Designation: A 886/A 886M – 05

Standard Specification for Steel Strand, Indented, Seven-Wire Stress-Relieved for Prestressed Concrete[1]

This standard is issued under the fixed designation A 886/A 886M; 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 seven-wire uncoated, indented, stress-relieved steel strand for use in pretensioned prestressed concrete construction. Grade 250I and Grade 270I have minimum ultimate strengths of 250 ksi [1725 MPa] and 270 ksi [1860 MPa], respectively, based on the nominal area of the strand.

1.2 Supplement I describes low-relaxation strand and relaxation testing for that product. Low-relaxation strand shall be furnished when specifically ordered and furnished in place of stress-relieved strand if mutually agreed to by the purchaser and supplier.

1.3 This specification is applicable for orders in either inch-pound units (as Specification A 886) or in SI units (as Specification A 886M).

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

2. Referenced Documents

2.1 *ASTM Standards:* [2]

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

E 328 Methods for Stress Relaxation Tests for Materials and Structures

2.2 *U.S. Military Standards:*

MIL-STD-129 Marking for Shipment and Storage[3]

MIL-STD-163 Steel Mill Products Preparation for Shipment and Storage[3]

2.3 *U.S. Federal Standards:*

Fed. Std. No. 123 Marking for Shipments (Civil Agencies)[3]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *strand*, *n*—all strand shall be of the seven-wire type having a center wire enclosed tightly by six helically placed outer wires with uniform pitch of not less than 12 and not more than 16 times the nominal diameter of the strand.

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 (meters [feet]),

4.1.2 Diameter of strand (millimeters [inches]),

4.1.3 Grade of strand,

4.1.4 Packaging,

4.1.5 ASTM designation and year of issue, and

4.1.6 Special requirements, if any.

NOTE 1—A typical ordering description is as follows: 25 600 m (84 000 ft) 12.70-mm (0.5-in.), Grade 1860I (2701) strand, in 3658-m (12 000-ft) spoolless packs to ASTM A 886/A 886M—_____.

5. Materials and Manufacture

5.1 *Base Metal*—The base metal shall be carbon steel of such quality that when it is drawn to wire, subjected to the indentation process, fabricated into strand, and then stress-relieved, 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 have a common dry-drawn finish.

NOTE 2—This product is a composite of seven wires and is produced to mechanical properties only, 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 pack. Traceability is based on pack identity as maintained and reported by the manufacturer.

[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 Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

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

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TABLE 1 Nominal Dimensions of Indentations

Fig.	Wire Diameter, *d*		Strand Diameter		Depth, *a*		Length, *L*		Pitch, *P*	
	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.
1 (*a*)	2.6 and below	[0.104 and below]	7.9	[0.312]	0.05 to 0.10	[0.002 to 0.004]	2.0	[0.079]	5.6	[0.220]
1 (*a*)	over 3.2	[over 0.125]	9.5	[0.375]	0.05 to 0.13	[0.002 to 0.005]	2.7	[0.108]	5.6	[0.220]
			11.1	[0.438]						
			12.7	[0.500]						
1 (*b*)	3.2 and below	[0.125 and below]	9.5	[0.375]	0.05 to 0.15	[0.002 to 0.006]	2.9	[0.115]	5.6	[0.220]

5.3 *Indentations*—The outer wires shall have indentations designed to reduce longitudinal movement of the strand within the concrete, and conform to the provisions in Section7. The surface of the outer wires shall be suitably deformed mechanically by rolling to produce a series of indentations. Indentations shall be in two or more lines spaced uniformly around the wire. Indentations in adjacent lines shall be staggered throughout the length of the wire. At least 90 % of the indentations in any 0.6 m (2 ft) length of strand shall meet the pitch and shape requirements of Table 1. The center wire need not be indented.

5.4 *Stress-Relieving*—After stranding, all strand shall be subjected to a stress-relieving continuous heat treatment to produce the prescribed mechanical properties. Temper colors which result from the stress-relieving operation are considered normal for the finished appearance of this strand.

