Designation: A 411 – 08

Standard Specification for Zinc-Coated (Galvanized) Low-Carbon Steel Armor Wire[1]

This standard is issued under the fixed designation A 411; 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 Department of Defense.

1. Scope*

1.1 This specification covers zinc-coated low-carbon steel wire for use in armoring for protection against damage of submarine and underground cables used for communication, control, or power purposes.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

A 90/A 90M Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

A 938 Test Method for Torsion Testing of Wire

B 6 Specification for Zinc

E 8 Test Methods for Tension Testing of Metallic Materials

3. Ordering Information

3.1 It shall be the responsibility of the purchaser to specify all requirements that are necessary for material under this specification. Such requirements may include, but are not limited to, the following information:

3.1.1 Quantity of each size,

3.1.2 Wire size, diameter in inches or (millimetres) (Section 12), and

3.1.3 Weight (Mass), inside diameter, and method of banding of coils.

4. Zinc for Coating

4.1 The slab zinc used for the coating shall be any grade of zinc conforming to Specification B 6.

5. Base Metal

5.1 The base metal shall be manufactured by any commercially accepted steel making practice, and of such quality that, when processed and zinc-coated, the finished wire shall have the properties prescribed in this specification.

6. Joints

6.1 The wire shall be furnished in coils of one continuous length. Welds made prior to final wire drawing shall be permitted.

7. Tensile Strength

7.1 The zinc-coated wire shall have a tensile strength of not less than 50 000 psi (345 MPa), nor more than 70 000 psi (483 MPa). The tensile strength of the zinc-coated wire shall be determined in accordance with Test Methods E 8. The diameter of the wire shall be measured over the zinc coating for the purpose of calculating the tensile strength.

8. Elongation

8.1 The zinc-coated wire shall have an elongation of not less than 10 % in 10 in. (254 mm) for nominal sizes 0.284 in. (7.21 mm) and smaller. Nominal sizes larger than 0.284 in. shall have an elongation of not less than 9 % in 10 in. The elongation shall be determined as the permanent increase in length after failure of a marked section of the wire originally 10 in. in length.

9. Torsion Test

9.1 The zinc-coated wire shall withstand without fracture the minimum number of turns specified in Table 1. This test shall be done in accordance with Test Method A 938 and the number of turns to failure shall meet the requirements of Table 1.

10. Weight of Coating

10.1 The weight of zinc coating, in ounces per square foot or (grams per square metre) of uncoated wire surface, shall be not less than that specified in Table 2.

10.2 *Weight of Coating Test*—The zinc coating shall be tested for weight by a stripping test in accordance with Test Methods A 90/A 90M.

[1] This specification is under the jurisdiction of ASTM Committee A05 on Metallic-Coated Iron and Steel Products and is the direct responsibility of Subcommittee A05.12 on Wire Specifications.

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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.

***A Summary of Changes section appears at the end of this standard.**

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TABLE 1 Minimum Number of Turns

Nominal Wire Diameter, in. (mm)	Minimum Turns (8 in. gage length)
0.239 (6.07) and over	7
0.238 to 0.166 (6.05 to 4.22)	9
0.165 to 0.110 (4.19 to 2.79)	13
0.109 to 0.065 (2.77 to 1.65)	19

TABLE 2 Minimum Weights of Zinc Coating

Nominal Diameter of Coated Wire, in. (mm)	Minimum Weight of Zinc Coating oz/ft^2(g/m^2) of Uncoated Wire Surface
0.340 (8.64)	1.00 (300)
0.300 (7.62)	1.00 (300)
0.284 (7.21)	1.00 (300)
0.259 (6.58)	1.00 (300)
0.238 (6.05)	1.00 (300)
0.220 (5.59)	1.00 (300)
0.203 (5.16)	1.00 (300)
0.165 (4.19)	0.90 (270)
0.134 (3.40)	0.80 (240)
0.109 (2.77)	0.80 (240)
0.083 (2.11)	0.60 (180)
0.065 (1.65)	0.50 (150)

11. Adherence of Coating

11.1 The zinc coating shall remain adherent when the wire is wrapped at a rate of not more than 15 turns per minute in a close helix of at least 2 turns around a cylindrical mandrel of the diameter specified in Table 3. The zinc coating shall be considered as meeting this requirement if, when the wire is wrapped about the specified mandrel, the coating does not flake and none of it can be removed from the wire by rubbing with fingers. Loosening or detachment during the adhesion test of superficial, small particles of zinc formed by mechanical polishing of the surface of zinc-coated wire shall not be considered cause for rejection.

