



Designation: A722/A722M – 18

## Standard Specification for High-Strength Steel Bars for Prestressed Concrete<sup>1</sup>

This standard is issued under the fixed designation A722/A722M; 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 Type I and Type II high-strength steel bars intended for use in prestressed concrete construction or in prestressed ground anchors. Type I bars have a plain surface. Type II bars have surface deformations. Bars are of a minimum tensile strength level of 150 000 psi [1035 MPa].

1.2 A supplementary requirement (S1) is provided for use where bend tests of bars are required by the purchaser. The supplementary requirement applies only when specified in the purchase order.

1.3 The text of this specification 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 specification.

1.4 This specification is applicable for orders in either inch-pound units (as Specification A722) or in SI units (as Specification A722M).

1.5 The values stated in either inch-pound 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 specification.

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

### 2. Referenced Documents

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

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A700 Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment

A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

#### 2.2 Military Standard:<sup>3</sup>

MIL-STD-129 Marking for Shipment and Storage

#### 2.3 U.S. Federal Standard:<sup>3</sup>

Fed. Std. 123 Marking for Shipment (Civil Agencies)

### 3. Ordering Information

3.1 Orders for high-strength steel bars under this specification shall contain the following information:

3.1.1 Quantity,

3.1.2 Size and length,

3.1.3 Type I or Type II, and

3.1.4 ASTM designation A722 [A722M] and year-date of issue.

3.2 The purchaser shall have the option to specify additional requirements, including but not limited, to the following:

3.2.1 Report on chemical composition (5.1),

3.2.2 Special inspection requirements (14.2),

3.2.3 Load-elongation curve (16.2),

3.2.4 Special preparation for delivery, if desired (see Section 17), and

3.2.5 Supplementary requirement (S1).

### 4. Materials and Manufacture

4.1 The bars shall be rolled from properly identified heats of mold-cast or strand-cast steel. The standard sizes and dimensions of Type I and II bars shall be those listed in Table 1 and Table 2, respectively.

<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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<sup>2</sup> 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.

<sup>3</sup> Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://www.dodssp.daps.mil.

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

**TABLE 1 Nominal Dimensions for Type I (Plain) Bars**

Nominal Diameter		Nominal Weight (Mass)		Nominal Area <sup>A</sup>	
in.	mm	lb/ft	kg/m	in. <sup>2</sup>	mm <sup>2</sup>
3/4	19	1.50	2.23	0.44	284
7/8	22	2.04	3.04	0.60	387
1	25	2.67	3.97	0.78	503
1 1/8	29	3.38	5.03	0.99	639
1 1/4	32	4.17	6.21	1.23	794
1 3/8	35	5.05	7.52	1.48	955

<sup>A</sup> Nominal area is determined from the nominal diameter in inches [millimetres].

**TABLE 2 Nominal Dimensions for Type II (Deformed) Bars**

Nominal Diameter <sup>A</sup>		Nominal Weight (Mass)		Nominal Area <sup>B</sup>	
in.	mm	lb/ft	kg/m	in. <sup>2</sup>	mm <sup>2</sup>
5/8	15	0.98	1.46	0.28	181
3/4	20	1.49	2.22	0.42	271
1	26	3.01	4.48	0.85	548
1 1/4	32	4.39	6.54	1.25	806
1 3/8	36	5.56	8.28	1.58	1019
1 3/4	46	9.10	13.54	2.58	1664
2 1/2	65	18.20	27.10	5.16	3331
3	75	24.09	35.85	6.85	4419

<sup>A</sup> Nominal diameters are for identification only.

<sup>B</sup> Nominal area is determined from the bar weight [mass] less 3.50% for the weight [mass] of the deformations.

4.2 The bars shall be subjected to cold-stressing to not less than 80 % of the minimum tensile strength, and then shall be stress-relieved, to produce the prescribed tensile properties.

## 5. Chemical Composition

5.1 A chemical analysis of each heat of steel shall be determined in accordance with Test Methods, Practices, and Terminology **A751**. The manufacturer shall make the analysis on test samples taken during the pouring of the heat. When requested in the purchase order or contract, the chemical composition determined shall be reported to the purchaser.

5.1.1 Choice and use of chemical composition and alloying elements, to produce the tensile properties of the bars prescribed in Section 6, shall be made by the manufacturer, subject to the limitations in **5.1.2**.

5.1.2 On heat analysis, phosphorus and sulfur shall not exceed the following:

Phosphorus	0.040 %
Sulfur	0.050 %

5.2 A product analysis may be made by the purchaser from the bar representing each heat of steel. The phosphorus and sulfur contents thus determined shall not exceed the limits specified in **5.1.2** by 0.008 %.

## 6. Tensile Requirements

6.1 Tension tests shall be conducted in accordance with Test Methods and Definitions **A370**.

6.2 Bars shall have a minimum tensile strength of 150 000 psi [1035 MPa].

6.3 The minimum yield strength of Type I and Type II bars shall be 85 % and 80 %, respectively, of the minimum tensile strength of the bars. The yield strength shall be determined by either of the methods described in Test Methods and Defini-

tions **A370**; however, in the extension under load method, the total strain shall be 0.7 %, and in the offset method the offset shall be 0.2 %.

