Designation: B803/B803M – 22

Standard Specification for High-Strength Zinc–5 % Aluminum-Mischmetal Alloy-Coated Steel Core Wire for Use in Overhead Electrical Conductors[1]

This standard is issued under the fixed designation B803/B803M; 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 round, high strength, zinc–5 % aluminum-mischmetal (Zn–5Al–MM) alloy-coated, steel core wire with one class of Zn–5Al–MM coating (MA3) for use in overhead electrical conductors.

1.2 This specification covers wire of diameter from 0.0500 in. to 0.1900 in. inclusive or 1.27 mm to 4.82 mm inclusive.

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

1.4 *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 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein.

2.2 *ASTM Standards:*[2]

A90/A90M Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A751 Test Methods and Practices for Chemical Analysis of Steel Products

B193 Test Method for Resistivity of Electrical Conductor Materials

B750 Specification for GALFAN (Zinc-5 % Aluminum-Mischmetal) Alloy in Ingot Form for Hot-Dip Coatings

E47 Test Methods for Chemical Analysis of Zinc Die-Casting Alloys (Withdrawn 1997)[3]

E1277 Test Method for Analysis of Zinc-5 % Aluminum-Mischmetal Alloys by ICP Emission Spectrometry

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

2.3 *Other Standard:*

GF-1 Standard Practice for Determination of Cerium and Lanthanum Compositions in Galfan Alloy (5 % Al-0.04 % La-0.04 % Ce-Bal SHG Zn)[4]

3. Terminology

3.1 *Abbreviations:*

3.1.1 *MM*—mischmetal

3.1.2 *Zn–5Al–MM*—zinc–5 % aluminum mischmetal alloy

3.2 *Definitions:*

3.2.1 *lot*—unless otherwise specified in the contract or order, a lot shall consist of all coils of wire of the same diameter and unit lengths submitted for inspection at the same time.

3.2.2 *product code*—defines product coating type, coating class and strength grade; this specification covers only High Strength Class A *Zn–5Al–MM* coated products and identified as product code MA3.

4. Ordering Information

4.1 Orders for material under this specification shall include the following information:

4.1.1 Quantity of each size,

4.1.2 Wire diameter in inches or millimeters (Section 13),

4.1.3 Certification, if required (Section 18),

4.1.4 Test report, if required (Section 18),

4.1.5 Package size (Section 19), and

[1] This specification is under the jurisdiction of ASTM Committee B01 on Electrical Conductors and is the direct responsibility of Subcommittee B01.05 on Conductors of Ferrous Metals.

Current edition approved Oct. 1, 2022. Published October 2022. Originally approved in 1989. Last previous edition approved in 2019 as B803/B803M – 19. DOI: 10.1520/B0803_B0803M-22.

[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] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from International Lead Zinc Research Organization (ILZRO), 1822 NC Highway 54 East, Suite 120, Durham, NC 27713, http://www.ilzro.org.

4.1.6 Product code (Paragraph 3.2.2).

4.1.7 *Order Example*—Five multiple lengths of 12 000 ft each, 0.1327 in. MA3 wire, packaged onto wooden non-returnable reels, with certified test report.

5. Materials and Manufacture

5.1 The base metal shall be steel produced by the open-hearth, electric furnace, or basic oxygen process.

5.2 The wire shall be cold drawn and coated with Zn–5Al–MM alloy to produce the desired properties.

6. Chemical Composition

6.1 The steel shall conform to the requirements prescribed in Table 1.

6.2 Chemical analysis of the steel shall be conducted in accordance with Test Methods and Practices A751.

6.3 The ingot form of zinc-5 % aluminum-mischmetal alloy shall conform to Specification B750.

6.3.1 For a two-step coating operation where the first coating is zinc (hot-dip galvanized or electrogalvanized), the final bath may have an aluminum content of up to 7.2 %, to prevent depletion of the aluminum content of the bath.

6.3.2 *Method of Analysis*—The determination of chemical composition shall be made in accordance with suitable chemical (Test Methods E47 for Tin), ICP Argon Plasma Spectrometric (Practice E1277), or other methods. In case of dispute, the results secured by Practice E1277 shall be the basis of acceptance.

6.3.3 *A Method of Coating Material Analysis*—Refer to Specification B750. In case of dispute, the results secured by Practice E1277 shall be the basis of acceptance.