6. Mechanical Property Requirements

6.1 Methods of testing for mechanical properties are described in Supplement VII of Methods and Definitions A 370.

6.2 *Breaking Strength*—The breaking strength of the finished strand shall conform to the requirements prescribed in Table 2.

6.3 *Yield Strength*—Yield strength in kN (lb) shall be measured at 1 % extension under load. The load at this extension shall be recorded as the yield strength and shall meet the requirements prescribed in Table 3.

6.3.1 The extension under load shall be measured by an extensometer calibrated with the smallest division not larger than 0.0001 mm/mm (0.001 in./in.) of gage length.

6.4 *Elongation*—The total elongation under load shall not be less than 3.5 % using a gage length of not less than 600 mm (24 in.). It shall be permissible to determine the total elongation value by adding to the 1 % 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.

7. Dimensions and Permissible Variations

7.1 The size of the finished strand shall be expressed as the diameter of the strand in decimals of an inch [millimetre]. All nominal dimensional requirements for wires and strands shall refer to the wire and strand before indenting.

7.2 The diameter of the center wire of any strand must be larger than the diameter of any outer wire in accordance with Table 4.

7.3 *Permissible Variations in Diameter*:

7.3.1 All Grade 250I strand shall conform to a size tolerance of ±0.40 mm (±0.016 in.) from the nominal diameter measured across the crowns of the wire.

TABLE 2 Breaking Strength Requirements

Diameter of Strand		Breaking Strength of Strand, kN [lbf]		Steel Area of Strand, mm²[in.²]		Mass [Weight] of Strand, kg/1000 m [lb/1000 ft]	
mm	in.						
Grade 1725I [250I]							
6.4	[0.250]	40.0	[9 000]	23.2	[0.036]	182	[122]
7.9	[0.313]	64.5	[14 500]	37.4	[0.058]	294	[197]
9.5	[0.375]	89.0	[20 000]	51.6	[0.080]	405	[272]
11.1	[0.438]	120.1	[27 000]	69.7	[0.108]	548	[367]
12.7	[0.500]	160.1	[36 000]	92.9	[0.144]	730	[490]
15.2	[0.600]	240.2	[54 000]	139.4	[0.216]	1094	[737]
Grade 1860I [270I]							
7.9	[0.313]	74.3	[16 500]	39.4	[0.061]	313	[210]
9.5	[0.375]	102.3	[23 000]	54.8	[0.085]	432	[290]
11.1	[0.438]	137.9	[31 000]	74.2	[0.115]	582	[390]
12.7	[0.500]	183.7	[41 300]	98.7	[0.153]	775	[520]
15.2	[0.600]	266.7	[58 600]	140.0	[0.217]	1102	[740]

TABLE 3 Yield Strength Requirements[A]

Diameter of Strand		Initial Load, kN [lbf]		Minimum Load at 1 % Extension, kN [lbf]	
mm	[in.]				
Grade 1725I[250I]					
6.4	[0.250]	4.0	[900]	34.0	[7 650]
7.9	[0.313]	6.5	[1 450]	54.7	[12 300]
9.5	[0.375]	8.9	[2 000]	75.6	[17 000]
11.1	[0.438]	12.0	[2 700]	102.3	[23 000]
12.7	[0.500]	16.0	[3 600]	136.2	[30 600]
15.2	[0.600]	24.0	[5 400]	204.2	[45 900]
Grade 1860I[270I]					
7.9	[0.313]	7.3	[1 650]	62.4	[14 030]
9.5	[0.375]	10.2	[2 300]	87.0	[19 550]
11.1	[0.438]	13.8	[3 100]	117.2	[26 350]
12.7	[0.500]	18.4	[4 130]	156.1	[35 000]
15.2	[0.600]	26.1	[5 860]	221.5	[49 800]

[A]Yield strength minimum is 85 % of specified minimum breaking strength.

