Designation: A 434 – 06

Standard Specification for Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered[1]

This standard is issued under the fixed designation A 434; 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.

1. Scope*

1.1 This specification covers hot-wrought and cold-finished quenched and tempered alloy steel bars.

1.2 Hot-wrought bars are available in three strength level classes designated BB, BC, and BD, and cold-finished bars in two strength level classes designated BB and BC. The bars are available in the conditions specified in 4.4 subject to the size limitations shown.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

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

A 108 Specification for Steel Bar, Carbon and Alloy, Cold-Finished

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

E 112 Test Methods for Determining Average Grain Size

3. Ordering Information

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

3.1.1 Quantity (weight or number of pieces),

3.1.2 Name of material (heat-treated alloy steel bars),

3.1.3 Method of finish (condition) (4.4),

3.1.4 Dimensions, including length (if hot-wrought bars are for cold finishing, the cold-finished size should also be specified),

3.1.5 ASTM designation and date of issue,

3.1.6 Chemical composition grade (Section 5),

3.1.7 Strength class (Table 1),

3.1.8 Test report, if required (Section 11),

3.1.9 Supplementary Requirements or Special Requirements, if required, and

3.1.10 End use.

NOTE 1—A typical ordering description is as follows: 10 000 lb, Heat-Treated Alloy Steel Bars, Hot Rolled, 1.000 in. diameter × 10 ft, ASTM A 434 dated ____, Grade 4140, Class BB, Test Report Required, Motor Shafts.

4. Materials and Manufacture

4.1 *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.

4.2 *Discard*—Sufficient discard shall be made to secure freedom from injurious piping and undue segregation.

4.3 *Slow Cooling*—Hot-wrought alloy bars shall, immediately after rolling, be allowed to cool to a temperature below the critical range under suitable conditions to prevent injury by too rapid cooling.

4.4 *Condition*—Bars shall be furnished in one of the following conditions, as specified by the purchaser. Generally, size limits for various methods of processing round bars are:

Hot-wrought or hot-wrought descaled	9½ in. (241.3 mm), max
Cold-drawn	⅛ to 4 in. (3.2 to 102 mm), incl
Cold-drawn, ground, and polished	⅛ to 4 in. (3.2 to 102 mm), incl
Turned and polished	¾ to 9 in. (19.1 to 229 mm), incl
Turned, ground, and polished	¾ to 9 in. (19.1 to 229 mm), incl

4.5 *Heat Treatment*:

4.5.1 Heat treatment shall include quenching and tempering for all classes of material. The material shall be uniformly heated to the austenitizing temperature, soaked for a sufficient

[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 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 Properties

NOTE—The mechanical properties of hot-wrought bars ordered for cold finishing, shall be governed by the cold-finished size.

Class	Diameter, in. (mm)	Yield Strength, min, ksi (MPa)[A]	Tensile Strength, min, ksi (MPa)	Elongation in 2 in. or 50 mm, min, %	Reduction of Area, min, %	SAE or AISI Representative Grade Types[B]
BB[C]	1½ (38.1) and under	90 (620)	110 (760)	20	50	3100, 4100, 8600, 8700
	Over 1½ to 2½ (38.1 to 63.5), incl	80 (550)	105 (720)	20	50	
	Over 2½ to 4 (63.5 to 114), incl	75 (520)	100 (690)	20	50	
	Over 4 to 7 (114 to 178), incl	75 (520)	95 (660)	20	50	
	Over 7 to 9½ (178 to 241.3), incl	65 (450)	90 (620)	18	40	
BC[C]	1½ (38.1) and under	110 (760)	130 (900)	16	50	3100, 4100, 6100, 8600, 8700
	Over 1½ to 2½ (38.1 to 63.5), incl	105 (720)	125 (860)	16	50	
	Over 2½ to 4 (63.5 to 114), incl	95 (660)	115 (790)	16	45	
	Over 4 to 7 (114 to 178), incl	85 (590)	110 (760)	16	45	3100, 4100
	Over 7 to 9½ (178 to 241.3), incl	80 (550)	105 (720)	15	40	4300, 9800
BD[C]	1½ (38.1) and under	130 (900)	155 (1070)	14	35	4100, 4300, 9800
	Over 1½ to 2½ (38.1 to 63.5), incl	120 (830)	150 (1030)	14	35	
	Over 2½ to 4 (63.5 to 114), incl	110 (760)	140 (960)	14	35	
	Over 4 to 7 (114 to 178), incl	105 (720)	135 (930)	14	35	
	Over 7 to 9½ (178 to 241.3), incl	100 (690)	130 (900)	14	35	

[A] The carbon content of all steels listed in this column may vary up to 0.55 % max, as agreed upon by the manufacturer and the purchaser.
[B] Determined by the 0.2 % offset method.
[C] Class BB, BC, BD hot-wrought; Class BB, BC cold-finished.

length of time to produce the desired structure (a lot thus heated being known as a "quenching charge"), and quenched in a suitable medium under substantially uniform conditions for each quenching charge. The material shall then be uniformly reheated to the proper temperature for tempering (a lot thus reheated being known as a "tempering charge"), and allowed to cool uniformly. The temperature selected for tempering shall be not less than 800°F (427°C).

