



# Standard Specification for Steel Wire, Hard-Drawn for Prestressed Concrete Tanks<sup>1</sup>

This standard is issued under the fixed designation A821/A821M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This specification covers uncoated, high-strength, hard-drawn steel wire for use in the construction of prestressed concrete tanks and similar structures. In application, the wire is continuously wrapped on the structure maintaining tension by a device using a wire drawing die, or mechanical tensioning system without re-drawing.

1.2 This specification is applicable only to the condition of the wire as delivered to the purchaser. It is not applicable to the properties or condition of the wire after application.

1.2.1 Type A wire is to be tensioned by drawing through a wire drawing die or by a mechanical system without re-drawing.

1.2.2 Type B wire is drawn to finished size by the manufacturer for tensioning by a mechanical system without re-drawing.

NOTE 1—Type A wire, when tensioned by drawing through a die, may not function properly if the purchaser does not ensure that during application the surface of the wire is free of rust and foreign materials that can be detrimental to good wire drawing practice. Further, the purchaser should ensure that proper wire drawing techniques are followed, including adequate lubrication, cooling, and proper die mechanics.

1.3 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.4 This specification is applicable for orders in either inch-pounds units (as Specification A821) or in SI units (as Specification A821M).

1.5 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 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.

<sup>1</sup> 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. Referenced Documents

### 2.1 *ASTM Standards:*<sup>2</sup>

- A370 Test Methods and Definitions for Mechanical Testing of Steel Products
- A510 Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
- A700 Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment
- A938 Test Method for Torsion Testing of Wire
- E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

## 3. Ordering Information

3.1 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:

- 3.1.1 Quantity (weight) [mass],
- 3.1.2 Name of material (hard-drawn steel wire for prestressed concrete tanks, Type A wire or Type B wire),
- 3.1.3 Wire diameter,
- 3.1.4 Certification, if required (12.1),
- 3.1.5 Marking (13.1),
- 3.1.6 Packaging (14.1), and
- 3.1.7 ASTM designation and year of issue.

3.2 Pre-lubrication, if required, shall be specified by the purchaser (see Note 2).

NOTE 2—Pre-lubrication refers to the intentional addition or residue of solid lubricant on the wire surface prior to shipment to facilitate redrawing for Type A wire. Pre-lubrication is not used in Type B wire.

## 4. Manufacture

4.1 The steel may be made by any commercially accepted steel-making process. The steel may be either ingot cast or strand cast.

4.2 The steel shall be of such quality, that the finished wire shall be free of detrimental pipe and undue segregation.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

4.3 The wire shall be cold-drawn to produce the prescribed mechanical properties.

4.4 There shall be no welds or joints in the finished wire. Welds or joints made during drawing to enable continuity of operations shall be removed.

## 5. Chemical Composition Requirements

5.1 The steel shall conform to the chemical composition requirements specified in **Table 1**.

5.2 An analysis of each heat of steel shall be furnished by the manufacturer showing the percentages of all the elements specified in **Table 1**. The wire shall be subject to permissible variation for product analysis specified in Specification **A510**, Table 7.

## 6. Mechanical Property Requirements

6.1 *Tensile Strength Test*—Type A wire as represented by the test specimens shall conform to the requirements prescribed in **Table 2**. Type B wire as represented by the test specimens shall conform to the requirements in **Table 3**.

6.2 *Wrap Test*—The wire as represented by the wrap-test specimens shall conform to the requirements prescribed in **Table 4**.

6.3 The tensile strength test and wrap test shall be made in accordance with Test Methods and Definitions **A370**, Annex A4.

6.4 *Torsion Test*—Torsion requirements shall conform to those prescribed in **Table 5** for Type A wire and Type B wire. The test shall be conducted according to Test Method **A938**.

## 7. Permissible Variations in Diameter

7.1 The diameter of the wire shall not vary from that specified by more than the tolerances shown in **Table 6**.

7.2 If wire diameters other than those specified in **Table 2**, **Table 3**, and **Table 5** are ordered, tensile strength values and torsion values may be interpolated.

7.3 For purposes of determining conformance with this specification, all specified limits are absolute as defined in Practice **E29**.

## 8. Workmanship, Finish, and Appearance

8.1 The surface of the wire, as received, shall be smooth and generally free of rust (see **Note 3**). A light oxidation film that does not cause pitting of the wire surface visible to a person with normal or corrected vision after wiping or light cleaning, shall not be cause for rejection. Type A wire shall be suitable for further reasonable reduction of cross-sectional area during application. Coils of wire with visible pitting shall be rejected.