6.4 The minimum elongation after rupture shall be 4.0 % in a gage length equal to 20 bar diameters, or 7.0 % in a gage length equal to 10 bar diameters.

## 7. Number of Tests

7.1 The number of tension test specimens shall be one from each 39 tons [36 tonnes] or fraction thereof, of each size of bar rolled from each heat but not less than two tension test specimens from each heat.

7.2 For Type II bars, one set of dimensional property tests including bar weight [mass], and spacing, height and projected area of deformations shall be made of each bar size rolled from each heat.

## 8. Retests

8.1 If any tensile property of any tension test specimen is less than that specified, and any part of the fracture is outside the middle third of the gage length, as indicated by scribe scratches marked on the test specimen before testing, a retest shall be permitted.

8.2 If the results of an original tension test specimen fail to meet specified requirements, two additional tests shall be made on specimens from the same heat and bar size, and if failure occurs in either of these tests, the bar size from that heat shall be rejected.

8.3 If any test specimen fails because of mechanical reasons such as failure of testing equipment, it shall be discarded and another specimen taken.

8.4 If any test specimen develops flaws, it shall be discarded and another specimen of the same size bar from the same heat substituted.

## 9. Test Specimens

9.1 Tension test specimens shall be the full section of the bar as rolled. Machined-reduced section test specimens are not permitted. All unit stress determinations shall be based on the nominal area shown in **Table 1** or **Table 2**.

## 10. Requirements for Deformations

10.1 Type II bars shall have deformations spaced uniformly along the length of the bar. The deformations on opposite sides of the bar shall be similar in size and shape. The average spacing or distance between deformations on both sides of the bar shall not exceed seven-tenths of the nominal diameter of the bar.

10.2 The minimum height and minimum projected area of the deformations shall conform to the requirements shown in **Table 3**.

10.3 *Mechanical Coupling*—For those bars having deformations arranged in a manner to permit coupling of the bars with a screw-on type coupler, it shall be the responsibility of the finished-bar manufacturer to demonstrate that a bar cut at any point along its length may be coupled to any other length of bar

**TABLE 3 Deformation Dimensions for Type II Bars**

Nominal Diameter		Deformation Dimensions					
		Maximum Average Spacing		Minimum Average Height		Minimum Projected Area <sup>A</sup>	
in.	mm	in.	mm	in.	mm	in. <sup>2</sup> /in.	mm <sup>2</sup> /mm
5/8	15	0.44	11.1	0.03	0.7	0.09	2.4
3/4	20	0.52	13.3	0.04	1.0	0.13	3.4
1	26	0.70	17.8	0.05	1.3	0.17	4.4
1 1/4	32	0.89	22.5	0.06	1.6	0.21	5.4
1 3/8	36	0.99	25.1	0.07	1.8	0.24	6.1
1 3/4	46	1.19	30.1	0.09	2.2	0.29	7.3
2 1/2	65	1.75	44.5	0.11	2.9	0.38	9.7
3	75	2.00	50.8	0.13	3.3	0.46	11.7

<sup>A</sup> Calculated from equation, min projected area = 0.75πd h/s

where:

d = nominal diameter,

h = minimum average height, and

s = maximum average spacing.

and that a coupled joint is capable of developing the minimum specified tensile strength of the coupled bars.

### 11. Measurements of Deformations

11.1 The average spacing of deformations shall be determined by dividing a measured length of the bar specimen by the number of individual deformations and fractional parts of deformations on any one side of the bar specimen. A measured length of the bar specimen shall be considered the distance from a point on a deformation to a corresponding point on any other deformation on the same side of the bar.

11.2 The average height of deformations shall be determined from measurements made on not less than two typical deformations. Determinations shall be based on three measurements per deformation: one at the center of the overall length, and the other two at the quarter points of the overall length.

11.3 To indicate adequately the conformity to the dimensional requirements, measurements shall be taken at random from one bar from each 39 tons [36 tonnes] of each lot or fraction thereof.

11.4 Insufficient height, insufficient projected area, or excessive spacing of deformations shall not constitute cause for rejection unless it has been clearly established by determinations on each lot that typical deformation height or spacing does not conform to the minimum requirements prescribed in Section 10. No rejection shall be made on the basis of measurements if fewer than ten adjacent deformations on each side of the bar are measured.

NOTE 1—As used within the intent of 11.3, the term “lot” means all bars of the same nominal weight [mass] per linear foot [metre] contained in an individual shipping release or shipping order.

### 12. Permissible Variation in Size or Weight [Mass]

12.1 For Type I bars, the permissible variation from the nominal diameter specified in Table 1 shall not exceed +0.030, -0.010 in. [+0.75, -0.25 mm].

12.2 For Type II bars, the permissible variation from the nominal weight [mass] specified in Table 2 shall not exceed +3 %, -2 %.

