Designation: A 722/A 722M – 07

Standard Specification for Uncoated High-Strength Steel Bars for Prestressing Concrete[1]

This standard is issued under the fixed designation A 722/A 722M; 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 high-strength steel bars intended for use in pretensioned and post-tensioned prestressed concrete construction or in prestressed ground anchors. Bars are of a minimum ultimate tensile strength level of 1035 MPa (150 000 psi).

1.2 Two types of bars are provided: Type I bar has a plain surface and Type II bar has surface deformations.

1.3 Supplementary requirements of an optional nature are provided. They shall apply only when specified by the purchaser.

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

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

A 700 Practices for Packaging, Marking, and Loading Methods for Steel Products for Shipment

E 30 Test Methods for Chemical Analysis of Steel, Cast Iron, Open-Hearth Iron, and Wrought Iron[3]

2.2 *Government Standards:*[4]

MIL-STD-129 Marking for Shipment and Storage

2.3 *U.S. Federal Standards:*[4]

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

3. Ordering Information

3.1 Orders for material under this specification should include the following information:

3.1.1 Quantity,

3.1.2 Name of material (uncoated high-strength bars for prestressing concrete),

3.1.3 ASTM designation and year of issue,

3.1.4 Size and length,

3.1.5 Type,

3.1.6 Special inspection requirements, if desired (see Section 12),

3.1.7 Special preparation for delivery, if desired (see Section 11),

3.1.8 Load-elongation curve, if required (see Section 15), and

3.1.9 Supplementary requirements, if desired.

NOTE 1—A typical ordering description is as follows: 50 uncoated high-strength steel bars for prestressing concrete to ASTM A 722/A 722M – __; 26 mm diameter, 12.20 m long, Type II; packed in accordance with A 700; meeting supplementary bending properties.

4. Materials and Manufacture

4.1 The bars shall be rolled from properly identified heats of ingot 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.

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

5. Chemical Composition

5.1 An analysis of each heat of steel shall be made by the manufacturer from test samples taken during the pouring of each heat.

5.1.1 Choice and use of chemical composition and alloying elements, to produce the mechanical properties of the finished bar prescribed in 6.2, 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 %

[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] Withdrawn.

[4] 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.**

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TABLE 1 Dimensions for Type I (Plain) Bar

Nominal Diameter		Nominal Mass (Weight)		Nominal Area[A]	
mm	in.	kg/m	lb/ft	mm^2	$in.^2$
19	¾	2.23	1.50	284	0.44
22	⅞	3.04	2.04	387	0.60
25	1	3.97	2.67	503	0.78
29	1⅛	5.03	3.38	639	0.99
32	1¼	6.21	4.17	794	1.23
35	1⅜	7.52	5.05	955	1.48

[A] The nominal area is determined from the nominal diameter in inches. Values have been converted from inch-pound units to metric units.

TABLE 2 Dimensions for Type II (Deformed) Bar

Nominal Diameter[A]		Nominal Mass (Weight)		Nominal Area[B]	
mm	in.	kg/m	lb/ft	mm^2	$in.^2$
15	⅝	1.46	0.98	181	0.28
20	¾	2.22	1.49	271	0.42
26	1	4.48	3.01	548	0.85
32	1¼	6.54	4.39	806	1.25
36	1⅜	8.28	5.56	1019	1.58
46	1¾	13.54	9.10	1664	2.58
65	2½	27.10	18.20	3331	5.16

[A] Nominal diameters are for identification only. Values have been converted from metric to inch-pound units.
[B] The nominal area is determined from the bar weight less 3.5 % for the ineffective weight of the deformations.

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

5.3 Test Methods E 30 shall be used for referee purposes.

6. Mechanical Properties

6.1 All testing for mechanical properties shall be performed in accordance with the requirements of Test Methods and Definitions A 370.

6.2 *Tensile Properties*:

6.2.1 Finished bars shall have a minimum ultimate tensile strength of 1035 MPa (150 000 psi).

6.2.2 The minimum yield strength of Type I and Type II bars shall be 85 % and 80 %, respectively, of the minimum ultimate tensile strength of the bars. The yield strength shall be determined by either of the methods described in Test Methods and Definitions A 370; 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 %.

6.2.3 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.

6.3 *Test Specimens*—Tension tests shall be made using full-size bar test specimens. Machined reduced section test specimens are not permitted. All unit stress determinations shall be based on the nominal area shown in Table 1 or the effective area shown in Table 2.

6.4 *Number of Tests*—The number of tensile specimens tested shall be one from each 36 Mg (39 tons) or fraction thereof, of each size of bar rolled from each heat but not less than two from each heat. The specimens shall be randomly selected following the final processing operation.

6.5 *Retests*:

6.5.1 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 specimen before testing, a retest shall be allowed.

6.5.2 If the results of an original tension test fail to meet specified requirements, two additional tests shall be made on samples of bar 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.

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

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

7. Requirements for Deformations

7.1 Material furnished as Type II bar 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.

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

7.3 *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 and that a coupled joint supports the minimum specified ultimate tensile strength of the coupled bars. The coupler type shall be provided or designed by the finished-bar manufacturer.

