



Designation: A910/A910M – 16

Standard Specification for Uncoated, Weldless, 2-Wire and 3-Wire Steel Strand for Prestressed Concrete¹

This standard is issued under the fixed designation A910/A910M; 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 two types and two grades of 2-wire and 3-wire, uncoated steel strand for use in prestressed concrete construction. The two types of strand are low-relaxation and stress-relieved (normal-relaxation). Low-relaxation is to be regarded as the standard type. Stress-relieved (normal-relaxation) strand will not be furnished unless specifically ordered. The two grades are 250 [1725] and 270 [1860]. Grades 250 [1725] and 270 [1860] have minimum tensile strengths of 250 ksi [1725 MPa] and 270 ksi [1860 MPa] respectively, based on the nominal area of the strand.

1.2 This specification is applicable for orders in either inch-pound units (as Specification A910) or in SI units (as Specification A910M).

1.3 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not 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 specification.

2. Referenced Documents

2.1 ASTM Standard:²

A1061/A1061M Test Methods for Testing Multi-Wire Steel Prestressing Strand

2.2 U.S. Military Standard:³

MIL-STD-129 Marking for Shipment and Storage

2.3 Federal Standard:³

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

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.

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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 U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, <http://www.access.gpo.gov>.

3. Terminology

3.1 Definition of Term Specific to This Specification:

3.1.1 *strand, n*—Either two or three wires helically wound around each other with uniform pitch not less than 12 and not more than 16 times the nominal diameter of the strand.

3.1.1.1 *Discussion*—The direction of lay is either right-handed or left-handed.

4. Ordering Information

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

4.1.1 Quantity (feet [metres]),

4.1.2 Nominal diameter and description of strand (Table 1),

4.1.3 Number of wires (2 or 3),

4.1.4 Grade,

4.1.5 Type of strand (low-relaxation or stress-relieved (normal relaxation)),

4.1.6 Inspection (11.1),

4.1.7 Load-elongation curve (13.2),

4.1.8 Packaging (14.1), and

4.1.9 ASTM designation and year of issue.

5. Materials and Manufacture

5.1 *Base Metal*—The base metal shall be carbon steel of such quality that when drawn to wire, fabricated into strand and then thermally treated, it shall have the properties and characteristics prescribed in this specification.

5.2 *Wire*—The wire from which the strand is to be fabricated shall be round and have a dry-drawn finish.

NOTE 1—This product is a composite of two or three wires and is produced only to meet the prescribed mechanical properties, of which the chemical composition of all wires or any individual wire is not pertinent to this application, and heat identity is not necessarily maintained. It is possible that wire from more than one heat may be used in the manufacture of a reel or reelless pack. Traceability is based on the identity of reels or reelless packs as maintained and reported by the manufacturer.

5.3 *Treatment*—After stranding, low-relaxation strand shall be subjected to a continuous thermo-mechanical treatment to produce the prescribed mechanical properties. For stress-relieved (normal-relaxation) strand, only thermal treatment is

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

TABLE 1 Breaking Strength Requirements

Description and Nominal Diameter of Strand				Breaking Strength of Strand		Steel Area of Strand		Weight [Mass] of Strand	
in.		[mm]							
Description	Nominal Diameter	Description	Nominal Diameter	lbf	[kN]	in. ²	[mm ²]	lbs/1000 ft	[kg/1000 m]
GRADE 250 [1725 MPa]									
2 × 0.114	0.228	[2 × 2.90]	[5.8]	5000	[22.2]	0.020	[13.2]	69.9	[104.0]
3 × 0.089	0.189	[3 × 2.25]	[4.8]	4750	[21.1]	0.019	[12.0]	63.3	[94.2]
3 × 0.095	0.205	[3 × 2.40]	[5.2]	5250	[23.4]	0.021	[13.6]	71.9	[107.0]
3 × 0.114	0.244	[3 × 2.90]	[6.2]	7750	[34.5]	0.031	[19.8]	104.0	[155.0]
3 × 0.118	0.256	[3 × 3.00]	[6.5]	8250	[36.7]	0.033	[21.3]	112.0	[167.0]
3 × 0.138	0.295	[3 × 3.50]	[7.5]	11 250	[50.0]	0.045	[29.0]	153.0	[228.0]
3 × 0.158	0.340	[3 × 4.00]	[8.6]	14 500	[64.5]	0.058	[37.4]	200.6	[298.4]
GRADE 270 [1860 MPa]									
2 × 0.114	0.228	[2 × 2.90]	[5.8]	5400	[24.0]	0.020	[13.2]	69.9	[104.0]
3 × 0.089	0.189	[3 × 2.25]	[4.8]	5130	[22.8]	0.019	[12.0]	63.3	[94.2]
3 × 0.095	0.205	[3 × 2.40]	[5.2]	5670	[25.2]	0.021	[13.6]	71.9	[107.0]
3 × 0.114	0.244	[3 × 2.90]	[6.2]	8370	[37.2]	0.031	[19.8]	104.0	[155.0]
3 × 0.118	0.256	[3 × 3.00]	[6.5]	8910	[39.6]	0.033	[21.3]	112.0	[167.0]
3 × 0.138	0.295	[3 × 3.50]	[7.5]	12 150	[54.0]	0.045	[29.0]	153.0	[228.0]
3 × 0.158	0.340	[3 × 4.00]	[8.6]	15 660	[69.7]	0.058	[37.4]	200.6	[298.4]

necessary. Temper colors that result from the stress-relieving operation are considered normal for the finished appearance of this strand.

