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

Standard Specification for Steel Wire, Plain, for Concrete Reinforcement[1]

This standard is issued under the fixed designation A 82/A 82M; 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 manufacturer.

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. (The inch-pound units are shown in brackets except in Table 6.)

2. Referenced Documents

2.1 *ASTM Standards:* [2]

A 185/A 185M Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products

A 641/A 641M Specification for Zinc–Coated (Galvanized) Carbon Steel Wire

A 700 Practices for Packaging, Marking, and Loading Methods for Steel Products for Shipment

E 83 Practice for Verification and Classification of Extensometer Systems

2.2 *U.S. Military Standards:*[3]

MIL-STD-129 Marking for Shipment and Storage

2.3 *U.S. Federal Standard:*[3]

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

2.4 *ACI Standard:*[4]

ACI 318 Building Code Requirements for Structural Concrete

3. Ordering Information

3.1 It shall be the responsibility of the purchaser to specify all requirements that are necessary for the manufacture and delivery of the wire under this specification. Such requirements to be considered include, but are not limited to, the following:

3.1.1 Quantity (mass [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 Yield strength measurement (see 5.1, 11.3),

3.1.5 Packaging (see Section 15),

3.1.6 ASTM designation and year of issue, and

3.1.7 Special requirements, if any. (See Supplement S1.)

NOTE 1—A typical ordering description is as follows: 50 000 kg [100 000 lb] cold-drawn steel wire for concrete reinforcement, Size No. W5 in 800 kg [2000 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 When required by the purchaser, yield strength shall be determined as described using a Class B-1 extensometer as

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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] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://www.dodssp.daps.mil.

[4] Available from American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333-9094, http://www.aci-int.org.

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

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TABLE 1 Tension Test Requirements

Tensile strength, min, MPa [ksi]	550 [80]
Yield strength, min, MPa [ksi]	485 [70]
Reduction of area, min, %	30[A]

[A] For material testing over 690 MPa [100 ksi] tensile strength, the reduction of area shall be not less than 25 %.

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

	Size MW7.7 [W1.2] and Larger	Smaller than Size MW7.7 [W1.2]
Tensile strength, min, MPa [ksi]	515 [75]	485 [70]
Yield strength, min, MPa [ksi]	450 [65]	385 [56]
Reduction of area, min, %	30[A]	30[A]

[A] For material testing over 690 MPa [100 ksi] tensile strength, the reduction of area shall be not less than 25 %.

TABLE 3 Bend Test Requirements

Size Number of Wire	Bend Test
MW45 [W7] and smaller	Bend around a pin the diameter that is equal to the diameter of the specimen
Larger than MW 45 [W7]	Bend around a pin the diameter that is equal to twice the diameter of the specimen

TABLE 4 Permissible Variation in Wire Diameter

Size Number	Nominal Diameter, mm [in.]	Permissible Variation Plus and Minus, mm [in.]
Smaller than MW32 [W5]	under 6.40 [0.252]	0.08 [0.003]
MW32 [W5] to MW77 [W12], incl	6.40 [0.252] to 9.93 [0.391], incl	0.10 [0.004]
Over MW77 [W12] to MW129 [W20], incl	over 9.93 [0.391] to 12.83 [0.505], incl	0.15 [0.006]
Over MW129 [W20]	over 12.83 [0.505]	0.20 [0.008]

described in Practice E 83. The yield strength shall be determined as described in Test Methods and Definitions A 370 at an extension under load of 0.5 % of gage length. It shall be permissible to remove the extensometer after the yield strength has been determined. The wire shall meet the requirements of Table 1 or Table 2, whichever is applicable.

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.

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

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 wire diameter shall conform to the requirements in Table 4.

6.2 The difference between the maximum and minimum diameters, as measured on any given cross section of the wire, shall not exceed 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/A 641M, 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 Any test specimen exhibiting obvious isolated imperfections that are not representative of the product shall be discarded and another specimen substituted.

10. Number of Tests

10.1 One tension and one bend test shall be made from each 9000 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.

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 facilities 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 manufacturer's facilities prior to shipment, unless otherwise specified. Such tests shall be so conducted as not to interfere unnecessarily with the operation of the manufacturer's facilities.

