Designation: A 675/A 675M – 03$^{\epsilon 1}$

Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties[1]

This standard is issued under the fixed designation A 675/A 675M; 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 Department of Defense.

ε[1] NOTE—Editorial changes were made to S7.1 in June 2005.

1. Scope*

1.1 This specification[2] covers hot-wrought special quality carbon steel bars and bar size shapes produced to mechanical property requirements and intended for general constructional applications.

1.2 The bars are available in nine strength grades designated 45, 50, 55, 60, 65, 70, 75, 80, and 90 [310, 345, 380, 415, 450, 485, 515, 550, and 620] corresponding to the minimum ultimate tensile strength in ksi [MPa]. The chemical composition is selected by the manufacturer to develop the required mechanical properties.

1.3 Hot-wrought special quality carbon steel bars subject to mechanical property requirements are hot wrought in straight lengths only. Sections and sizes available are covered in Specification A 29/A 29M.

1.4 Some applications may require one or more of the available designations shown under Supplementary Requirements.

NOTE 1—Merchant-quality hot-wrought carbon steel bars subject to mechanical property requirements are covered in Specification A 663/A 663M.

1.5 The values stated in either inch-pound units or SI units are to be regarded separately as the standard. Within the text, the SI units are shown in brackets. The values stated in each system are not equivalents, therefore each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

2. Referenced Documents

2.1 *ASTM Standards:* [3]

A 29/A 29M Specification for Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished, General Requirements for

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

A 663/A 663M Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties

E 290 Test Method for Semi-Guided Bend Test for Ductility of Metallic Materials

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *special quality*—Special quality bars are used when end use, method of fabrication, or subsequent processing treatment requires quality characteristics not available in merchant quality. Typical applications involve bending or machining for general constructional uses. Some end uses or fabricating procedures can necessitate one or more requirements which are described in the Supplementary Requirements.

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 Name of material (hot-wrought special quality bars),

4.1.3 Dimensions, including length,

4.1.4 Cross section (round, square, hexagon, equal leg angle, etc.),

4.1.5 Specification designation and date of issue,

4.1.6 Grade designation (Table 1),

[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 A01.15 on Bars.

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[2] For ASME Boiler and Pressure Vessel Code applications see related Specification SA 675 in Section II of that Code.

[3] 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.**

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TABLE 1 Tensile Requirements

Grade Designation[A]	Tensile Strength		Yield Point, min[B]		Elongation, min, %[C]	
	ksi	[MPa]	ksi	[MPa]	8 in. or [200 mm] Gage Length	2 in. or [50 mm] Gage Length
45 [310]	45 to 55	[310 to 380]	22.5	[155]	27	33
50 [345]	50 to 60	[345 to 415]	25	[170]	25	30
55 [380]	55 to 65	[380 to 450]	27.5	[190]	23	26
60 [415]	60 to 72	[415 to 495]	30	[205]	21	22
65 [450]	65 to 77	[450 to 530]	32.5	[225]	17	20
70 [485]	70 to 85	[485 to 585]	35	[240]	14	18
75 [515]	75 to 90	[515 to 620]	37.5	[260]	14	18
80 [550]	80 min	[550 min]	40	[275]	13	17
90 [620]	90 min	[620 min]	55	[380]	10	14

[A] When lead is required, add the letter "L" after the grade designation, for example, 45L.
[B] 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.
[C] See 7.1.1.3 through 7.1.1.6 for deduction in elongation due to section size.

4.1.7 Leaded steel, if required (6.2),
4.1.8 Copper bearing steel, if required (6.3),
4.1.9 Test report, if required (Section 10),
4.1.10 Supplementary Requirements or special requirements if required, and
4.1.11 Application and processing.

NOTE 2—A typical ordering description is as follows: 10 000 lb, [5000 kg] Hot Wrought Special Quality Carbon Steel Bars, 1 in. diameter × 10 ft, [25m × 3m] Round, ASTM A 675/A 675M dated ____, Grade 50, [345] Copper Bearing, Test Report Required, S3 Special Straightness, Boiler Supports.

5. Materials and Manufacture

5.1 *Melting Practice*—The steel shall be made by one or more of the following primary processes: open-hearth, basic-oxygen, or electric-furnace. The primary melting may incorporate separate degassing or refining and may be followed by secondary melting using electroslag remelting or vacuum-arc remelting. Where secondary melting is employed, the heat shall be defined as all of the ingots remelted from a single primary heat.