6. Mechanical Property Requirements

6.1 Tests for mechanical properties shall be conducted in accordance with Test Methods **A1061/A1061M**. Low-relaxation strand shall also be tested as prescribed in Test Methods **A1061/A1061M**.

6.2 *Breaking Strength*—The breaking strength of the finished strand shall conform to the requirements prescribed in **Table 1**.

6.3 *Yield Strength*—Yield strength in lbs [kN] shall be measured at 1 % extension under load in accordance with the test procedure delineated in Test Methods **A1061/A1061M**, Section 9.1. The minimum yield strength shall be 90 % for low-relaxation strand and 85 % for stress-relieved (normal-

relaxation) strand of the breaking strength listed in **Table 1**. Initial loads for the test and minimum yield strengths are listed in **Table 2**.

6.3.1 The extension under load shall be measured by an extensometer calibrated with the smallest division not larger than 0.0001 in./in. [0.0001 mm/mm] of gage length.

6.4 *Elongation*—The total elongation under load shall be determined in accordance with Test Methods **A1061/A1061M**, Section 9.2. The total elongation under load shall not be less than 3.5 % using a gage length of not less than 24 in. [600 mm]. It shall be permissible to determine the total elongation value by adding to the 1.0 % yield extension the percent extension or movement between the jaws gripping the strand after yield determination. The percent is calculated on the new base length of jaw-to-jaw distance.

6.5 *Relaxation Properties*—Low-relaxation strand shall have relaxation losses of not more than 2.5 % when initially

TABLE 2 Yield Strength Requirements

Description and Nominal Diameter of Strand				Minimum Load at 1 % Extension					
in.		[mm]		Initial Load		Stress-Relieved (Normal-Relaxation)		Low-Relaxation	
Description	Nominal Diameter	Description	Nominal Diameter	lbf	[kN]	lbf	[kN]	lbf	[kN]
GRADE 250 [1725 MPa]									
2 × 0.114	0.228	[2 × 2.90]	[5.8]	500	[2.2]	4250	[18.9]	4500	[20.0]
3 × 0.089	0.189	[3 × 2.25]	[4.8]	475	[2.1]	4038	[18.0]	4275	[19.0]
3 × 0.095	0.205	[3 × 2.40]	[5.2]	525	[2.3]	4463	[20.0]	4725	[21.0]
3 × 0.114	0.244	[3 × 2.90]	[6.2]	775	[3.5]	6588	[29.3]	6975	[31.0]
3 × 0.118	0.256	[3 × 3.00]	[6.5]	825	[3.7]	7013	[32.2]	7425	[33.0]
3 × 0.138	0.295	[3 × 3.50]	[7.5]	1250	[5.0]	9563	[42.5]	10 125	[45.0]
3 × 0.158	0.340	[3 × 4.00]	[8.5]	1450	[6.5]	12 325	[54.8]	13 050	[58.7]
GRADE 270 [1860 MPa]									
2 × 0.114	0.228	[2 × 2.90]	[5.8]	540	[2.4]	4590	[20.4]	4860	[21.6]
3 × 0.089	0.189	[3 × 2.25]	[4.8]	513	[2.3]	4360	[19.4]	4617	[20.5]
3 × 0.095	0.205	[3 × 2.40]	[5.2]	567	[2.5]	4820	[21.4]	5103	[22.7]
3 × 0.114	0.244	[3 × 2.90]	[6.2]	837	[3.7]	7115	[31.6]	7533	[33.5]
3 × 0.118	0.256	[3 × 3.00]	[6.5]	891	[4.0]	7574	[33.7]	8019	[36.0]
3 × 0.138	0.295	[3 × 3.50]	[7.5]	125	[5.4]	10 328	[45.9]	10 125	[45.0]
3 × 0.158	0.340	[3 × 4.00]	[8.6]	566	[7.0]	13 311	[59.2]	14 094	[62.7]

loaded to 70 % of specified minimum breaking strength or not more than 3.5 % when loaded to 80 % of specified minimum breaking strength of the strand after 1000 h tested in accordance with the specific procedures in Test Methods **A1061/A1061M**, Section 9.4.

6.5.1 If required, relaxation evidence shall be provided from the manufacturer's records of tests on similarly dimensioned strand of the same grade.

7. Dimensions and Permissible Variations

7.1 The size of the finished strand shall be expressed as the nominal diameter of the strand in in. [mm].

7.2 Variations in individual wire diameters shall not be cause for rejection provided that the other requirements of this specification are met.

