



Designation: A 82 – 02

American Association State Highway and Transportation Officials
Standard AASHTO No.: M 32

Standard Specification for Steel Wire, Plain, for Concrete Reinforcement¹

This standard is issued under the fixed designation A 82; 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 cold-drawn steel wire, as-drawn or galvanized, to be used as such, or in fabricated form, for the reinforcement of concrete, in sizes not less than 2.03 mm (0.080 in.) nominal diameter.

1.2 Supplement S1 describes high-strength wire, which shall be furnished when specifically ordered. It shall be permissible to furnish high-strength wire in place of regular wire if mutually agreed to by the purchaser and the supplier.

1.3 The values stated in either inch-pound units or SI units are to be regarded as standard. Within the text the inch-pound units are shown in parentheses. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values may result in nonconformance with the specification.

2. Referenced Documents

2.1 ASTM Standards:

A 185 Specification for Steel Welded Wire Reinforcement, Plain, for Concrete²

¹ This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel, and Related Alloys and is the direct responsibility of Subcommittee A01.05 on Steel Reinforcement.

Current edition approved Sept 10, 2002. Published June 2003. Originally approved in 1921. Last previous edition A 82 – 01.

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

- A 370 Test Methods and Definitions for Mechanical Testing of Steel Products³
- A 641 Specification for Zinc-Coated (Galvanized) Carbon Steel Wire⁴
- A 700 Practices for Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment⁵
- E 83 Practice for Verification and Classification of Extensometers⁶

2.2 *U.S. Military Standards:*

- MIL-STD-129 Marking for Shipment and Storage⁷
- MIL-STD-163 Steel Mill Products Preparation for Shipment and Storage⁷

2.3 *U.S. Federal Standard:*

- Fed. Std. No. 123 Marking for Shipments (Civil Agencies)⁷

2.4 *Other Standard:*

- ACI 318 Building Code Requirements for Structural Concrete⁸

3. Ordering Information

3.1 Orders for material to this specification should include the following information:

- 3.1.1 Quantity (weight),
- 3.1.2 Name of material (cold-drawn steel wire for concrete reinforcement),
- 3.1.3 Wire size number (see Section 8),
- 3.1.4 Packaging (see Section 15), and
- 3.1.5 ASTM designation and year of issue.
- 3.1.6 Special requirements, if any. (See Supplement S1.)

NOTE 1—A typical ordering description is as follows: 100 000 lb cold-drawn steel wire for concrete reinforcement, Size No. W5 in 500 lb secured coils, to ASTM – _____.

4. Materials and Manufacture

- 4.1 The steel shall be made by one of the following processes: open-hearth, electric furnace, or basic-oxygen.
- 4.2 The wire shall be cold drawn from rods that have been hot rolled from billets.
- 4.3 Unless otherwise specified, the wire shall be supplied uncoated. When specified as galvanized, it shall be galvanized at finish size.

5. Mechanical Property Requirements

5.1 *Tension Tests:*

5.1.1 When tested as described in Test Methods and Definitions A 370, the material, except as specified in 5.1.2, shall conform to the tensile property requirements in Table 1 based on nominal area of wire.

5.1.2 The yield strength shall be determined as described in Test Methods and Definitions A 370 at an extension of 0.5 % of gage length. The manufacturer is not required to test for yield strength, but is responsible for supplying a product that will meet the stipulated limit when tested in conformance with the provisions of 11.3. For determining the yield strength, use a Class B-1 extensometer as described in Practice E 83. The extensometer should be removed from the specimen after the yield strength has been determined.

5.1.3 For material to be used in the fabrication of welded wire reinforcement, the tensile and yield strength properties shall conform to the requirements given in Table 2, based on nominal area of the wire.

5.1.4 The material shall not exhibit a definite yield point as evidenced by a distinct drop of the beam or halt in the gage of the testing machine prior to reaching ultimate tensile load. The purchaser may opt to accept this feature as sufficient evidence of compliance with the specified minimum yield strength tests covered in 11.3.

5.2 *Bend Test*—The bend test specimen shall stand being bent at room temperature through 180° without cracking on the outside of the bent portion, as prescribed in Table 3.

² Annual Book of ASTM Standards, Vol 01.04.

