Designation: A 881/A881M – 05

Standard Specification for Steel Wire, Deformed, Stress-Relieved or Low-Relaxation for Prestressed Concrete Railroad Ties[1]

This standard is issued under the fixed designation A 881/A881M; 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 uncoated, deformed, stress-relieved, and stress-relieved low-relaxation wire for use as prestressed tendons in concrete railroad ties.

1.2 The values stated in either-inch-pound units or SI units are to be regarded separately 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 for the two systems may result in non-conformance with the specification.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

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

A 421/A 421M Specification for Uncoated Stress-Relieved Steel Wire for Prestressed Concrete

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 Standard:*

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

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *deformed steel wire for railroad ties*, *n*—a deformed, uncoated steel stress-relieved or low-relaxation wire intended for use as reinforcement in prestressed concrete railroad ties, the wire surface having deformations that reduce longitudinal movement of the wire in such construction, and conform to the provisions of Section 7.

3.1.2 *low-relaxation wire*, *n*—indented cold-drawn wire, straightened, that receives a suitable continuous thermo-mechanical treatment as the last operation to produce the properties listed.

3.1.3 *stress-relieved wire*, *n*—indented cold-drawn wire, straightened, that receives a suitable continuous thermal treatment as a last operation to produce the properties listed.

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 (mass [weight]),

4.1.2 Name of material (deformed steel stress-relieved or low-relaxation wire for prestressed concrete railroad ties),

4.1.3 Grade (see Table 1),

4.1.4 Nominal diameter,

4.1.5 Packaging,

4.1.6 Stress-relieved or low relaxation,

4.1.7 ASTM designation and year of issue, and

4.1.8 Special requirements, if any.

NOTE 1—A typical ordering description is as follows: 23 000 kg (50 000 lb) Grade 235, deformed stress-relieved steel wire for prestressed concrete railroad ties. 5.03-mm (0.198-in.) diameter wire in approximately 550-kg (1200-lb) coils, ASTM A 881/A 881M-_____.

5. Materials and Manufacture

5.1 The steel shall be made by the basic-oxygen, open-hearth, or electric-furnace process.

5.2 The base metal shall be carbon steel of such quality that when drawn and stress relieved, or thermo-mechanically treated at a suitable wire size, shall have the properties and characteristics prescribed in the specification.

[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.

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

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TABLE 1 Breaking Strength Requirements

Wire Grade	Nominal Diameter mm	(in.)	Breaking Strength kN	(lbf)	Nominal Area[A] mm²	(in.²)	Nominal Mass (Weight), g/m (lb/1000 ft)
1550 (225)	5.03	(0.198)	30.8	(6920)	19.86	(0.0308)	155.9 (104.8)
1620 (235)	5.03	(0.198)	32.2	(7230)	19.86	(0.0308)	155.9 (104.8)
1720 (250)	5.03	(0.198)	34.3	(7700)	19.86	(0.0308)	155.9 (104.8)
1790 (260)	5.5	(0.216)	42.6	(9570)	23.7	(0.0368)	187.4 (126.0)

[A]The nominal cross-sectional area is based on the nominal diameter. The actual area in mm^2 ($in.^2$) may be calculated by dividing the mass (weight) per linear millimetre (in.) of the specimen in kg (lb) by 7.850×10^{-6} kg/mm^3 (mass of 1 mm^3 of steel) (0.2836 (weight of 1 $in.^3$ of steel)). The amount of variation is dependent on the shape and character of the deformations.

6. *Mechanical Property Requirements* Mechanical Property Requirements

6.1 *General*—Deformed wire shall be supplied in coils to the specified mechanical properties in Table 1. It shall be permissible to furnish nominal diameters of wire not specifically itemized in this specification provided that the strength is defined and they conform otherwise to the requirements of this specification.

6.2 *Breaking Strength*—The minimum breaking strength of the deformed wire shall conform to the requirements of Table 1. Other values of breaking strength and nominal diameters can be specified if shown by test that the strength exceeds that specified. The tension test shall be made in accordance with Test Methods A 370.

6.3 *Load at 1 % Extension*—The load at 1 % extension shall be at least 85 % of the minimum specified breaking strength for stress relieved and 90 % for stress-relieved low-relaxation wire when tested in accordance with Test Methods A 370.

6.4 *Elongation*—The percent elongation after fracture on a 250-mm (10-in.) gage length shall be 3.0 % minimum.

6.5 *Bend Test*—The deformed wire shall withstand being bent through 90° without cracking on the outside of the bent portion when bent around a pin, the diameter of which is two times the nominal diameter of the specified wire size.

6.6 *Relaxation*—If required, relaxation evidence shall be provided from records of tests on similar dimensioned wire of the same grade. Tests to satisfy this requirement shall comply with the conditions of Supplementary Requirement S6 of Specification A 421/A 421M. The relaxation losses are not to exceed the limits specified in Table 2.

7. Requirements for Deformations

7.1 *Deformations*—Deformations shall be in two or more lines spaced uniformly around the wire and one line of deformations may be inclined in the opposite direction to the other(s). The deformations shall be placed in respect to the axis of the wire so that the included angle is not less than 45°, as shown in Fig. 1. Pitch and shape shall be as consistent as possible, with not more than 10 % being malformed in any 600 mm (2 ft) length of wire, judged visually.