7.3.2 All Grade 270I strand shall conform to a size tolerance of +0.65 mm, −0.15 mm (+0.026 in., −0.006 in.) from the nominal diameter measured across the crowns of the wire.

7.3.3 Variation in cross-sectional area and in stress resulting therefrom shall not be cause for rejection provided the diameter differences of the individual wires and the diameters of the strand are within the tolerances specified.

7.4 *Indentations*:

7.4.1 Two acceptable types of indented wire are shown in Fig. 1 (*a*) and (*b*) with dimensions given in Table 1.

7.4.2 Other types of indented wire are permitted, by agreement between the purchaser and supplier.

8. Workmanship, Finish, and Appearance

8.1 *Joints:*

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TABLE 4 Diameter Relation Between Center and Outer Wires

Nominal Diameter of Strand		Minimum Difference Between Center Wire Diameter and Diameter of Any Outer Wire	
mm	[in.]	mm	[in.]
Grade 1725I [1250I]			
6.4	[0.250]	0.025	[0.001]
7.9	[0.313]	0.038	[0.0015]
9.5	[0.375]	0.051	[0.002]
11.1	[0.438]	0.064	[0.0025]
12.7	[0.500]	0.076	[0.003]
15.2	0.600	0.102	[0.004]
Grade 1860I [270I]			
7.9	[0.313]	0.0381	[0.0015]
9.5	[0.375]	0.0508	[0.002]
11.1	[0.438]	0.0635	[0.0025]
12.7	[0.500]	0.0762	[0.003]
15.2	0.600	0.1016	[0.004]

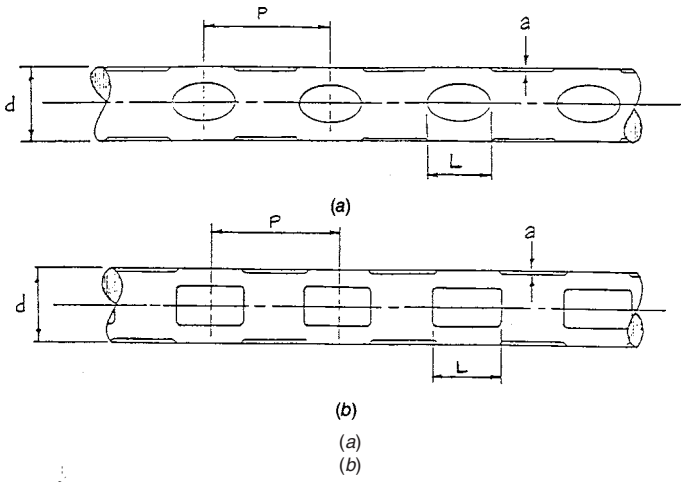

FIG. 1 Acceptable Types of Indented Wire

8.1.1 There shall be no strand joints or strand splices in any length of the completed strand unless specifically permitted by the purchaser.

8.1.2 During the process of manufacture of the 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 the wire drawing except as provided in 8.1.3.

8.1.3 During fabrication of the strand, butt-welded joints are permitted in the individual wires, provided there is not more than one such joint in any 45-m (150-ft) section of the completed strand.

NOTE 3—When specifically ordered as "weldless grade," a product free of welds shall be furnished. When this grade is specified, no welds or joints are permitted except as detailed in 8.1.2.

8.2 The finished strand shall be uniform in diameter and shall be free of imperfections not consistent with good commercial stranding practice.

8.3 When strand is cut without seizing, if no wire flies out of position, or if any wire that flies out of position can be repositioned by hand, the strand shall be considered satisfactory.

8.4 The strand shall not be oiled or greased. Slight rusting, provided it is not sufficient to cause pits visible to the unaided eye, shall not be cause for rejection.

9. Sampling

9.1 Test specimens cut from either end of the strand package of reels or either end of coils or reelless packs are permitted. Discard any specimen found to contain a wire joint and obtain a new specimen.

10. Number of Tests

10.1 One specimen for test shall be taken from each 18 –Mg (20-ton) production lot of finished strand and tested for tensile strength, yield strength, and elongation.