³ Annual Book of ASTM Standards, Vol 01.03.

⁴ Annual Book of ASTM Standards, Vol 01.06.

⁵ Annual Book of ASTM Standards, Vol 01.05.

⁶ Annual Book of ASTM Standards, Vol 03.01.

⁷ Available from Standardization Documents Order Desk, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094.

⁸ Available from American Concrete Institute, P. O. Box 9094, Farmington Hills, MI 48333-9094.

TABLE 1 Tension Test Requirements

Tensile strength, min, ksi (MPa)	80 (550)
Yield strength, min, ksi (MPa)	70 (485)
Reduction of area, min, %	30 ^A

^AFor material testing over 100 ksi (690 MPa) tensile strength, the reduction of area shall be not less than 25 %.

TABLE 2 Tension Test Requirements (Material for Welded Wire Reinforcement)

	Size W1.2 and Larger	Smaller than Size W1.2
Tensile strength, min, ksi (MPa)	75 (515)	70 (485)
Yield strength, min, ksi (MPa)	65 (450)	56 (385)
Reduction of area, min, %	30 ^A	30 ^A

^AFor material testing over 100 ksi (690 MPa) tensile strength, the reduction of area shall be not less than 25 %.

TABLE 3 Bend Test Requirements

Size Number of Wire	Bend Test
W7 and smaller	Bend around a pin the diameter that is equal to the diameter of the specimen
Coarser than W7	Bend around a pin the diameter that is equal to twice the diameter of the specimen

5.3 *Reduction of Area Test*—The reduction of area shall be determined as described in Test Methods and Definitions A 370, and the wire shall conform to the reduction of area requirements in Table 1 and Table 2.

6. Permissible Variation in Wire Diameter

6.1 The permissible variation in the diameter of the wire shall conform to the requirements given in Table 4.

6.2 The difference between the maximum and minimum diameters, as measured on any given cross section of the wire, shall be no more than the tolerances listed in Table 4 for the given wire size.

7. Workmanship, Finish, and Appearance

7.1 The wire shall be free of detrimental imperfections and shall have a workmanlike finish.

7.2 Galvanized wire shall be produced as described in Specification A 641, regular coating.

7.3 Rust, surface seams, or surface irregularities shall not be a cause for rejection provided the requirements of 7.4 are met, and the minimum dimensions and mechanical properties of a hand wire-brushed test specimen are not less than the requirements of this specification.

7.4 Wire intended for welded wire reinforcement shall be sufficiently free of rust and drawing lubricant so as not to interfere with electric resistance welding.

8. General Requirements

8.1 When wire for concrete reinforcement is ordered by size number, the relation between size number, diameter, and area shown in Table 5 and Table 6 shall apply.

9. Sampling

9.1 Test specimens for testing mechanical properties shall be full wire sections and shall be obtained from ends of wire coils as drawn or as galvanized. The specimens shall be of sufficient length to perform testing described in 5.1 and 5.2.

9.2 If any test specimen exhibits obvious isolated imperfections not representative of the product, it may be discarded and another specimen substituted.

10. Number of Tests

10.1 One tension and one bend test shall be made from each 9070 kg (10 tons) or less of each size of wire or fraction thereof in a lot, or a total of seven samples, whichever is less. A lot shall consist of all the coils of a single size offered for delivery at the same time.

TABLE 4 Permissible Variation in Wire Diameter

Size Number	Nominal Diameter, in. (mm)	Permissible Variation Plus and Minus, in. (mm)
Smaller than W5	under 0.252 (6.40)	0.003 (0.08)
W5 to W12, incl	0.252 (6.40) to 0.391 (9.93), incl	0.004 (0.10)
Over to W20, incl	over 0.391 (9.93) to 0.505 (12.83), incl	0.006 (0.15)
Over W20	over 0.505 (12.83)	0.008 (0.20)