11.3 The purchaser shall have the option to require a yield strength measurement to determine compliance with yield strength requirements in 5.1, and shall specify that the measurement be performed by the manufacturer at the manufacturer's facilities, a recognized laboratory, or the purchaser's

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

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

Size Number	Nominal Diameter, mm [in.]	Nominal Area, mm^2 [in.^{2}]
MW 5	2.52 [0.099]	5 [0.008]
MW 10	3.57 [0.140]	10 [0.016]
MW 15	4.37 [0.172]	15 [0.023]
MW 20	5.05 [0.199]	20 [0.031]
MW 25	5.64 [0.222]	25 [0.039]
MW 30	6.18 [0.243]	30 [0.047]
MW 35	6.68 [0.263]	35 [0.054]
MW 40	7.14 [0.281]	40 [0.062]
MW 45	7.57 [0.298]	45 [0.070]
MW 50	7.98 [0.314]	50 [0.078]
MW 55	8.37 [0.329]	55 [0.085]
MW 60	8.74 [0.344]	60 [0.093]
MW 65	9.10 [0.358]	65 [0.101]
MW 70	9.44 [0.372]	70 [0.109]
MW 80	10.1 [0.397]	80 [0.124]
MW 90	10.7 [0.421]	90 [0.140]
MW 100	11.3 [0.444]	100 [0.155]
MW 120	12.4 [0.487]	120 [0.186]
MW 130	12.9 [0.507]	130 [0.202]
MW 200	16.0 [0.628]	200 [0.310]
MW 290	19.2 [0.757]	290 [0.450]

TABLE 6 Dimensional Requirements for Plain Wire—Inch-pound Units, Wire Sizes[A]

Size Number	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 [3.14]	0.012 [7.74]
W 1.4	0.134 [3.39]	0.014 [9.03]
W 2	0.160 [4.05]	0.020 [12.9]
W 2.5	0.178 [4.53]	0.025 [16.1]
W 2.9	0.192 [4.88]	0.029 [18.7]
W 3.5	0.211 [5.36]	0.035 [22.6]
W 4	0.226 [5.73]	0.040 [25.8]
W 4.5	0.239 [6.08]	0.045 [29.0]
W 5	0.252 [6.41]	0.050 [32.3]
W 5.5	0.265 [6.72]	0.055 [35.5]
W 6	0.276 [7.02]	0.060 [38.7]
W 8	0.319 [8.11]	0.080 [51.6]
W 10	0.357 [9.06]	0.100 [64.5]
W 11	0.374 [9.50]	0.110 [71.0]
W 12	0.391 [9.93]	0.120 [77.4]
W 14	0.422 [10.7]	0.140 [90.3]
W 16	0.451 [11.5]	0.160 [103]
W 18	0.479 [12.2]	0.180 [116]
W 20	0.505 [12.8]	0.200 [129]
W 22	0.529 [13.4]	0.220 [142]
W 24	0.553 [14.0]	0.240 [155]
W 26	0.575 [14.6]	0.260 [168]
W 28	0.597 [15.2]	0.280 [181]
W 30	0.618 [15.7]	0.300 [194]
W 31	0.628 [16.0]	0.310 [200]
W 45	0.757 [19.2]	0.450 [290]

[A] In this table only, inch-pound units are regarded as standard and SI units are shown in brackets.

representative at the manufacturer's facilities. Such measurements shall be conducted without unnecessarily interfering with manufacturing 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 shall have the option to 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 facilities shall 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.

12.3 Any rejection based on tests made in accordance with the specification shall be reported to the manufacturer within two weeks of the date of inspection or test. The material shall be adequately protected and correctly identified such that the manufacturer is able to make a proper investigation.

13. Rehearing

13.1 Rejected materials shall be preserved for a period of not less than two weeks from the date of inspection, during which time the manufacturer shall have the option to make claim for a rehearing and retesting.

13.2 The manufacturer shall have the option to resubmit the rejected lot for re-inspection or retesting by inspecting or testing every coil for the property in which the test specimen failed and sorting out non-conforming coils.

14. Certification

14.1 When specified in the purchase order or contract, the purchaser shall be furnished with the manufacturer's written certification that the material was manufactured, sampled, tested, and inspected in accordance with, and meets the requirements of, this specification. 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.

14.2 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 shall meet the requirements of the invoked ASTM standard(s) and conform to any existing EDI agreement between the purchaser and the manufacturer. 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.

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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 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.

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 2 and Table 3 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*—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/A 185M, as applicable.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A 82/A 82M–05a) that may impact the use of this standard.

(*1*) Removed references to MIL-STD-163.

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