11. Inspection

11.1 The purchaser may request that a representative inspect or witness the inspection and testing of the material prior to shipment. Such agreement shall be made by the purchaser and producer as part of the purchase contract.

11.2 When such inspection or witness of inspection and testing is agreed upon, the purchaser's representative shall be afforded all reasonable facilities to assure that the material meets the requirements of this specification. Inspection and tests shall be conducted so as to avoid unnecessary interference with the producer's operations.

12. Rejection

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

12.2 The lot may be resubmitted for inspection by testing a sample from each reel or pack and sorting out nonconforming material.

12.3 In the event that testing of any individual sample results in a reasonable doubt as to the ability of the strand to satisfy any requirement of this specification, two additional tests shall be made on samples of strand from the same reel or pack, and if failure occurs in either of these tests, the represented reel or pack shall be rejected.

13. Certification

13.1 In the event that outside inspection is waived, 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.

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

13.3 When the modulus of elasticity of a seven-wire strand is provided, the cross-sectional area used to compute that 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, 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

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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 4—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.

14. Packaging and Marking

14.1 The strand shall be furnished on reels or in compact coils having a minimum core diameter of 600 mm (24 in.), unless otherwise specified by the purchaser. Lengths 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 strong tags securely fastened to it showing the length, size, grade, ASTM designation A 886/A 886M, and the name or mark of the manufacturer.

14.2 Low-relaxation strand produced in accordance with the requirements of Supplement I shall be specially identified.

14.3 *For Government Procurement Only*— When specified in the contract or order, and for direct procurement by or direct shipment to the United States government, material shall be preserved, packaged, and packed in accordance with the requirements of MIL-STD-163. The applicable levels shall be as specified in the contract. Marking for shipment of such material shall be in accordance with Fed. Std. No. 123 for use by civil agencies and MIL-STD-129 for use by military agencies.

15. Keywords

15.1 indentations; prestressed concrete; seven-wire strand (tendon); steel wire

SUPPLEMENTARY REQUIREMENTS

I. LOW-RELAXATION STRAND

S1. Scope

S1.1 This supplement delineates only those details that are peculiar to low-relaxation strand, and to the methods of relaxation testing related to seven-wire strand having properties generally as described in Specification A 886 /A 886M.

S2. Test Method

S2.1 Low-relaxation strand shall be tested as prescribed in Method E 328 .

S3. Relaxation Properties

S3.1 Low-relaxation strand shall meet the mechanical property requirements of this specification, with the added requirement that the relaxation loss after 1000 h under the conditions of S 5 shall be not more than 2.5 % when initially 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.

S4. Yield Strength

S4.1 Yield strength of low-relaxation strand, as described in 6.3, shall be not less than 90 % of the specified minimum breaking strength of the strand.

S5. Conditions of Relaxation Test

S5.1 If required, relaxation evidence shall be provided from the manufacturer's records of tests on similarly dimensioned strand of the same grade.

S5.2 The temperature of the test specimen shall be maintained at 20± 2°C (68 ± 3.5°F).

S5.3 The test specimen shall not be subjected to loading prior to the relaxation test.

S5.4 The initial load shall be applied uniformly over a period of not less than 3 min and not more than 5 min, and the gage length shall be maintained constant; load relaxation readings shall commence 1 min after application of the total load.

S5.5 Overstressing of the test specimen during the loading operation shall not be permitted.

S5.6 The duration of the test shall be 1000 h or a shorter computed period extrapolated to 1000 h which can be shown by records to provide similar relaxation values.

S5.7 The test gage length should be at least 60 times the nominal diameter. If this gage length exceeds the capacity of the extensometer or testing machine, then a gage length of at least 40 times the nominal diameter may be substituted.

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SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A886/A 886M–00) that may impact the use of this standard.

(1) Revised sections 4.1, 6.3, 6.4, S5.2, S5.3, S5.5, and Note 2.

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