5.2 *Deoxidation*:

5.2.1 Unless otherwise specified, the steel shall be rimmed, capped, semi-killed, or killed at the producer's option.

5.2.2 When required, the purchaser may specify the required deoxidation practice, dependent upon strength grade specified, purchaser's methods of fabrication, and end use requirements. Killed steels can be produced to coarse or fine austenitic grain size (Supplementary Requirement S1).

5.3 *Condition*—Unless otherwise specified, the bars shall be furnished as-rolled and not pickled, blast cleaned, or oiled. At the producer's option, bars may be cleaned for inspection.

6. Chemical Composition

6.1 The steel shall conform to the chemical requirements specified in Table 2.

TABLE 2 Chemical Requirements (Heat Analysis)

Element	
Phosphorus, max	0.040
Sulfur, max	0.050
Copper, when copper steel is specified, min	0.20
Lead	[A]

[A] When required, lead may be specified as an added element. See 6.2.

6.2 *Leaded Steel*—When required, lead may be specified as an added element. When lead is specified as an added element, a range from 0.15 to 0.35 % inclusive shall be furnished. Such a steel is identified by adding the letter L after the grade designation, for example 60L [415L].

6.3 *Copper-Bearing Steel*—When required copper may be specified as an added element. Copper-bearing steel is identified by stating "copper-bearing" on the purchase order.

6.4 When tension tests are waived in accordance with 7.1.1.2, chemistry consistent with the mechanical properties desired shall be applied.

7. Mechanical Properties

7.1 *Tension Tests*

7.1.1 *Requirements*:

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

7.1.1.2 Shapes less than 1 in.^{2} [645 mm^2] in cross section and bars (other than flats) less than ½ in. [12.5 mm] in thickness or diameter need not be subject to tension tests by the manufacturer.

7.1.1.3 For material over ¾ in. [19 mm] in thickness or diameter, a deduction of 0.25 % from the percentage of elongation in 8 in. [200 mm] specified in Table 1 shall be made for each increase of 1/32 in. [0.8 mm] in the specified thickness or diameter above ¾ in. [19 mm].

7.1.1.4 For material under 5/16 in. [8 mm] in thickness or diameter, a deduction of 2.00 % from the percentage of elongation in 8 in. [200 mm] specified in Table 1 shall be made for each decrease of 1/32 in. [0.8 mm] in the specified thickness or diameter below 5/16 in. [8 mm].

7.1.1.5 For Grades 45, 50, 55, 60, and 65 [310, 345, 380, and 415] for material over 2 in. [50 mm] in thickness or diameter, a deduction of 1.00 % from the percentage of elongation in 2 in. [50 mm] specified in Table 1 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.

7.1.1.6 For Grades 70, 75, 80, and 90 [485, 515, 550 and 620] for material over 2 in. [50 mm] in thickness or diameter, a deduction of 1.00 % from the percentage of elongation in 2 in. [50 mm] specified in Table 1 shall be made for each 1 in.

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[25 mm] of specified thickness or diameter, or fraction thereof, over 2 in. [50 mm] in diameter or thickness, to a maximum deduction of 3 %.

7.1.2 *Test Specimens*:

7.1.2.1 Test specimens shall be prepared for testing from the material in its as-rolled condition unless otherwise specified (see Supplementary Requirements). The tension specimen may be aged as described in Test Methods and Definitions A 370.

7.1.2.2 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 Fig. 4 or Fig. 5 of Test Methods and Definitions A 370. 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.

7.1.2.3 Test specimens for shapes and flats may be machined to the form and dimensions shown in Fig. 4 of Test Methods and Definitions A 370 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 A 370.

7.1.3 *Number of Tests*—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 (larger than the sizes in 7.1.1.2) regardless of the weight represented. For material over 2 in. [50 mm] thick, when the material from 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.

7.1.4 *Test Method*—Tension tests shall be made in accordance with Test Methods and Definitions A 370 using the applicable method for determining yield point.

7.2 *Bend Tests*:

7.2.1 *Requirements*:

7.2.1.1 Bend requirements apply only to flat bars (all sizes), bars other than flats less than ½ in. [12.5 mm] in thickness or diameter, and shapes less than 1 in.^{2} [645 mm^2] in cross section. When bend tests are required for other sizes, Supplementary Requirement S6 must be specified.

7.2.1.2 The bend test specimen shall stand being bent at room temperature through 180° without cracking on the outside of the bent portion, to an inside diameter which shall have the relation to the thickness or diameter of the specimen as given in Table 3.

