



Standard Specification for Zinc-Coated (Galvanized) Steel Core Wire for Use in Overhead Electrical Conductors¹

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1. Scope

1.1 This specification covers round, zinc-coated, steel core wire with two classes of zinc coating for use in overhead electrical conductors.

1.2 This specification covers wire of diameter from 0.0500 to 0.1900 in. 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.

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

[B6 Specification for Zinc](#)

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

[E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications](#)

3. Terminology

3.1 *Definitions:*

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.

3.1.1 *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.

3.1.2 *product code*—Defines product coating type, coating class and strength grade. Two product codes for product produced to this specification: Class A Zinc Coated (Code GA2); and Class C Zinc Coated (Code GC2).

4. Classification

4.1 The wire is furnished in two classes of coating, Class A or Class C, as specified, in conformance with the requirements of Section 10 and Table 6 or Table 7.

5. Ordering Information

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

5.1.1 Quantity of each size,

5.1.2 Wire diameter in inches or millimeters (Section 14),

5.1.3 Product Code (see 3.1.2 and 4.1),

5.1.4 Certification, if required (Section 19),

5.1.5 Test report, if required (Section 19), and

5.1.6 Package size (Section 20).

5.1.7 Order Example: Five multiple lengths of 12 000 ft. each, 0.1327 in. GA2 wire, packaged onto wooden nonreturnable reels, with certified test report.

6. Materials and Manufacture

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

6.2 The wire shall be cold drawn and coated with zinc to produce the desired properties.

6.3 The slab zinc used for coating shall be high-grade or better, conforming to Specification B6.

7. Chemical Composition

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

7.2 Chemical analysis shall be conducted in accordance with Test Methods, Practices, and Terminology A751.

TABLE 1 Chemical Requirements

Element	Composition, %
Carbon	0.50 to 0.88
Manganese	0.50 to 1.10
Phosphorus, max	0.035
Sulfur, max	0.045
Silicon	0.10 to 0.35

8. Tensile Test

8.1 The zinc-coated steel core wire shall conform to the tensile and elongation requirements prescribed in [Table 2](#) or [Table 3](#).

8.2 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.

8.3 *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.

9. Wrap Test

9.1 The material, as represented by the test specimens, shall not fracture when the galvanized 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 two times the specified diameter of the wire under test, $\pm 5\%$.

10. Coating Test

10.1 The material, as represented by the test specimens, shall conform to the coating requirements of [Table 6](#) or [Table 7](#) for the diameter and class of coating specified.

10.2 The coating test shall be conducted in accordance with Test Method [A90/A90M](#).

11. Adherence of Coating Test

11.1 The zinc-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 zinc coating to such an extent that any zinc can be removed by rubbing with the bare fingers.

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

12. Joints

12.1 No joints shall be made in the finished wire.

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

12.3 Welding equipment and procedure shall be such that it can be demonstrated that the tensile strength of a finished wire

specimen containing the welded section shall not be less than 96 % of the specified minimum stress at 1 % extension.

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

13. Density and Resistivity

13.1 For the purposes of calculating mass per unit length, cross-sections, and so forth, the density of galvanized steel wire at 20°C shall be taken as 0.281 lb/in.³ (7780 kg/m³).

13.2 A maximum resistivity of galvanized steel wire is not guaranteed, but a typical value of 0.191 57 $\Omega \cdot \text{mm}^2/\text{m}$ may be used for purposes of calculation. For conversion to other units of conductivity or resistivity, refer to Test Method [B193](#).

14. Dimensions and Permissible Variations

14.1 The specified diameter of the zinc-coated wire shall be expressed in decimal fractions of an inch to four decimal places, or in millimeters to two decimal places.

14.2 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](#).

14.3 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](#).

15. Workmanship, Finish, and Appearance

15.1 The zinc coating shall be reasonably smooth, continuous, of reasonably uniform thickness, and free from imperfections not consistent with good commercial practice.

16. Number of Tests and Retests

16.1 One test specimen shall be taken from each 5000 lbs or 2500 kg, or fraction, thereof, in the inspection lot.

16.2 Each specimen shall be tested for compliance with Sections [8](#), [9](#), [11](#), and [14](#). At least half of the specimens shall be tested for compliance with Section [10](#).

16.3 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 lbs or 2500 kg in the lot shall be sampled and tested for the property in which the original sample failed to comply.

16.4 Should any of the retest specimens fail to meet the properties specified, the lot represented by the test specimens shall be rejected.

16.5 Instead of rejecting the entire lot as provided in [16.4](#), the producer may test specimens from every coil in the lot for the property in which failure occurred, and reject only the nonconforming coils.