**TABLE 1 Chemical Composition Requirements**

Element	Composition, %
Carbon	0.50 to 0.85
Manganese	0.60 to 1.10
Phosphorus, max	0.040
Sulfur, max	0.050
Silicon	0.10 to 0.35

**TABLE 2 Tensile Requirements (Type A)**

Diameter, in. [mm]	Tensile Strength, ksi [MPa]	
	Min	Max
0.162 [4.1]	218 [1500]	258 [1780]
0.177 [4.5]	213 [1470]	253 [1740]
0.192 [4.9]	210 [1450]	250 [1720]
0.207 [5.3]	208 [1430]	248 [1710]
0.225 [5.7]	204 [1410]	244 [1680]
0.235 [6.0]	202 [1390]	242 [1670]

**TABLE 3 Tensile Requirements (Type B)**

Decimal Size, in. [mm]	Minimum Tensile Strength, ksi [MPa]	
	Min	Max
0.162 [4.1]	231 [1590]	262 [1810]
0.192 [4.9]	222 [1530]	252 [1740]
0.250 [6.4]	211 [1450]	241 [1660]

**TABLE 4 Wrap-Test Requirements**

Diameter, in. [mm]	Mandrel Size
0.162 to 0.250 [4.1 to 6.4], incl	2X <sup>A</sup>

<sup>A</sup> X is specified wire diameter.

**TABLE 5 Torsion Requirements**

Diameter, in. [mm]	Minimum Number of Turns to Failure in 8 in. [200 mm]
0.162 [4.1]	9
0.177 [4.5]	8
0.192 [4.9]	7
0.207 [5.3]	6
0.225 [5.7]	5
0.235 [6.0]	5
0.250 [6.4]	4

**TABLE 6 Permissible Variations in Wire Diameter**

Diameter, in. [mm]	Permissible Variations, ±in. [mm]	Permissible Out-of-Round, in. [mm]
0.162 to 0.250 [4.1 to 6.4]	0.002 [0.05]	0.002 [0.05]

8.2 The wire shall not have piping, cross checking, torn surfaces, chatter marks, splits, die marks, scratches, pits, or seams that are detrimental to its application.

8.3 The wire shall not be kinked, improperly cast, or show a wavy condition.

8.4 Each coil shall be one continuous length of wire, properly coiled.

8.5 The wire shall not be oiled or greased.

**NOTE 3**—The wire should be protected to help mitigate the formation of oxidation on the surface of the wire during storage and transportation.

## 9. Sampling and Number of Tests

9.1 A lot shall consist of all the coils of wire of the same size and class and offered for inspection at one time.

9.2 At a minimum, one test specimen shall be taken for each ten coils, or fraction thereof, in a lot. Each heat in a given lot shall be tested.



9.3 Test specimens cut from either end of the coil are permitted.

9.4 Any test specimen showing the presence of an obvious defect, shall be discarded and another specimen substituted.

9.5 Test specimens shall be tested for tensile strength (6.1), wrap test (6.2), and torsion test (6.4).

## **10. Inspection**

10.1 Unless otherwise specified in the purchase order or contract, the manufacturer shall be responsible for the performance of all inspection and test requirements specified in this specification. Except as otherwise specified in the purchase order or contract, the manufacturer shall be permitted to use one's own or any other suitable facilities for the performance of the inspection and test requirements unless disapproved by the purchaser at the time the order is placed. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification when such inspections and tests are deemed necessary to assure that the material conforms to prescribed requirements.

## **11. Rejection and Rehearing**

11.1 Material that fails to conform to the requirements of this specification shall be subject to rejection. Rejections shall be reported to the manufacturer promptly and in writing. In case of dissatisfaction with the results of the test, the manufacturer shall have the right to make claim for a rehearing.

11.2 The material shall be adequately protected and correctly identified so that the manufacturer can make a proper investigation.

## **12. Certification**

12.1 When specified in the purchase order or contract, a manufacturer's certification shall be furnished to the purchaser that the material was manufactured, tested, and inspected in accordance with this specification and has been found to meet the requirements. The certification shall include the specification number, year/date of issue and revision letter, if any.

12.2 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 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.

## **13. Marking**

13.1 The type of wire, size of the wire, purchase order number, ASTM specification designation A821/A821M, heat number, and name of the manufacturer shall be marked on a weather-resistant tag securely attached to each coil of wire.

## **14. Packaging**

14.1 When specified in the purchase order or contract, packaging shall be in accordance with the procedures in Practices A700.

## **15. Keywords**

15.1 prestressed concrete tanks; steel wire

## **SUMMARY OF CHANGES**

Committee A01 has identified the location of selected changes to this standard since the last issue (A821/A821M – 10) that may impact the use of this standard. (Approved May 1, 2015.)

- (1) Added Note 2 and Note 3 and renumbered subsequent notes.
- (2) Revised 4.1 to match language in other similar specifications.
- (3) Revised 4.2 to replace advisory language with mandatory.
- (4) Removed footnote from Table 2.

- (5) Revised format and updated content of Table 3.
- (6) Revised headings of Table 5.
- (7) Revised Section 5 throughout.
- (8) Revised 6.4 to refer to Test Method A938.
- (9) Revised 9.2.



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