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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 Conductors¹

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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 to 0.1900 in. inclusive or 1.27 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 and health practices and determine the applicability of regulatory limitations prior to use.*

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, Practices, and Terminology for Chemical Analysis of Steel Products](#)

[B193 Test Method for Resistivity of Electrical Conductor Materials](#)

[B750 Specification for GALFAN](#)

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.

[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](#)

2.2 *Other Standard:*

[GF-1 Standard Practice for Determination of Cerium and Lanthanum Compositions in Galfan Alloy \(5 % Al-0.04 % La- 0.04 % Ce-Bal SHG Zn\)](#)³

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), and

4.1.5 Package Size (Section 19).

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.

³ Available from the International Lead Zinc Research Organization (ILZRO), 1822 NC Highway 54 East, Suite 120, Durham NC 27713, <http://www.ilzro.org>.

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, Practices, and Terminology **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 Coating Material Analysis*—Refer to Specification **B750**.

7. Tensile Test

7.1 The Zn-5Al-MM-coated steel core wire shall conform to the tensile and elongation requirements prescribed in **Table 2**, **Table 3**, **Table 4**, or **Table 5** depending on which strength grade and unit base ordered.

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 close 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 %.

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**.

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

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)

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 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.