TABLE 2 Tensile Requirements

Specified Diameter, in.	Stress at 1 % Extension, min, Kpsi		Ultimate Tensile Strength, min, Kpsi		Elongation in 10 in., min, %	
	Class A	Class C	Class A	Class C	Class A	Class C
0.0500 to 0.0899, incl	190	170	210	190	3.0	3.0
0.0900 to 0.1199, incl	185	165	205	185	3.5	3.0
0.1200 to 0.1399, incl	180	160	205	185	4.0	3.0
0.1400 to 0.1900, incl	170	155	200	180	4.0	4.0

TABLE 3 Tensile Requirements (Metric)

Specified Diameter, mm	Stress at 1 % Extension, min, MPa		Ultimate Tensile Strength, min, MPa		Elongation in 250 mm, min, %	
	Class A	Class C	Class A	Class C	Class A	Class C
1.27 to 2.28, incl	1310	1170	1450	1310	3.0	3.0
2.29 to 3.04, incl	1280	1140	1410	1280	3.5	3.0
3.05 to 3.55, incl	1240	1100	1410	1280	4.0	3.0
3.56 to 4.82, incl	1170	1070	1380	1240	4.0	4.0

TABLE 4 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	14	0.0005 (0.05 % extension)
0.0900 to 0.1199, incl	28	0.0010 (0.10 % extension)
0.1200 to 0.1900, incl	42	0.0015 (0.15 % extension)

TABLE 5 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	100	0.0005 (0.05 % extension)
2.29 to 3.04, incl	190	0.0010 (0.10 % extension)
3.05 to 4.82, incl	290	0.0015 (0.15 % extension)

TABLE 6 Zinc Coating

Specified Diameter of Coated Wire, in.	Area Density of Coating, min, of Uncoated Wire Surface, oz/ft ²	
	Class A	Class C
0.0500 to 0.0599, incl	0.60	1.80
0.0600 to 0.0749, incl	0.65	1.95
0.0750 to 0.0899, incl	0.70	2.10
0.0900 to 0.1039, incl	0.75	2.25
0.1040 to 0.1199, incl	0.80	2.40
0.1200 to 0.1399, incl	0.85	2.55
0.1400 to 0.1799, incl	0.90	2.70
0.1800 to 0.1900, incl	1.00	3.00

TABLE 7 Zinc Coating (Metric)

Specified Diameter of Coated Wire, mm	Area Density of Coating, min, of Uncoated Wire Surface, g/m ²	
	Class A	Class C
1.27 to 1.52, incl	183	549
1.53 to 1.90, incl	198	594
1.91 to 2.28, incl	214	642
2.29 to 2.64, incl	229	687
2.65 to 3.04, incl	244	732
3.05 to 3.55, incl	259	777
3.56 to 4.57, incl	274	822
4.58 to 4.82, incl	305	915

TABLE 8 Mandrel Size for Adherence Test

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

17. Inspection

17.1 Unless otherwise specified in the contract or purchase order, the manufacturer shall be responsible for the performance of all inspection and test requirements specified.

17.2 All inspections and tests shall be made at the place of manufacture, unless otherwise especially agreed upon between the manufacturer and the purchaser at the time of the purchase.

17.3 The manufacturer shall afford the inspector representing the purchaser all reasonable manufacturer's facilities to

satisfy him that the material is being furnished in accordance with this specification.

18. Rejection and Rehearing

18.1 Material that fails to conform to the requirements of this specification shall be rejected. Rejection should be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the producer or supplier may make claim for a rehearing.

TABLE 10 Permissible Variations in Diameter of Zinc-Coated Steel Wire

NOTE 1—It is recognized that the surface of zinc coatings, particularly those produced by hot-dip galvanizing, 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 galvanizing.

Specified Diameter, in	Permissible Variation, 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

TABLE 11 Permissible Variations in Diameter of Zinc-Coated Steel Wire (Metric)

NOTE 1—It is recognized that the surface of zinc coatings, particularly those produced by hot-dip galvanizing, 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 galvanizing.

Specified Diameter, mm	Permissible Variation, mm	
	Plus	Minus
1.27 to 1.90, incl	0.038	0.025
1.91 to 3.04, incl	0.051	0.051
3.05 to 3.55, incl	0.076	0.051
3.56 to 4.82, incl	0.102	0.076

19. Certification

19.1 When specified in the purchase order or contract, a producer's or supplier's certification shall be furnished to the purchaser showing that the material was manufactured, sampled, tested, and inspected in accordance with this specification and has been found to meet the requirements. When specified in the purchase order or contract, a report of the test results shall be furnished.

20. Packaging and Package Marking

20.1 The unit lengths shall be as specified in the contract or order. Length tolerances shall be plus or minus 2 %, unless otherwise specified by the purchaser. (See Explanatory **Note 1**.)

20.2 Package dimensions, kind of package (coils, reels or reelless coils), and quantity of wire in each package shall be agreed upon between the manufacturer and purchaser.

20.3 A durable tag shall be securely attached to each package showing the nominal diameter of wire, class of coating, length, approximate weight, purchaser's order number, and manufacturer's name.

20.4 The starting end shall be identified.

20.5 In case there is more than one piece in a package, the length and position of each piece shall be shown on the tag.

21. Keywords

21.1 coated steel wire; steel core wire; steel wire; zinc-coated steel wire

EXPLANATORY NOTES

NOTE 1—Steel wire cannot be produced to exact specified lengths. Since welding of steel wires for use in electrical conductors is not accepted, the random lengths of wire that results from normal production can result in otherwise good product being rejected and scrapped. In order to reduce cost, the purchaser and manufacturer should, at the time of

purchase, have an agreed upon method to permit the acceptance of odd lengths of steel wire. A typical agreement would be to permit lengths other than the specified length for up to 5 % of the purchased quantity with any single piece being not less than 50 % of the specified length.

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