4.5.2 Material cold drawn after heat treatment shall be stress relieved, when this is necessary, in order to meet the specified mechanical properties.

4.5.3 Cold-finished bars may be stress relieved after straightening.

4.5.4 For heat-treated hot-wrought bars, where it is desirable to minimize internal stresses introduced by machine straightening, the purchaser may specify a stress relief as a final operation.

4.5.5 If warpage occurs in the stress-relieving operation, the bars may be restraightened without further stress-relieving, provided they meet the required mechanical properties.

5. Chemical Composition

5.1 The grade of steel furnished shall be specified by the purchaser and shall be selected from the standard alloy grades in Table 2 of Specification A 29/A 29M, or to such other compositions as may be specified using the ranges and limits in Table 4 of Specification A 29/A 29M.

5.2 In all cases, the grade specified shall be capable of developing the required mechanical properties. If, in the opinion of the manufacturer, the grade specified is not capable of developing the mechanical properties, the manufacturer shall notify the purchaser and whenever possible suggest an alternative grade.

5.3 Representative grade types listed for the respective classes and bar sizes in Table 1 are for information only.

6. Grain Size

6.1 *Requirement*—The bars shall have an austenitic grain size of 5 and finer. The grain structure shall be considered satisfactory if 70 % is within the specified size limits.

6.2 *Specimens*—Grain size specimens shall be taken in accordance with Test Methods E 112.

6.3 *Number of Tests*—Not less than one grain size test shall be made per heat.

6.4 *Test Method*—Grain size shall be determined in accordance with the Comparison Method of Test Methods E 112.

7. Mechanical Properties

7.1 *Requirements*—The material, as represented by test specimens, shall conform to the tensile properties in Table 1 for the class specified.

7.2 *Specimens*:

7.2.1 Test specimens shall be taken longitudinally after final processing.

7.2.2 Test specimens shall be selected from the locations and prepared for testing as specified in Test Methods and Definitions A 370.

7.3 *Number of Tests*—One tension test shall be made from each tempering or stress-relieving charge. If more than one quenching charge is represented, one tension test shall be made from each quenching charge. If more than one heat is represented in a quenching charge, one tension test shall be made from each heat and size. For continuous-type treatment, one tension test shall be made for each 25 tons (22.7 Mg) of each heat or size.

7.4 *Test Method*—Tension tests shall be made in accordance with Test Methods and Definitions A 370 using the 0.2 % offset method when determining yield strength.

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8. Permissible Variation of Dimensions

8.1 *Special Straightness*—Unless otherwise specified, all material shall be supplied to a straightness tolerance of ⅛ in. (3.18 mm) in any 5 ft (1.5 m), but may not exceed the following:

Maximum straightness deviation, in. = 1/8 × (length in feet/5)

9. Workmanship, Finish, and Appearance

9.1 *Workmanship*—The bars shall be free of pipe, cracks, and flakes. Within the limits of good manufacturing and inspection practices, the bars shall be free of injurious seams, laps, segregation, or other imperfections which, due to their nature, degree, or extent, will interfere with the use of the material in machining or fabrication of suitable parts.

9.2 *Oiling*—Unless otherwise specified, hot-wrought descaled bars and cold-finished bars shall be given a surface coating of oil or other rust inhibitor to protect against rust during shipment.

10. General Requirements

10.1 Material furnished under this specification shall conform to the applicable requirements for the current edition of Specification A 29/A 29M or Specification A 108.

11. Certification and Report of Testing

11.1 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, grain size, and tensile requirement test results shall be furnished. The report shall include the name of the manufacturer, ASTM designation number and yeardate and revision letter, if any, grade, class, heat number, and size.

11.2 When Supplementary Requirement S1 is specified, the report shall include a statement of compliance with the requirement or the results of tests when the requirement involves measured test values.

12. Keywords

12.1 alloy steel bars; cold-finished steel bars; hot-wrought steel bars; quenched and tempered steel bars; steel bars

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirement shall be applied only when specified by the purchaser in the inquiry, contract, or order. Details of this supplementary requirement 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. Hardness Test

S1.1 Maximum surface Brinell hardness, if specified by the purchaser, shall be as agreed upon between the manufacturer and the purchaser.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue, A 434 – 04, that may impact the use of this standard. (Approved May 1, 2006.)

(*1*) Changed wording in Section 6.1.

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