TABLE 1 Chemical Requirements

Element	Composition, %
Carbon	0.50 to 0.88
Manganese	0.50 to 1.30
Phosphorus, max	0.035
Sulfur, max	0.045
Silicon	0.10 to 0.35

TABLE 2 Tensile Requirements

Specified Diameter	Stress at 1 % Extension, min	Ultimate Tensile Strength, min	Elongation in 10 in., min %
in.	ksi	ksi	
0.0500 to 0.0899, incl	210	235	3.0
0.0900 to 0.1199, incl	205	230	3.0
0.1200 to 0.1399, incl	200	225	3.5
0.1400 to 0.1900, incl	195	220	3.5

TABLE 3 Tensile Requirements [Metric]

Specified Diameter	Stress at 1 % Extension, min	Ultimate Tensile Strength, min	Elongation in 250 mm, min %
mm	MPa	MPa	
1.27 to 2.28, incl	1450	1620	3.0
2.29 to 3.04, incl	1410	1590	3.0
3.05 to 3.55, incl	1380	1550	3.5
3.56 to 4.82, incl	1340	1520	3.5

TABLE 4 Initial Settings for Determining Stress at 1 % Extension

Specified Diameter	Initial Stress	Initial Setting of Extensometer,
in.	ksi	in./in.
0.0500 to 0.0899, incl	15	0.0005 (0.05 % Extension)
0.0900 to 0.1199, incl	30	0.0010 (0.10 % Extension)
0.1200 to 0.1900, incl	46	0.0015 (0.15 % Extension)

TABLE 5 Initial Settings for Determining Stress at 1 % Extension [Metric]

Specified Diameter	Initial Stress	Initial Setting of Extensometer,
mm	MPa	mm/mm
1.27 to 2.28, incl	110	0.0005 (0.05 % Extension)
2.29 to 3.04, incl	210	0.0010 (0.10 % Extension)
3.05 to 4.82, incl	320	0.0015 (0.15 % Extension)

7. Tensile Test

7.1 The Zn–5Al–MM alloy-coated steel core wire shall conform to the tensile and elongation requirements prescribed in Table 2 or Table 3 and a minimum breaking strength (lb [N]) calculated from the minimum required tensile and nominal wire diameter. The wire tensile strength used to determine compliance to Table 2 or Table 3 shall be calculated using the actual wire breaking strength and the nominal finished diameter of the wire.

7.2 Tensile tests shall be conducted in accordance with Test Methods and Definitions A370, using the initial settings for determining stress at 1 % extension given in Table 4 or Table 5 of this specification.

7.3 *Test Specimens*—The test specimens shall be free of bends or kinks other than the curvature resulting from the usual coiling operations. Any hand straightening necessary to permit insertion of the specimen in the jaws of the testing machine shall be performed by drawing between wood blocks or by some other equally satisfactory means.

8. Wrap Test

8.1 The material, as represented by the test specimens, shall not fracture when the Zn–5Al–MM alloy-coated wire is wrapped at a rate not exceeding 15 turns/min in a helix of at least eight turns around a cylindrical mandrel with a diameter equal to three times the specified diameter of the wire under test, ±5 %. The edge-to-edge spacing of consecutive turns shall not exceed two times the diameter of the wire.

9. Coating Test

9.1 The Zn–5Al–MM alloy-coated wire shall conform to the coating requirements prescribed in Table 6 or Table 7.

9.2 The coating test shall be conducted in accordance with Test Method A90/A90M.

10. Adherence of Coating Test

10.1 The Zn–5Al–MM alloy-coated wire shall be capable of being wrapped in a close helix at a rate not exceeding 15 turns/min around a cylindrical mandrel having a diameter as prescribed in Table 8 or Table 9, without cracking or flaking the coating to such an extent that any Zn–5Al–MM alloy can be removed by rubbing with the bare fingers.

TABLE 6 Zn–5Al–MM Alloy Coating

Specified Diameter of Coated Wire	Area Density of Zn–5Al–MM Alloy Coating min of Uncoated Wire Surface, oz/ft^2
in.	Class A
0.0500 to 0.0599, incl	0.60
0.0600 to 0.0749, incl	0.65
0.0750 to 0.0899, incl	0.70
0.0900 to 0.1039, incl	0.75
0.1040 to 0.1199, incl	0.80
0.1200 to 0.1399, incl	0.85
0.1400 to 0.1799, incl	0.90
0.1800 to 0.1900, incl	1.00

TABLE 7 Zn–5Al–MM Alloy Coating [Metric]

