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Standard Specification for Copper-Clad Steel Wire Strand[1]

This standard is issued under the fixed designation A460; 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 copper-clad steel wire strand composed of a number of round steel, copper-clad wires, for use as guys, messengers, span wires, and for similar purposes where electrical conductance is not a requirement.

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]

A902 Terminology Relating to Metallic Coated Steel Products

3. Terminology

3.1 For definitions of terms used in this specification see Terminology A902.

4. Classification

4.1 The strand is classified by the minimum breaking strength and number of wires in the strand as stated in Table 1.

5. Ordering Information

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

5.1.1 Quantity of strand in feet.

5.1.2 Breaking strength and number of wires in strand (4.1 and Table 1).

5.1.3 Package size of coils or reels from Table 2.

5.1.4 ASTM designation and year of issue.

6. Materials and Manufacture

6.1 Each wire in the strand shall be composed of a steel core made from steel produced by any commercially-accepted steel-making process, with a substantially uniform and continuous copper cladding thoroughly bonded to it throughout. The thickness and adherence of the copper cladding on the finished wire shall comply with the requirements prescribed in this specification.

6.2 Each wire in the strand shall be of such quality that, when drawn to the size specified in Table 1 and when fabricated into strand, the finished copper-clad steel wire strand shall have the properties and characteristics prescribed in this specification.

7. Stranding

7.1 The strand shall consist of either 3 or 7 wires and, unless otherwise specified, shall have a left lay with a uniform pitch. In 3-wire strand, the pitch shall be not less than 12 nor more than 20 times the nominal diameter of the strand. In 7-wire strand, the pitch shall be not less than 10 nor more than 16 times the nominal diameter of the strand. A left lay is defined as a counter-clockwise twist away from the observer looking along the axis of the strand. All wires shall be stranded with uniform tension.

7.2 All wires in the strand shall lie naturally in their true positions in the completed strand, and when the strand is cut, the ends shall remain in position or be readily replaced by hand and then remain in position. This may be accomplished by any means or process, such as preforming, post forming, or form setting.

8. Joints and Splices

8.1 Joints or splices may be made prior to final wire drawing in individual finished wires composing the strand, provided that such joints or splices have protection from corrosion equivalent to that of the copper-clad wire itself and that they do not decrease the strength of the finished strand below the minimum breaking strength shown in Table 1. A joint or splice shall be not closer than 50 ft (15.2 m) to any other wire joint or splice in the strand.

8.2 The finished strand shall not be joined or spliced as a unit, unless specifically permitted by the purchaser.

9. Thickness of Copper Cladding

9.1 The minimum thickness of the copper cladding at any point around the circumference of the wires taken from the finished strand shall be not less than 8 % of the wire radius.

[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.

TABLE 1 Physical Properties of Copper-Clad Steel Wire Strands

Minimum Breaking Strength of Strand, lbf (N)	Number of Wires in Strand	Nominal Diameter of Strand, in. (mm)[A]	Nominal Diameter of Wires, in. (mm)	Approximate Weight of Strand, lb/1000 ft (kg/km)
2 200 (9 790)	3	0.164 (4.2)	0.076 (1.93)	49 (73)
4 000 (17 800)	3	0.209 (5.3)	0.097 (2.46)	79 (118)
6 000 (26 700)	3	0.258 (6.6)	0.120 (3.0)	121 (180)
6 000 (26 700)	7	0.237 (6.0)	0.079 (2.01)	122 (182)
8 000 (35 600)	7	0.276 (7.0)	0.092 (2.34)	166 (247)
10 000 (44 500)	7	0.303 (7.7)	0.101 (2.6)	200 (298)
12 500 (55 600)	7	0.345 (8.8)	0.115 (2.9)	259 (385)
14 000 (62 300)	7	0.360 (9.1)	0.120 (3.0)	283 (421)
16 000 (71 200)	7	0.386 (9.8)	0.128 (3.3)	324 (482)
18 000 (80 100)	7	0.414 (10.5)	0.138 (3.5)	374 (557)
20 000 (89 000)	7	0.438 (11.1)	0.146 (3.7)	418 (662)

[A] This diameter is given for the purpose of information and as a guide for the size of fittings, hardware, etc.

TABLE 2 Lengths of Strand in Coils and on Reels

Minimum Breaking Strength of Strand, lbf (N)	Approximate Length of Strand	
	In Coil, ft (m)	On Reel, ft (m)
2 200 (9790)	1000 (305)	10 000 (3050)
4 000 (17 800)	500 (152)	10 000 (3050)
6 000 to 10 000, incl (26 700 to 44 500, incl)	500 (152)	5 000 (1520)
12 500 to 20 000, incl (55 600 to 89 000, incl)	250 (76)	5 000 (1520)
12 500 to 20 000, incl (55 600 to 89 000, incl)	500 (152)	. . . (. . .)

9.2 The copper thickness shall be determined by either of the following:

9.2.1 By direct measurements of cross sections of the wires, the ends of the specimens having been ground smooth, polished, and etched before being measured microscopically, or

9.2.2 By means of a suitable electrical indicating instrument operating on the permeameter principle.

10. Sampling

10.1 For the purpose of inspecting the strand, tests shall be made on representative samples. For lots of 10 000 lb (4536 kg) or less, two samples shall be taken from separate reels or coils in the lot, except that only one sample shall be required where the total length of the strand is 5000 ft (1524 m) or less. For lots over 10 000 lb (4536 kg) one sample from each 10 000 lb (4536 kg) or fraction thereof shall be taken, but the minimum number of samples shall be three.