**TABLE 5 Dimensional Requirements for Plain Wire—SI Units,
Wire Sizes**

Size Number ^A	Nominal Diameter mm (in.)	Nominal Area mm ² (in. ²)
MW 5	2.50 (0.100)	5 (0.008)
MW 10	3.60 (0.142)	10 (0.016)
MW 15	4.40 (0.173)	15 (0.024)
MW 20	5.00 (0.197)	20 (0.030)
MW 25	5.60 (0.220)	25 (0.039)
MW 30	6.20 (0.244)	30 (0.046)
MW 35	6.70 (0.264)	35 (0.054)
MW 40	7.10 (0.280)	40 (0.062)
MW 45	7.60 (0.299)	45 (0.070)
MW 50	8.00 (0.315)	50 (0.077)
MW 55	8.40 (0.331)	55 (0.085)
MW 60	8.70 (0.343)	60 (0.093)
MW 65	9.10 (0.358)	65 (0.101)
MW 70	9.40 (0.370)	70 (0.108)
MW 80	10.1 (0.397)	80 (0.124)
MW 90	10.70 (0.421)	90 (0.139)
MW 100	11.30 (0.445)	100 (0.155)
MW 120	12.40 (0.488)	120 (0.186)
MW 130	12.90 (0.508)	130 (0.201)
MW 200	15.95 (0.628)	200 (0.310)
MW 290	19.22 (0.757)	290 (0.450)

^AThis table represents a hard metrication of the most readily available sizes in the welded wire reinforcement industry. Table 5 should be used in projects that are designed using SI units; Table 6 should be used on projects designed using inch-pound units. Areas of wire should be checked with the most efficient and readily available material from producers. Other wire sizes are available and many manufacturers can produce them in 1-mm²(0.0015-in.²) increments.

**TABLE 6 Dimensional Requirements for Plain Wire—Inch-pound
Units, Wire Sizes**

Size Number ^A	Nominal Diameter in. (mm)	Nominal Area in. ² (mm ²)
W 0.5	0.080 (2.03)	0.005 (3.23)
W 1.2	0.124 (3.15)	0.012 (7.74)
W 1.4	0.134 (3.40)	0.014 (9.08)
W 2	0.160 (4.06)	0.020 (12.90)
W 2.5	0.178 (4.52)	0.025 (16.13)
W 2.9	0.192 (4.88)	0.029 (18.70)
W 3.5	0.211 (5.36)	0.035 (22.58)
W 4	0.226 (5.74)	0.040 (25.81)
W 4.5	0.239 (6.07)	0.045 (29.03)
W 5	0.252 (6.40)	0.050 (32.26)
W 5.5	0.265 (6.73)	0.055 (35.48)
W 6	0.276 (7.01)	0.060 (38.71)
W 8	0.319 (8.10)	0.080 (51.61)
W 10	0.357 (9.07)	0.100 (64.52)
W 12	0.391 (9.93)	0.120 (77.42)
W 14	0.422 (10.72)	0.140 (90.32)
W 16	0.451 (11.46)	0.160 (103.25)
W 18	0.479 (12.17)	0.180 (116.13)
W 20	0.505 (12.83)	0.200 (129.03)
W 22	0.529 (13.44)	0.220 (141.90)
W 24	0.533 (14.05)	0.240 (154.80)
W 26	0.575 (14.61)	0.260 (167.70)
W 28	0.597 (15.16)	0.280 (180.60)
W 30	0.618 (15.70)	0.300 (193.50)
W 31	0.628 (15.95)	0.310 (200.00)
W 45	0.757 (19.23)	0.450 (290.32)

^AThis table represents the most readily available sizes in the welded wire reinforcement industry in sizes using inch-pound units. Areas of wire should be checked with the most efficient and readily available material from producers. Other wire sizes are available and many manufacturers can produce them in 0.0015-in.² increments.

11. Inspection

11.1 The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works that concern the manufacture of the material ordered. The manufacturer shall afford the inspector all reasonable facilities to assure that the material is being furnished in accordance with this specification.

11.2 Except for yield strength, all tests and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified. Such tests shall be so conducted as not to interfere unnecessarily with the operation of the works.

11.3 If the purchaser considers it desirable to determine compliance with the yield strength requirements in 5.1, yield strength tests may be made in a recognized laboratory, or their representative may make the test at the mill if such tests do not interfere unnecessarily with the mill operations.

11.4 *For U. S. Government Procurement Only*—Except as otherwise specified in the contract, the contractor is responsible for the performance of all inspection and test requirements specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless disapproved by the purchaser at the time of purchase. The purchaser shall have the right to perform any of the inspections and tests at the same frequency as set forth in this specification where such inspections are deemed necessary to ensure that material conforms to prescribed requirements.