7.2 *Type*—Two acceptable types of deformed wire are shown in Fig. 1(*a*) and (*b*), with dimensions in Table 3.

7.3 *Options*—Other types of deformed wire are permitted by agreement, provided the wire is comparable with the accepted types in mechanical properties and bond with concrete.

TABLE 2 Limits of Relaxation[A]

	Maximum Percentage Relaxation of 1000 h from a Minimum Initial Stress of	
	70 % of Minimum Tensile Strength	80 % of Minimum Tensile Strength
Normal stress-relieved wire	6.5	8.5
Low-relaxation stress-relieved wire	2.5	3.5

[A] The relaxation losses are not to exceed the limits specified in Table 2.

8. Permissible Variation in Dimensions

8.1 The diameter of the deformed wire shall not vary from the nominal diameter by more than ±0.08 mm (±0.003 in.).

8.2 The deformed wire shall not be out-of-round by more than 0.08 mm (0.003 in.). (Measured at maximum indent.)

9. Workmanship, Finish, and Appearance

9.1 The wire shall be free of kinks.

9.2 The wire shall be furnished in firmly tied coils. Each coil shall be of one continuous length.

9.3 There shall be no welds or joints in the finished wire. Any welds or joints made during manufacture to promote continuity of operations shall be removed.

9.4 *Cast (Curvature)*—The curvature of the wire shall be large enough to suit the purchaser but shall normally be 75 mm (3 in.) maximum offset on a chord 1.8 m (6 ft) long.

9.5 The wire shall not be oiled or greased and must be essentially free of residual wire-drawing lubricants. Slight rusting, providing it is not sufficient to cause pits visible to the unaided eye, shall not be cause for rejection.

10. Sampling

10.1 Unless otherwise agreed upon between the manufacturer and the purchaser, one test specimen shall be taken from each ten coils or less in a lot (see Note 2) and tested to determine compliance with 6.2 to 6.5 and deformation dimensions.

NOTE 2—The term "lot" means all the coils of wire of the same nominal wire diameter contained in an individual shipping release or shipping order.

11. Inspection

11.1 The purchaser shall state, at the time of order, whether outside inspection is required or waived. If outside inspection

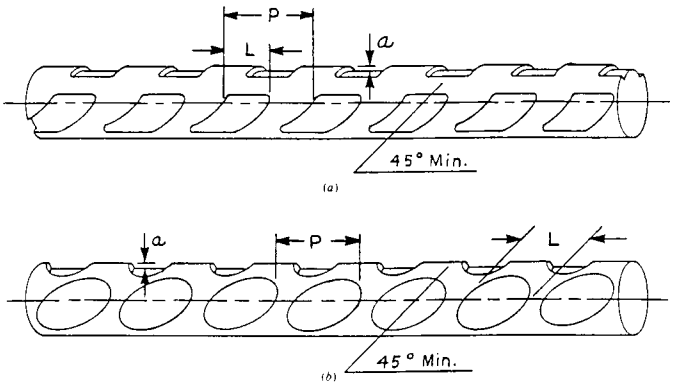


FIG. 1 Acceptable Type of Deformed Wire

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TABLE 3 Dimensions of Deformations

NOTE 1—Depth of indent shall be the average depth of six or more random indents measured at maximum depth.

Nominal Wire Diameter, mm	(in.)	Depth, *A*, mm (in.)	Nominal Length, *L*, mm	(in.)	Nominal Pitch, *P*, mm	(in.)
5.03	(0.198)	0.13 + 0.02, –0.05 (0.005 + 0.001, –0.002)	3.5	(0.138)	5.5	(0.217)
5.5	(0.216)	0.13 + 0.02, –0.05 (0.005 + 0.001, –0.002)	3.5	(0.138)	5.5	(0.217)

is required, the manufacturer shall afford the inspector representing the purchaser all reasonable facilities to satisfy him 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 operation of the works.

12. Rejection

12.1 In case a test specimen fails to meet any requirement of this specification, two additional tests shall be made on samples of wire from the same coil and if failure occurs in either of these tests, the coil shall be rejected.

12.2 Unless otherwise specified, any rejection based on tests made in accordance with this specification shall be reported to the manufacturer within a reasonable length of time.

13. Certification

13.1 When specified in the purchase order or contract, the manufacturer's or supplier's certification shall be furnished to the purchaser stating that samples representing each lot have been manufactured, tested, and inspected in accordance with this specification and the requirements have been met. The certification shall include the specification number, year-date of issue, and revision letter, if any. When specified in the purchase order or contract, a report of the test results shall be furnished.

13.2 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 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 3—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 Package Marking

14.1 The nominal diameter of the deformed wire, ASTM specification designation, and name or mark of the manufacturer shall be marked on a tag securely attached to each bundle of wire.

14.2 *For Government Procurement Only*— When specified in the contract or order, and for direct procurement by or direct shipment to the U.S. 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 civil agencies and MIL-STD-129 for military agencies.

15. Keywords

15.1 concrete railroad ties; deformed wire; prestressed concrete; steel wire (tendon)

SUMMARY OF CHANGES

Committee A01 has identified the location of the following changes to this standard since the last issue (A 881/A 881M–99) that may impact the use of this standard.

(1) Revised sections 4.1 and 6.1.

(2) Deleted former section 12.3 and Note 3.

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