7.2.2 *Test Specimens*:

7.2.2.1 Bend test specimens for material 1½ in. [40 mm] and under in diameter or thickness may be the full thickness of the section. For flat bars over 2 in. [50 mm] in width, the width may be reduced by milling to 1½ in. [40 mm].

7.2.2.2 Bend test specimens for material over 1½ in. [40 mm] in diameter or thickness may be machined to a thickness or diameter of at least ¾ in. [20 mm] or to 1 by ½ in. [25 by 12.5 mm] in section. Machined sides of bend test specimens may have the corners rounded to a radius of not over 1/16 in. [1.6 mm] for material 2 in. [50 mm] and under in thickness, and not over ⅛ in. [3.2 mm] in radius for material over 2 in. [50 mm] in thickness.

7.2.3 *Number of Tests*—When subject to bend test, two bend tests shall be made from each heat, unless the finished material from a heat is less than 50 tons [45 Mg], when one bend 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 bend test shall be made from both the thickest and the thinnest material rolled regardless of the 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 bend 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.

7.2.4 *Test Methods*—Bend tests shall be made in accordance with Test Method E 290.

8. Workmanship, Finish, and Appearance

8.1 Bars shall be free of visible pipe, undue segregation, and injurious surface imperfections.

8.2 *Surface Finish*—The bars shall have a commercial hot-wrought finish obtained by conventional hot rolling. See 5.3 for producer's descaling option.

TABLE 3 Bend Requirements

Grade Designation	Ratio of Bend Diameter to Thickness of Specimen for Thickness or Diameter of Bar, in. (mm)						
	¾ [20] and Under	Over ¾ [20] to 1 [25], incl	Over 1 [25] to 1½ [40], incl	Over 1½ [40] to 2 [50], incl	Over 2 [50] to 3 [75], incl	Over 3 [75] to 5 [125], incl	Over 5 [125]
45 [310]	flat	flat	½	1	1	2	3
50 [345]	flat	½	1	1½	2½	3	3½
55 [380]	½	1	1½	2	2½	3	3½
60 [415]	½	1	1½	2½	3	3½	4
65 [450]	1	1½	2	3	3½	4	5
70 [485]	1½	2	2½	3	3½	4	5
75 [515]	2	2	3	3½	4	4½	6
80 [550]	2	2½	3	3½	4	4½	6
90 [620][A]							

[A] Bend requirements are not required for Grade 90 [620], but may be specified by agreement between purchaser and manufacturer (see Supplementary Requirement S6).

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9. General Requirements

9.1 Material furnished under this specification shall conform to the applicable requirements for the current edition of Specification A 29/A 29 M.

10. Certification

10.1 When specified by the purchaser, a manufacturer's certification that the material was manufactured and tested in accordance with this specification together with a report of the heat analysis, tensile requirements, and bend test (if applicable) test results shall be furnished. 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 (7.1.3) and (7.2.3) are not exceeded. The report shall include the name of the manufacturer, ASTM designation number and year date and revision letter, if any, grade, heat number, and size.

10.2 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.

10.3 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.

11. Keywords

11.1 carbon steel bars; hot-wrought steel bars; steel bars

SUPPLEMENTARY REQUIREMENTS

One or more of the following supplementary requirements shall apply only when specified by the purchaser in the inquiry, contract, or order. Details of these supplementary requirements shall be agreed upon in writing by the manufacturer and purchaser. Supplementary requirements shall in no way negate any requirements of the specification itself.

S1. Grain Size

S1.1 The steel shall conform to the coarse austenitic grain size requirement, or the fine austenitic grain size requirement of Specification A 29/A 29M.

S2. Thermal Treatment

S2.1 When required, the purchaser may specify that the material be stress relieved.

S3. Special Straightness

S3.1 Bars may be specified to special straightness tolerance (refer to Specification A 29/A 29M).

S4. Cleaning

S4.1 The purchaser may specify that the surface of bars be descaled by pickling or blast cleaning.

S5. Coating

S5.1 The purchaser may specify oil on bars that have been descaled.

S6. Bend Requirement

S6.1 Bend requirements for Grade 90 [620] may be specified. The bend ratio shall be as agreed upon. Bend requirements for all other grades, when specified, shall be as specified in Table 3.

S7. Carbon Restriction

S7.1 On grades 45 [310], 50 [345], 55 [380], and 60 [415], carbon shall be 0.35 % max.

SUMMARY OF CHANGES

Committee A01 has identified the location of the following changes to this standard since A 675/A 675M-90a (2000) that may impact the use of this standard.

(1) Added Supplementary Requirement S7.

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