12. Rejection

12.1 Material that shows detrimental imperfections subsequent to its acceptance at the manufacturer's works will be rejected, and the manufacturer shall be notified.

12.2 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 resubmitted for inspection by testing every coil for the property in which the specimen failed and sorting out nonconforming coils.

12.3 Any rejection based on tests made in accordance with the specification shall be reported to the manufacturer within a reasonable period of time. The material must be adequately protected and correctly identified in order that the producer may make a proper investigation.

13. Rehearing

13.1 Rejected materials shall be preserved for a period of at least two weeks from the date of inspection, during which time the manufacturer may make claim for a rehearing and retesting.

14. Certification

14.1 When specified in the purchase order or contract, a producer's or supplier's certification shall be furnished to the purchaser 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. The certification shall include the specification number, year-date of issue, and revision letter, if any.

15. Packaging and Marking

15.1 The size of the wire, ASTM specification, and name or mark of the manufacturer shall be marked on a tag securely attached to each coil of wire.

15.2 Unless otherwise specified, packaging, marking, and loading for shipment shall be in accordance with Practices A 700.

15.3 When specified in the contract or order, and for direct procurement by or direct shipment to the U.S. government, when Level A is specified, preservation, packaging, and packing shall be in accordance with the Level A requirement of MIL-STD-163.

15.4 When specified in the contract or order, and for the direct procurement by or direct shipment to the U.S. government, marking for shipment, in addition to requirements specified in the contract or order, shall be in accordance with MIL-STD-129 for military agencies and in accordance with Fed. Std. No. 123 for civil agencies.

15.5 A material test report, certificate of inspection, or similar document printed from or used in electronic form from an electronic data interchange (EDI) transmission shall be regarded as having the same validity as a counterpart printed in the certifier's facility. The content of the EDI transmitted document must meet the requirements of the invoked ASTM standard(s) and conform to any existing EDI agreement between the purchaser and the supplier. Notwithstanding the absence of a signature, the organization submitting the EDI transmission is responsible for the content of the report.

NOTE 2—The industry definition as invoked here is: EDI is the computer-to-computer exchange of business information in a standard format such as ANSI ASC X12.

16. Keywords

16.1 concrete reinforcement; reinforced concrete; reinforcing steels; steel wire

SUPPLEMENTARY REQUIREMENTS**S1. High-Strength Wire****S1.1 Scope:**

S1.1.1 This supplement delineates only those details that are relative to high-strength wire and to the mechanical requirements for wire having properties generally as described in this specification.

NOTE S1—Building codes, for example, ACI 318, permit the use of reinforcement with a yield strength up to 550 MPa (80 000 psi). For compatibility with the codes' design provisions for high-strength reinforcement, this supplement prescribes requirements for the mechanical properties of wire that exceed the minimum values for yield strength and tensile strength in Table 1 and Table 2 of this specification.

S1.2 Mechanical Property Requirements:

S1.2.1 Minimum yield strength shall be specified in the purchase order in increments of 17.5 MPa (2500 psi). When tested, the yield strength shall be determined at an extension under load of 0.0035 mm/mm (0.0035 in./in.).

NOTE S2—To conform to the limit on yield strength in building codes, the minimum yield strength specified in the purchase order should not be greater than 550 MPa (80 000 psi).

S1.2.2 Minimum tensile strength shall be 70 MPa (10 000 psi) greater than the specified minimum yield strength.

NOTE S3—A typical order entry line for minimum yield strength is: “72 500 psi minimum yield strength” or “500 MPa minimum yield strength.”

S1.2.3 The minimum reduction of area shall be 30 %. For material testing over 690 MPa (100 000 psi) tensile strength, the reduction of area shall not be less than 25 %.

S1.3 Certification:

S1.3.1 Certification for material produced to this supplement shall include a report of the test results for yield strength, tensile strength, reduction of area, and bend tests. Frequency of testing shall conform to Section 10 of this specification or Section 12 of Specification A 185 as applicable.

SUMMARY OF CHANGES

Committee A01 has identified the location of the following changes to this standard since A 82/A 82M-01 that may impact the use of this standard.

(1) Added Section 15.5 and Note 2.

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