11. Breaking Strength

11.1 The breaking strength of the finished strand shall be not less than that specified in Table 1.

11.2 When the breaking strength is below the minimum specified, the cause of which may have been due to slipping of the specimen in the jaws of the testing machine, breaking within the jaws or within 1 in. (25.4 mm) of the jaws, or the improper socketing of a specimen, the results of the test shall be disregarded and another sample from the same coil or reel shall be tested.

12. Elongation

12.1 The elongation shall be not less than 1.5 % and shall be measured on a gage length of not less than 24 in. (610 mm) of finished strand which does not contain wire joints or splices. Elongation shall be determined by measurements made between the jaws of the testing machine or by an extensometer at the option of the manufacturer, unless otherwise agreed upon at the time of purchase.

12.2 When the elongation is so determined, the gage length shall be the distance between the jaws of the testing machine when a load equal to 10 % of the minimum breaking strength shall have been applied, and the final length shall be the distance between the jaws at the time of fracture of any wire. The fracture shall be between the jaws of the testing machine and not closer than 1 in. (25.4 mm) to either jaw, otherwise the test shall be disregarded.

12.3 When used, the extensometer shall be attached to the test specimen at a tension load equal to 10 % of minimum breaking strength. The elongation shall be observed while applying a tension load to the specimen, and the reading when fracture occurs shall be taken as the elongation of the specimen. Tests in which the extensometer reading is less than 1.5 %, but in which the fracture does not occur between the two attachments of the extensometer to the specimen, shall be disregarded.

12.4 Additional samples shall be taken from the same coil or reel when the previous tests are to be disregarded as stated in 12.2 and 12.3.

13. Torsion Test

13.1 Specimens of finished wires taken before stranding shall withstand without fracture not less than 20 twists in a length equivalent to 100 times the nominal diameter of the specimen. The rate of applying the twists shall be approximately 15 turns per minute, all twists to be made in the same direction.

13.2 Wire specimens shall be twisted to destruction and shall not reveal any seams, pits, slivers, or surface imperfections such that performance of the strand would be impaired. Examination of the wire at the break shall show no separation of the copper from the steel visible to the naked eye (normal eyeglasses excepted).

14. Wrap Test

14.1 When agreed upon at the time of purchase, samples of individual wires taken from the finished strand shall withstand

without fracture, eight complete turns wrapped on itself in a close helix or on a mandrel whose diameter shall be equal to the nominal diameter of the wire.

15. Dimensions, Weight, and Permissible Variations

15.1 The size of the component wires in the strand shall be expressed in decimals of an inch or (millimetres) as prescribed in Table 1.

15.2 The diameters of the component wires in the strand shall not vary from the nominal wire diameters by more than ±0.002 in. (0.05 mm).

15.3 Nominal diameter of strand and approximate weight of strand are indicated in Table 1.

16. Workmanship and Finish

16.1 The finished strand shall be tight, smooth, and free of imperfections not consistent with good commercial practice.

16.2 The diameter of the finished strand shall be uniform, except for a minor increase in diameter due to a wire joint or splice.

17. Inspection

17.1 The inspector representing the purchaser shall have free entry at all times to those parts of the plant concerned while work on the contract of the purchaser is being performed. The manufacturer shall afford the inspector all reasonable facilities to satisfy him that the material is being furnished in accordance with this specification. All tests and inspection shall be made prior to shipment at the place of manufacture of the strand, unless otherwise specified and agreed upon at the time of purchase, and shall be so conducted as not to interfere unnecessarily with the operation of the works. Such inspection and sampling shall be made in conjunction with and to the extent of the manufacturer's regular inspection operations. The purchaser may make the tests which govern the acceptance or rejection of the materials in his own laboratories or elsewhere.

18. Rejection

18.1 If the wire or strand fails in the first test to meet any requirement of this specification, two additional tests shall be made on samples of wire or strand from the same coil or reel. If failure occurs in either of these tests the lot of wire or strand shall be rejected.

19. Packaging, Marking, and Shipping

19.1 Strand shall be furnished in standard lengths in compact coils described in Table 2, unless otherwise agreed upon at the time of purchase. Reels shall be furnished only when so specified by the purchaser.

19.2 Only one length of strand shall be furnished in each coil or on each reel.

19.3 Each coil or reel shall have a weatherproof tag securely fastened to it showing the minimum breaking strength, number of wires and length of strand, ASTM designation, and the name or mark of the manufacturer. If additional information is required on the tag, it shall be so specified at the time of purchase.

19.4 The strand shall be protected against damage in ordinary handling and shipping. Coils shall be thoroughly wrapped with strong paper and properly tied. Reels shall be lagged when specified by the purchaser at the time of purchase.

19.5 The diameter of the coils and reels shall be that generally supplied by the manufacturer, unless otherwise agreed upon at the time of purchase.

20. Keywords

20.1 coatings—metallic; copper clad materials; steel wire—copper clad; steel wire strand