Specified Diameter of Coated Wire	Area Density of Zn–5Al–MM Coating, min, of Uncoated Wire Surface, g/m^2
mm	Class A
1.27 to 1.52, incl	183
1.53 to 1.90, incl	198
1.91 to 2.28, incl	214
2.29 to 2.64, incl	229
2.65 to 3.04, incl	244
3.05 to 3.55, incl	259
3.56 to 4.57, incl	274
4.58 to 4.82, incl	305

TABLE 8 Mandrel Size for Adherence Test

Specified Wire Diameter	Ratio of Mandrel Diameter to Wire Diameter
in.	
0.0500 to 0.0899, incl	3
0.0900 to 0.1399, incl	4
0.1400 to 0.1900, incl	5

TABLE 9 Mandrel Size for Adherence Test [Metric]

Specified Wire Diameter	Ratio of Mandrel Diameter to Wire Diameter
mm	
1.27 to 2.28, incl	3
2.29 to 3.04, incl	4
3.05 to 4.82, incl	5

NOTE 1—Loosening or detachment during the adhesion test of superficial, small particles of Zn–5Al–MM alloy formed by mechanical polishing of the surface of the coated wire shall not be considered cause for rejection.

11. Joints

11.1 No joints shall be made in the finished wire.

11.2 Joints may be made at any stage of processing prior to final cold drawing by the electric butt-weld or flash or flash-welding process.

11.3 Welding equipment and procedure shall be such that it can be demonstrated that the ultimate tensile strength of a finished wire specimen containing the welded section shall be not less than 96 % of the specified minimum stress at 1 % extension.

11.4 A welded section shall not be required to meet the stress at 1 % extension, elongation, and wrap tests.

12. Density and Resistivity

12.1 For the purpose of calculating mass per unit length, cross sections, and so forth, the density of Zn–5Al–MM alloy-coated steel wire at 20 °C shall be taken as 0.281 lb/in.^{3} [7780 kg/m^3].

12.2 A maximum resistivity of Zn–5Al–MM alloy-coated steel wire is not guaranteed but a typical value of 0.19157 Ω·mm^2/m may be used for purpose of calculation. For conversion to other units of conductivity or resistivity, refer to Test Method B193.

13. Dimensions and Permissible Variations

13.1 The specified diameter of the Zn–5Al–MM alloy-coated wire shall be expressed in decimal fractions of an inch to four decimal places, or in millimeters to two decimal places.

13.2 To determine the applicable tolerance range from Table 10 or Table 11, round the specified diameter to the nearest 0.001 in. [0.01 mm] in accordance with the rounding method of Practice E29.

13.3 Measure the largest and smallest diameter taken at the same cross section rounded to the nearest 0.001 in. [0.01 mm] in accordance with the rounding method of Practice E29. Calculate the average of the two measurements. The calculated value shall not differ from the specified diameter by more than the applicable tolerance range shown in Table 10 or Table 11.

14. Workmanship, Finish, and Appearance

14.1 The Zn–5Al–MM alloy coating shall be reasonably smooth, continuous, of reasonably uniform thickness and free of imperfections not consistent with good commercial practice.

15. Number of Tests and Retests

15.1 One test specimen shall be taken from each 5000 lb [2500 kg] or fraction thereof in the inspection lot.

15.2 Each specimen shall be tested for compliance with Sections 7, 8, 10, and 13. At least half of the specimens shall be tested for compliance with Section 9.

15.3 Should one or more of the test specimens fail any of the tests specified, the nonconforming coil or coils may be removed and the balance of the lot subjected to retests. For retest purposes, two additional coils for each 5000 lb [2500 kg]

TABLE 10 Permissible Variations in Diameter of Zn–5Al–MM Alloy-Coated Steel Wire

NOTE 1—It is recognized that the surface of coatings, particularly those produced by the hot-dip method of coating, are not perfectly smooth and devoid of irregularities. If the tolerances shown in the table are rigidly applied to such irregularities that are inherent to the product, unjustified rejections of wire that would actually be satisfactory for use could occur. It is intended that these tolerances be used in gaging the wires where there is a minimum of such diameter irregularities due to hot dip coating.

Specified Diameter	Permissible Variation	
in.	in.	
	Plus	Minus
0.0500 to 0.0749, incl	0.0015	0.001
0.0750 to 0.1199, incl	0.002	0.002
0.1200 to 0.1399, incl	0.003	0.002
0.1400 to 0.1900, incl	0.004	0.003