7.3 Specially-Dimensioned Strand:

7.3.1 It shall be permitted to furnish, under this specification, strands with nominal diameters that are different than those listed in **Table 1** and **Table 2**. The breaking strength shall be defined, and the yield strength, as defined in **6.3**, shall not be less than 90 % and 85 % of the specified minimum breaking strength for low-relaxation and stress-relieved (normal-relaxation) strand, respectively. All other requirements shall apply.

7.4 Permissible Variations in Diameter:

7.4.1 All Grade 250 [1725] strand shall conform to a size tolerance of ± 0.016 in. [± 0.41 mm] from the diameter measured across the crowns of the wires (2-wire strand only). For 3-wire strand, the diameter is that diameter of a circle which can be tangentially circumscribed around the 3 wires. This can be confirmed by comparing the individual wire diameters in the strand to those listed in **Table 1** and **Table 2**.

7.4.2 All Grade 270 [1860] strand shall conform to a size tolerance of $+0.026$ in., -0.006 in. [$+0.66$ mm, -0.15 mm] from the nominal diameter measured across the crowns of the wires (2-wire strand only). For 3-wire strand, the nominal diameter is that diameter of a circle which can be tangentially circumscribed around the 3 wires. This can be confirmed by comparing the individual wire diameters in the strand to those listed in **Table 1** and **Table 2**.

8. Workmanship, Finish and Appearance

8.1 Joints:

8.1.1 There shall be no strand splices in any length of the completed strand.

8.1.2 There shall be no wire welds made in the finished strands. During manufacturing of individual wires for stranding, welding is permitted only prior to or at the size of the last thermal treatment (for example, patenting or control cooling). There shall be no welds in the wire after it has been drawn through the first die in wire drawing.

8.2 When the strand is cut without seizings, the wire shall not fly out of position. If any wire flies out of position and can be replaced by hand, the strand will be considered satisfactory.

8.3 The strand shall not be oiled or greased. Slight rusting, provided it is not sufficient to cause pits visible to a person with normal or corrected vision, shall not be cause for rejection.

9. Sampling

9.1 Test specimens cut from either end of the reel or reelless pack are permitted.

10. Number of Tests

10.1 One test specimen shall be taken from each 30-ton [27-tonne] production lot of finished strand, and tested for breaking strength, yield strength, and elongation.

11. Inspection

11.1 If outside inspection is required, the manufacturer shall afford the inspector representing the purchaser all reasonable facilities to satisfy that the material is being furnished in accordance with this specification. All tests and inspections shall be made at the place of manufacture prior to shipment, unless otherwise agreed upon at the time of purchase, and shall be so conducted as not to interfere unnecessarily with the manufacturer's operations.

12. Rejection and Retesting

12.1 Failure of any test specimen to comply with the requirements of the specification shall constitute grounds for rejection of the lot represented by the specimen.

12.2 The lot shall be resubmitted for inspection by testing a specimen from each reel or reelless pack and sorting out non-conforming material.

12.3 In case there is a reasonable doubt in the initial testing as to the ability of the strand to meet any requirement of this specification, two additional tests shall be made on a specimen of strand from the same reel or reelless pack, and if failure occurs in either of these tests, the strand shall be rejected.

13. Certification

13.1 If outside inspection is not required, a manufacturer's certification that the material has been tested in accordance with and meets the requirements of this specification shall be the basis of acceptance of the material. The certification shall include Specification A910/A910M, year-date of issue, and revision letter, if any.

13.2 The manufacturer shall, when requested in the purchase order or contract, furnish a representative load-elongation curve for each size and grade of strand shipped.

13.3 When the modulus of elasticity of a 2-wire or 3-wire strand is provided, the cross-sectional area used to calculate the modulus shall also be provided. The area provided in the certification shall be the area used to calculate the modulus of elasticity.

13.4 A material test report, certification or 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 for EDI, as invoked here, is: “The computer-to-computer exchange of business information in a standard format, such as ANSI ASC X12.”

14. Packaging and Package Marking

14.1 The strand shall be furnished on reels or in reelless packs having a minimum core diameter of 24 in. [600 mm], unless otherwise specified by the purchaser. Length of strand on reels or in reelless packs shall be as agreed upon at the time of purchase. The strand shall be well protected against mechanical injury in shipping as agreed upon at the time of purchase. Each reel or reelless pack shall have two durable tags securely fastened to it showing the length, size, type and grade, ASTM designation, and the name of the manufacturer. One tag

shall be positioned where it will not be inadvertently lost during transit, such as inside the core of a reelless pack. The other should be on the outside where it will be accessible for easy identification.

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

15. Keywords

15.1 2-wire strand (tendons); 3-wire strand (tendons); pre-stressed concrete; steel wire

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A910/A910M – 12) that may impact the use of this standard. (Approved Dec. 1, 2016.)

(1) Revised 3.1.1.1 and **10.1.**

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