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

This standard is issued under the fixed designation B958/B958M; 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, extra-high-strength, and ultra-high-strength, Class A coated zinc–5 % aluminum-mischmetal (Zn–5Al–MM) alloy-coated, steel core wire for use in Overhead Electrical Conductors.

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

1.5 *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]

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
E1277 Test Method for Analysis of Zinc-5 % Aluminum-Mischmetal Alloys by Inductively Coupled Plasma Atomic Emission Spectrometry
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E47 Test Methods for Chemical Analysis of Zinc Die-Casting Alloys (Withdrawn 1997)[3]

[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.

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

2.2 *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 of Terms Specific to This Standard:*

3.2.1 *lot, n*—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, n*—defines product coating type, coating class, and strength grade.

3.2.2.1 *Extra High Strength Grade Zn–5Al–MM, Class A Coated*—use Code MA4.

3.2.2.2 *Ultra High Strength Grade Zn–5Al–MM, Class A Coated*—use Code MA5.

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 millimeter (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

4.1.6 Product code.

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.

TABLE 1 Chemical Requirements

Element	Composition, %
Carbon	0.50 to 1.00
Manganese	0.30 to 1.30
Phosphorus, max	0.035
Sulfur, max	0.045
Silicon	0.15 to 1.20

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

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 electro-galvanized), 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.

7. Tensile Test

7.1 The Zn–5Al–MM alloy-coated steel core wire shall conform to the ordered tensile and elongation requirements prescribed in Table 2, Table 3, Table 4, or Table 5 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, Table 3, Table 4, or Table 5 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 6 or Table 7 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.

7.4 The nominal diameter requested shall be used to determine the applicable strength specification from the tables.

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 four 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 8 or Table 9.

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

TABLE 2 Grade 4 Extra-High-Strength Tensile Requirements

Specified Diameter, in.	Stress at 1 % Extension, min, kpsi	Ultimate Tensile Strength, min, kpsi	Elongation in 10 in., min %
0.0500 to 0.0899, incl	225	265	3.0
0.0900 to 0.1199, incl	220	260	3.0
0.1200 to 0.1399, incl	215	255	3.5
0.1400 to 0.1900, incl	210	250	3.5

TABLE 3 Grade 4 Extra-High-Strength Tensile Requirements [Metric]

Specified Diameter, mm	Stress at 1 % Extension, min, MPa	Ultimate Tensile Strength, min, MPa	Elongation in 250 mm, min %
1.27 to 2.28, incl	1550	1825	3.0
2.29 to 3.04, incl	1515	1790	3.0
3.05 to 3.55, incl	1480	1760	3.5
3.56 to 4.82, incl	1450	1725	3.5

TABLE 4 Grade 5 Ultra-High-Strength Tensile Requirements

Specified Diameter, in.	Stress at 1 % Extension, min, kpsi	Ultimate Tensile Strength, min, kpsi	Elongation in 10 in., min %
0.0500 to 0.0899, incl	230	285	3.0
0.0900 to 0.1199, incl	225	275	3.0
0.1200 to 0.1399, incl	220	270	3.5
0.1400 to 0.1900, incl	215	265	3.5

TABLE 5 Grade 5 Ultra-High-Strength Tensile Requirements [Metric]

Specified Diameter, mm	Stress at 1 % Extension, min, MPa	Ultimate Tensile Strength, min, MPa	Elongation in 250 mm, min %
1.27 to 2.28, incl	1580	1965	3.0
2.29 to 3.04, incl	1550	1900	3.0
3.05 to 3.55, incl	1515	1860	3.5
3.56 to 4.82, incl	1480	1825	3.5

TABLE 6 Initial Settings for Determining Stress at 1 % Extension

Specified Diameter, in.	Initial Stress, kpsi	Initial Setting of Extensometer, in./in.
0.0500 to 0.0899, incl	18	0.0005 (0.05 % extension)
0.0900 to 0.1199, incl	36	0.0010 (0.10 % extension)
0.1200 to 0.1900, incl	54	0.0015 (0.15 % extension)

TABLE 7 Initial Settings for Determining Stress at 1 % Extension [Metric]

Specified Diameter, mm	Initial Stress, MPa	Initial Setting of Extensometer, mm/mm
1.27 to 2.28, incl	125	0.0005 (0.05 % extension)
2.29 to 3.04, incl	250	0.0010 (0.10 % extension)
3.05 to 4.82, incl	375	0.0015 (0.15 % extension)

around a cylindrical mandrel having a diameter as prescribed in Table 10 or Table 11, 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.

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-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.