8. Measurements of Deformations

8.1 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

TABLE 3 Deformation Dimensions for Type II Bar

Nominal Diameter		Deformation Dimensions					
		Maximum Average Spacing		Minimum Average Height		Minimum Projected Area[A]	
mm	in.	mm	in.	mm	in.	mm^2/mm	$in.^2/in.$
15	⅝	11.1	0.44	0.7	0.03	2.4	0.09
20	¾	13.3	0.52	1.0	0.04	3.4	0.13
26	1	17.8	0.70	1.3	0.05	4.4	0.17
32	1¼	22.5	0.89	1.6	0.06	5.4	0.21
36	1⅜	25.1	0.99	1.8	0.07	6.1	0.24
46	1¾	30.1	1.19	2.2	0.09	7.3	0.29
65	2½	44.5	1.75	2.9	0.11	9.7	0.38

[A] Calculated from equation, min projected area = $0.75\pi d\, h/s$
where:
d = nominal diameter,
h = minimum average height, and
s = maximum average spacing.

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from a point on a deformation to a corresponding point on any other deformation on the same side of the bar.

8.2 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.

8.3 To indicate adequately the conformity to the dimensional requirements, measurements shall be taken at random from one bar from each 30 Mg (33 tons) of each lot or fraction thereof.

8.4 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 7. 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 2—The term "lot" shall mean all bars of the same nominal mass (weight) per metre (linear foot) contained in an individual shipping release or shipping order.

9. Permissible Variation in Size or Weight

9.1 For Type I bars, the permissible variation from the nominal diameter specified in Table 1 shall not exceed +0.75, −0.25 mm (+0.030, −0.010 in.).

9.2 For Type II bars, the permissible variation from the nominal weight specified in Table 2 shall not exceed +3 %, −2 %.

10. Finish

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

11. Packaging and Package Marking

11.1 Packaging, marking, and loading for shipment shall be in accordance with Practices A 700.

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

11.3 Unless otherwise specified in the contract or order, bars shall be grouped by size. Each bundle or lift shall be tagged showing the heat number, bar size, specification number (Specification A 722/A 722M), and the identity of the finished bar manufacturer. The tags shall display the following statement "High Strength Prestressing Bars". Both ends of each bar shall be painted yellow.

12. Inspection

12.1 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.

12.2 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.

12.3 If outside inspection is waived, the finished-bar 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. Rejection

13.1 Unless otherwise specified, any rejection based on tests made in accordance with 5.2 shall be reported to the manufacturer within 5 working days from the receipt of samples by the purchaser.

13.2 Material that shows injurious defects subsequent to its acceptance at the manufacturer's works shall be subject to rejection, and the manufacturer shall be notified.

14. Rehearing

14.1 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.

15. Certification

15.1 If 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. The certification shall include the specification number, year-date of issue, and revision letter, if any.

15.2 The manufacturer shall, when required in the order, furnish a representative load-elongation curve for each size and type of bar shipped.

15.3 A modulus of elasticity value of 205 GPa (29 700 000 psi) shall be used for the purpose of elongation calculation for Type II bars.

NOTE 3—Experience has shown that plotted load-elongation curves from mill tests on Type II bars vary excessively and are not sufficiently reliable for use in calculating modulus of elasticity values.

15.4 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 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.

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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.

16. Keywords

16.1 deformed bars; high-strength steel bars; plain bars; post-tensioning; prestressed concrete

SUPPLEMENTARY REQUIREMENTS

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

S1. Bending Properties

S1.1 The bend test specimen shall withstand being bent, at ambient temperature but in no case less than 15°C (59°F), 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.

S1.2 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:

S1.2.1 Continuous and uniform application of force throughout the duration of the bending operation.

S1.2.2 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.

TABLE S1.1 Supplementary Bend Test Requirements

Nominal Bar Diameters		Diameter of Pin for 135° Bend[A]
mm	in.	
15	⅝	$d = 6t$
20	¾	$d = 6t$
26	1	$d = 6t$
32	1¼	$d = 8t$
36	1⅜	$d = 8t$
46	1¾	$d = 10t$
65	2½	$d = 10t$

[A] d = diameter of pin around which specimen is bent. t = nominal diameter of bar.

S1.2.3 Close wrapping of the specimen around the pin during the bending operation.

S1.3 Other methods of bend testing shall be permitted, but failures due to such methods shall not constitute a basis for rejection.

S1.4 The number of bend test specimens shall be one from each 20 Mg (22 tons), or fraction thereof, of each size of bar rolled from each heat but not less than two from each heat. The specimens shall be randomly selected following the final processing operation.

S1.5 If a bend test fails for reasons other than mechanical reasons or flaws in the specimen as described in 6.5.3 and 6.5.4, a retest shall be permitted on two random specimens from the quantity of the finished bar product for each bar size in S1.4. 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 15°C (59°F).

S2. Reduction of Area

S2.1 The minimum reduction of area from the effective area shall be 20 % for Type I plain bars.

S3. Chemical Requirements

S3.1 The chemical composition determined as specified in 5.1 shall be reported to the purchaser or his representative.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A 722/A 722M – 06) that may impact the use of this standard. (Approved March 1, 2007.)

*(1)*Revised 15.2 and added new paragraph 3.1.8.

Committee A01 has identified the location of selected changes to this standard since the last issue (A 722/A 722M – 05) that may impact the use of this standard. (Approved Sept. 1, 2006.)

(1) Section 11 was revised.

(2) Sections 2.2 and 2.3 were added.

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