



Designation: A663/A663M – 23

Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties¹

This standard is issued under the fixed designation A663/A663M; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This specification covers hot-wrought merchant quality carbon steel bars and bar size shapes produced to mechanical property requirements and intended for noncritical construction applications (see 8.2).

1.2 Merchant quality hot-wrought steel bar is available in the following ranges of size and section:

1.2.1 Rounds, squares, and hexagons with diameters or distance across flats under 3 in. [75 mm].

1.2.2 Bar size shapes with maximum dimensions under 3 in. [75 mm].

1.2.3 Other bar sections with weight per foot under 40.84 lb/ft [60.78 kg/m].

1.2.4 Flats 6 in. [152 mm] or under in width, over 0.203 in. [over 5 mm in thickness up to 150 mm in width] in thickness, and under 40.84 lb/ft or 12 in.² [77.4 cm²] in cross-sectional area.

1.2.5 Flats over 6 in. to 8 in., inclusive in width, 0.230 in. and over [over 6 mm in thickness and over 50 mm through 200 mm in width] in thickness and under 40.84 lb/ft [60.78 kg/m] or 12 in.² [77.4 cm²] in cross-sectional area.

1.2.6 Hot-wrought merchant quality carbon steel bars subject to mechanical property requirements are hot wrought in straight lengths only.

1.3 Some applications may require one or more of the available designations shown under supplementary requirements.

NOTE 1—Special quality hot-wrought carbon steel bars subject to mechanical property requirements are covered in Specification A675/A675M.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each

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system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.5 *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:²

A29/A29M Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A675/A675M Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties

A941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys

E290 Test Methods for Bend Testing of Material for Ductility

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this standard, refer to Terminology A941.

4. Ordering Information

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

4.1.1 Quantity (weight or number of pieces),

4.1.2 Dimensions (cross-sectional shape, size, and length),

4.1.3 Name of material (merchant quality carbon steel bars),

4.1.4 Specification number and date of issue,

4.1.5 Grade designation,

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.

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

- 4.1.6 Copper bearing steel (if required),
- 4.1.7 Heat analysis or test report (request, if required),
- 4.1.8 Application and processing, and
- 4.1.9 Supplementary requirements (if required).

5. Manufacture

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

6. Chemical Composition

6.1 The steel shall conform on heat analysis to the following chemical requirements:

Phosphorus, max, percent	0.040
Sulfur, max, percent	0.050
Copper, when copper steel is specified, min, percent	0.20

7. Mechanical Properties

7.1 Tensile Requirements:

7.1.1 The material as represented by the test specimen shall conform to the applicable requirements in **Table 1**.

7.1.2 Test specimens shall be prepared for testing from the material in its as-rolled condition. The tension specimen may be aged as described in Test Methods and Definitions **A370**.

7.1.3 Test specimens shall be taken longitudinally and may be tested in full thickness or section, or they may be machined to the dimensions shown in Figs. 4 or 5 of Test Methods and Definitions **A370**. If test specimens are selected conforming to the dimensions of Fig. 5, they shall be machined from a position midway between the center and the surface of the bar.

7.1.4 Test specimens for shapes and flats may be machined to the form and dimensions shown in Fig. 4 of Test Methods and Definitions **A370** or with both edges parallel. Test specimens for material over 1½ in. [40 mm] in thickness or diameter may be machined to a thickness or diameter of at least ¾ in. [20 mm] for a length of at least 9 in. [230 mm], or they may conform to the dimensions shown in Fig. 5 of Test Methods and Definitions **A370**.

7.1.5 Tensile requirements shall be determined in accordance with Test Methods and Definitions **A370**.

7.1.6 For material over ¾ in. [19 mm] in thickness or diameter, a deduction from the percentage of elongation in 8 in. [200 mm] specified in **Table 1** of 0.25 % shall be made for each

increase of ½ in. [0.8 mm] in the specified thickness or diameter above ¾ in. [19 mm].

7.1.7 For material under ⅝ in. [8 mm] in thickness or diameter, a deduction from the percentage of elongation in 8 in. [200 mm] specified in **Table 1** of 2.00 % shall be made for each decrease of ½ in. [0.8 mm] in the specified thickness or diameter below ⅝ in. [8 mm].

7.1.8 For material over 2 in. [50 mm] in thickness or diameter, a deduction from the percentage of elongation in 2 in. [50 mm] specified in **Table 1** of 1.00 % shall be made for each 1 in. [25 mm] of specified thickness or diameter or fraction thereof over 2 in. [50 mm] in thickness or diameter.

7.2 Number of Tests:

7.2.1 Two tension tests shall be made from each heat, unless the finished material from a heat is less than 50 tons [45 Mg], when one tension test will be sufficient. However, for material 2 in. [50 mm] and under in thickness, when the material from one heat differs ⅜ in. [9.5 mm] or more in thickness, one tension test shall be made from both the thickest and the thinnest material rolled, regardless of weight represented. For material over 2 in. [50 mm] thick, when the material from one heat differs 1 in. [25 mm] or more in thickness, one tension test shall be made from both the thickest and the thinnest material rolled that is more than 2 in. [50 mm] thick regardless of the weight represented.

7.3 Test Reports:

7.3.1 When test reports are required by the purchase order, the report shall show the results of each test required by **7.2**, except that only one test need be reported when the amount of material from a heat in a shipment is less than 10 tons [9 Mg] and when the thickness variations described in **7.2** are not exceeded.

7.3.2 The thickness of the product tested may not necessarily be the same as an individual ordered thickness since it is the heat that is tested rather than each ordered item.

7.3.3 When Supplementary Requirements are specified, the report shall include a statement of compliance with the requirement or the results of tests when the requirement involves measured test values.

TABLE 1 Tensile Requirements

Grade Designation	Tensile Strength, ksi [MPa]	Yield Point, ^A min, ksi [MPa]	Elongation, min, %	
			8 in. or [200 mm] Gage Length	2 in. or [50 mm] Gage Length
45 [310]	45–60 [310–415]	25.0 [175]	27	33
50 [345]	50–65 [345–450]	28.0 [195]	25	30
55 [380]	55–70 [380–485]	30.0 [210]	23	26
60 [415]	60–75 [415–515]	33.0 [230]	21	22
65 [450]	65–80 [450–550]	36.0 [250]	17	20
70 [485]	70–85 [485–585]	39.0 [270]	14	18
75 [515]	75–90 [515–620]	41.0 [285]	14	18
80 [550]	80 min [550 min]	44.0 [305]	13	17

^A When the tension test does not show a yield point (drop of the beam, halt of the pointer or sharp-kneed stress-strain diagram), yield strength shall be determined by either 0.5 % extension-under-load or 0.2 % offset. The minimum ksi (MPa) requirement does not change. The test report, if required, shall show yield strength.

8. General Requirements

8.1 Material furnished under this specification shall conform to the requirements of the current edition of Specification **A29/A29M**, except as stated in **1.2**.

8.2 Merchant quality bars shall be free from visible pipe; however, they may contain pronounced chemical segregation. Internal porosity, surface seams, and other surface irregularities may be present in this quality. Deoxidation practice and grain size are at the manufacturer's option.

8.3 Unless otherwise specified, the bars shall be furnished as rolled and not pickled, blast cleaned, or oiled.

9. Keywords

9.1 carbon steel bars; merchant quality steel bars; steel bars