12. Size and Permissible Variations

12.1 *Size*—The size of the zinc-coated wires shall be expressed as the diameter of the wire in decimal fractions of an inch or (millimetres).

12.2 *Permissible Variations*—The permissible variations of the zinc-coated wire from the nominal diameter shall be as specified in Table 4.

13. Workmanship, Finish and Appearance

13.1 The surface of the wire shall be free from injurious scale, flaws, splits, and other imperfections not consistent with good commercial practice. The coating shall be continuous and reasonably uniform.

TABLE 3 Mandrel Diameter for Adherence of Coating Tests

Wire Diameters, in. (mm)	Mandrel Size
0.259 (6.58) and over	5×
0.258 to 0.134 (6.55 to 3.40)	3×
0.133 (3.38) and under	2×

TABLE 4 Permissible Variations in Diameter of Zinc-Coated Wire

NOTE 1—It is recognized that the surfaces of zinc coatings, particularly those produced by hot-dip galvanizing, are not perfectly smooth and devoid of irregularities. If the tolerances shown 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. Therefore, it is intended that these tolerances be used in gaging the uniform areas of the galvanized wire.

Nominal Diameter of Coated Wire, in. (mm)	Permissible Variations, plus or minus, in. (mm)
0.340 to 0.260 (8.64 to 6.60)	0.006 (0.15)
0.259 to 0.166 (6.58 to 4.22)	0.005 (0.13)
0.165 to 0.109 (4.19 to 2.77)	0.004 (0.10)
0.108 to 0.065 (2.74 to 1.65)	0.003 (0.08)

14. Sampling

14.1 The inspector shall select at random one sample coil from every 10 coils in the first 100 coils of the lot, and one sample for every additional 35 coils but not less than 3 coils from the entire lot. From each coil of zinc-coated wire thus selected, a sample of suitable length shall be taken for the weight of coating and mechanical tests as specified in Sections 7-11, inclusive.

15. Inspection

15.1 Unless otherwise specified in the contract or purchase order, the manufacturer is responsible for the performance of all inspection and test requirements specified in this standard. Except as otherwise specified in the contract or purchase order, the manufacturer may use his own or any other suitable facility for the performance of the inspection and test requirements unless disapproved by the purchaser at the time the order is placed. The purchaser shall have the right to perform any of the inspections and tests set forth in this standard when such inspections and tests are deemed necessary to assure that the material conforms to prescribed requirements.

16. Rejection

16.1 Failure of any of the test specimens to comply with the requirements of this specification shall constitute grounds for rejection of the lot represented by the specimen. The lot may be re-submitted for inspection by testing every coil for the characteristics in which the specimen failed, and sorting out the defective coils.

17. Packaging

17.1 The finished zinc-coated wire shall be furnished in compact coils reasonably symmetrical in shape. The weight, inside diameter, and method of banding of the coils shall be agreed upon between the manufacturer and the purchaser.

18. Marking

18.1 A durable tag shall be attached to each coil showing the nominal size of wire and the name or mark of the manufacturer. The starting end of each coil shall be indicated by a suitable tag.

19. Keywords

19.1 armor wire; zinc coated steel armor wire

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SUMMARY OF CHANGES

Committee A05 has identified the location of selected changes to this standard since the last issue (A 411 - 03) that may impact the use of this standard. (May 1, 2008)

(*1*) Revised 5.1 to keep wording of steel making practices uniform between standards.

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