440 [6.590]

$$A = (1000/L) \times [100/(100+k)] \times (W/f)$$

where:

A = cross-sectional area, cmil [mm^2],
W = mass of test specimen, lb [g],
L = length of test specimen, ft [mm],
f = mass factor, lb/cmil·1000 ft [g/cm^3], (Table 2), and
k = increment (increase) of weight and electrical resistance (from product specifications), %.

8.2 Calculate the cross-sectional area of the conducting material of cored annular conductors and steel-reinforced aluminum conductors as follows:

$$A = (1000/L) \times [100/(100+k)] \times [(W_1 - W_2)/f]$$

where:

A = cross-sectional area, cmil [mm^2],
W_1 = mass of test specimen of the complete conductor, lb [g],
W_2 = mass of the core of the test specimen of the complete conductor, lb [g],
L = length of test specimen, ft [mm],
f = mass factor, in lb/cmil·1000 ft [g/cm^3], (Table 2), and
k = increment (increase) in mass and electrical resistance of the conducting material (from product specifications), %.

8.3 Calculate the cross-sectional area (expressed as the hard-drawn copper equivalent) of composite copper and copper-covered steel conductors, as follows:

$$A = (1000/L) \times [100/(100+k)] \times [(W_{cu}/f_{cu}) + (Z\,W_{ccs}/f_{ccs})]$$

where:

A = cross-sectional area, cmil [mm^2],
W_{cu} = mass of copper strands in test specimen, lb [g],
W_{ccs} = mass of copper-covered steel strands in test specimen, lb [g],
L = length of test specimen, ft [mm],
f_{cu} = mass factor of copper strands in test specimen, lb/cmil·1000 ft [g/cm^3] (Table 2),
f_{ccs} = mass factor of copper-covered steel strands in test specimen, lb/cmil·1000 ft [g/cm^3] (Table 2),
k = increment (increase) of mass and electrical resistance (from product specifications), %, and
Z = conductivity (usually 0.30) of copper-covered steel strands in test specimen.

8.4 Calculate the cross-sectional area of composite aluminum 1350 and aluminum alloy 6201 conductor as follows:

$$A = (1000/L) \times [100/(100+k)] \times (W_{a1}/f_{a1} + W_{a1a}/f_{a1a})$$

where:

A = cross sectional area, cmil [mm^2],
L = length of test specimen, ft [mm],
W_{a1} = mass of aluminum 1350 in test specimen, lb [g],
W_{a1a} = mass of aluminum alloy 6201 in test specimen, lb [g],
f_{a1} = mass factor of aluminum 1350, lb/cmil·1000 ft [g/cm^3], (Table 2),
f_{a1a} = mass factor of aluminum alloy 6201, lb/cmil·1000 ft [g/cm^3], (Table 2), and
k = increment (increase) of mass and electrical resistance for the complete conductor (from product specifications), %.

NOTE 2—The above method can also be used for a composite aluminum conductor manufactured using a combination of other alloys.

9. Precision and Bias

9.1 *Precision*—This test method has been in use for many years. No statement of precision has been made and no work has been planned to develop such a statement.

9.2 *Bias*—This test method has no bias because the value for cross-sectional area is determined solely in terms of this test method.

10. Keywords

10.1 cross-sectional area; mass method; stranded conductor