### 13. Finish

13.1 The bars shall be free of defects injurious to the tensile properties and shall have a workmanlike finish.

### 14. Inspection

14.1 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 works that concern the manufacture of the material ordered. The manufacturer shall afford the inspector all reasonable facilities to satisfy him that the material is being furnished in accordance with this specification. All tests (except product analysis) and inspection, shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

14.2 If specified in the purchase order, the purchaser shall reserve the right to perform any of the inspection set forth in the specification where such inspections are deemed necessary to assure that the material furnished conforms to prescribed requirements.

### 15. Rejection and Rehearing

15.1 Any rejection based on tests made in accordance with 5.2 shall be promptly reported to the manufacturer.

15.2 Material that shows injurious defects subsequent to its acceptance at the manufacturer’s facility shall be subject to rejection, and the manufacturer shall be notified.

15.3 Samples tested in accordance with 5.2 that represent rejected material shall be preserved for two weeks from the date rejection is reported to the manufacturer. In case of dissatisfaction with the results of the tests, the manufacturer shall be permitted to make claim for a rehearing within that time.

### 16. Certification

16.1 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 the ASTM designation, year-date of issue, and revision letter, if any.

16.2 When specified in the purchase order, the manufacturer shall furnish a representative load-elongation curve for each size and type of bar shipped.

16.3 A modulus of elasticity value of 29 700 000 psi [205 GPa] shall be used for the purpose of elongation calculation for Type II bars.

NOTE 2—Experience has shown that load-elongation curves plotted from mill tests on Type II bars exhibit variability and are not sufficiently reliable for use in calculating modulus of elasticity values.

16.4 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

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 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.

**17. Packaging and Package Marking**

17.1 Packaging, package marking, and loading for shipment shall be in accordance with Guide **A700**.

17.2 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 require-

ments specified in the purchase order or contract, shall be in accordance with MIL-STD-129 for military agencies and with Fed. Std. 123 for civil agencies.

17.3 Unless otherwise specified in the purchase order or contract, bars shall be grouped by size. Each bundle or lift shall be tagged showing the heat number, bar size, ASTM designation A722 [A722M], and the name of the manufacturer. The tags shall display the following statement: “High Strength Prestressing Bars.” Both ends of each bar shall be painted yellow.

**18. Keywords**

18.1 deformed bars; high-strength steel bars; plain bars ; prestressed concrete; prestressed ground anchors

**SUPPLEMENTARY REQUIREMENTS**

**S1. BEND TESTS**

The following supplementary requirement shall apply only when specified in the purchase order or contract:

**S1.1. Bending Requirements**

S1.1.1 The bend test specimen shall withstand being bent, at ambient temperature but in no case less than 59°F [15°C], around a pin without cracking on the outside of the bent portion. The requirements for degree of bending and sizes of pins are prescribed in **Table S1.1**.

S1.1.2 The bend test shall be made on full-size specimens of sufficient length to ensure free bending and with an apparatus that provides the following:

S1.1.2.1 Continuous and uniform application of force throughout the duration of the bending operation.

S1.1.2.2 Unrestricted movement of the specimen at points of contact with the apparatus and bending around a pin free to rotate or bending about a central pin on a simple span with end supports free to rotate.

S1.1.2.3 Close wrapping of the specimen around the pin during the bending operation.

S1.1.3 It shall be permissible to use other methods of bend testing, such as placing a specimen across two pins free to rotate and applying the bending force with a fixed pin. When failures occur using other bend-test methods, retests shall be permitted under the bend-test method prescribed in S1.1.2.

S1.1.4 The number of bend test specimens shall be one from each 22 tons [20 tonnes], or fraction thereof, of each size of bar rolled from each heat but not less than two specimens from each heat.

S1.1.5 If a bend test fails for reasons other than mechanical reasons or flaws in the specimen as described in **8.3** and **8.4**, a retest shall be permitted on two random specimens from the quantity of the bars for each bar size in S1.1.4. If the results of both test specimens meet the specified requirements, the bars shall be accepted. The retest shall be performed on test specimens that are at air temperature but not less than 59°F [15°C].

S1.6 Only 5/8-in. [15-mm] to 2-1/2-in. [65-mm] nominal diameter bars shall be subject to bend testing. Bend testing of 3-in. [75-mm] nominal diameter bars shall be subject to agreement between the purchaser and manufacturer.

NOTE S1.1—Safety issues may be involved in performing bend tests on 3-in. [75-mm] nominal diameter bars. Thus, S1.1.6 requires such bend testing to be subject to agreement between the purchaser and manufacturer.

**TABLE S1.1 Supplementary Bend Test Requirements**

Nominal Bar Diameter		Diameter of Pin for 135° Bend <sup>A</sup>
in.	mm	
5/8	15	6d
3/4	20	6d
1	26	6d
1 1/4	32	8d
1 3/8	36	8d
1 3/4	46	10d
2 1/2	65	10d
3	75	12d

<sup>A</sup> d = nominal diameter of bar.

**SUMMARY OF CHANGES**

Committee A01 has identified the location of selected changes to this standard since the last issue (A722/A722M – 15) that may impact the use of this standard. (Approved Sept. 1, 2018.)

(1) Removed 6.5.

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