Designation: A 331 – 95 (Reapproved 2000)

Standard Specification for Steel Bars, Alloy, Cold-Finished[1]

This standard is issued under the fixed designation A 331; 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 cold-finished alloy steel bars of grades and cross sections regarded as generally suitable for heat treatment, for machining into components, or for use in the "as-finished" condition in constructional applications, or for other similar purposes. Grades of steel are identified by grade numbers or by chemical composition (see Specifications A 304 or A 322, or Practice A 400).

1.2 Some end uses may require material superior to standard requirements, involving one or more of the available designations shown in the supplementary requirements. These shall apply only when specified individually by the purchaser in the order.

2. Referenced Documents

2.1 *ASTM Standards:*

A 29/A 29M Specification for Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished, General Requirements for[2]

A 304 Specification for Carbon and Alloy Steel Bars Subject to End-Quench Hardenability Requirements[2]

A 322 Specification for Steel Bars, Alloy, Standard Grades[2]

A 400 Practice for Steel Bars, Selection Guide, Composition, and Mechanical Properties[2]

E 45 Test Methods for Determining the Inclusion Content of Steel[3]

E 112 Test Methods for Determining the Average Grain Size[3]

2.2 *Other Documents:*

SAE Handbook[4]

Fed. Std. No. 66, Steel: Chemical Composition and Hardenability[5]

AISI Steel Products Manual for Alloy Steel: Semifinished, Hot-Rolled and Cold-Finished Bars[6]

3. Ordering Information

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

3.1.1 Quantity (weight or number of pieces),
3.1.2 Cross-sectional shape,
3.1.3 Dimensions (size, length),
3.1.4 Name of material (bars, alloy steel, cold-finished),
3.1.5 ASTM designation and date of issue,
3.1.6 Grade or chemical composition,
3.1.7 Condition (4.4),
3.1.8 Heat treatment (4.5),
3.1.9 Supplementary requirements, if any,
3.1.10 Additional requirements, if any,
3.1.11 End use, and
3.1.12 Report of heat analysis, if required.

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*—A sufficient discard shall be made to secure freedom from injurious piping and undue segregation.

4.3 *Material*—The bars shall be produced from hot-wrought alloy steel bars (Specification A 322), or from alloy steel bars subject to end-quenched hardenability requirements (Specification A 304).

4.4 *Condition*—The bars shall be furnished in one of the following surface finishes as specified by the purchaser:

4.4.1 *Rounds*:
4.4.1.1 Cold drawn.
4.4.1.2 Cold drawn, turned, and polished.
4.4.1.3 Cold drawn, ground, and polished.

[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] *Annual Book of ASTM Standards*, Vol 01.05.

[3] *Annual Book of ASTM Standards*, Vol 03.01.

[4] Available from Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.

[5] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

[6] Available from the American Iron and Steel Institute, 150 E. 42nd St., New York, NY 10017.

4.4.1.4 Cold drawn, turned, ground, and polished.
4.4.1.5 Hot wrought, turned, and polished.
4.4.1.6 Hot wrought, turned, ground, and polished.
4.4.1.7 Hot wrought, rough turned.
4.4.2 *Squares and Hexagons*—Cold drawn.
4.4.3 *Flats*:
4.4.3.1 Cold drawn.
4.4.3.2 Cold rolled.

4.5 *Heat Treatment*—When required, the bars shall be furnished in one of the following heat-treated conditions as specified by the purchaser:
4.5.1 Annealed and cold finished,
4.5.2 Spheroidize annealed and cold finished,
4.5.3 Normalized and cold finished,
4.5.4 Cold drawn and stress relieved,
4.5.5 Normalized, cold finished, and stress relieved,
4.5.6 Normalized, tempered, and cold finished,
4.5.7 Annealed, cold finished, and stress relieved,
4.5.8 Quenched and tempered and cold finished,
4.5.9 Quenched and tempered, cold finished, and stress relieved, or
4.5.10 Carbon restoration annealed to overcome surface decarburization on cold-drawn bars. (For round bars produced by turning, surface decarburization is removed during the manufacturing process.)

5. Chemical Composition

5.1 *Cast or Heat Analysis*:
5.1.1 The cast analysis of the steel shall conform to that specified in Specification A 29/A 29M for the steel grade ordered, or to such other limits as may be specified using the standard ranges in Specification A 29/A 29M.
5.1.2 When required, steels may also be selected from Fed. Std. No. 66, the *SAE Handbook*, or the AISI *Steel Products Manual for Alloy Cold-Finished Bars*.

6. Metallurgical Requirements

6.1 *Grain Size*—When required, austenitic grain size may be specified as either coarse (grain size 1 to 5, inclusive) or fine (grain size 5 to 8, inclusive). 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. Workmanship, Finish, and Appearance

7.1 *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.
7.2 *Surface Finish*:
7.2.1 Unless otherwise specified, the bars shall have a commercial bright smooth surface finish obtained by conventional cold-finishing operations such as cold drawing, cold rolling, or turning and polishing.
7.2.2 Bars that are thermal treated after cold finishing may have a discolored or oxidized surface.
7.3 *Oiling*—The bars shall be given a surface coating of oil or other rust inhibitor to protect against rust during shipment.

8. General Requirements

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

9. Certification

9.1 Upon request of the purchaser in the contract or order, a manufacturer's certification that the material was manufactured and tested in accordance with this specification together with a report of the test results shall be furnished at the time of shipment.

10. Keywords

10.1 alloy steel bars; cold-finished steel bars; steel bars

SUPPLEMENTARY REQUIREMENTS

When either Supplementary Requirement S1 or S2 is specified, the bars shall be subjected to mill tests and inspection procedures to ensure internal soundness, uniformity of chemical composition, and freedom from injurious surface defects to the extent that the bars shall be suitable for the manufacture of identified parts.

S1. Cold Working Quality

S1.1 This classification encompasses bars subject to severe cold plastic deformation such as, but not limited to, upsetting, heading, forging, and forward or backward extrusion.
S1.2 If the type of steel or chemical composition does not have adequate cold working characteristics, appropriate thermal treatments should be specified.
S1.3 When Supplementary Requirement S1 is specified, the bars shall be produced by manufacturing practices and subject to mill tests and inspection and freedom from injurious surface imperfections to the extent that the bars shall be suitable for the manufacture of identified parts. The quality requirements of individual application vary.

S2. Nonmetallic Inclusion Requirement

S2.1 The nonmetallic inclusion requirement comprises a metallographic examination of longitudinal sections to determine the nature and frequency of the nonmetallic inclusion.

Experience indicates that samples taken midway between the center and surface of the bloom, billet, slab, or bar are most representative of the average inclusion content of the lot involved. The test specimen is generally heated and quenched to harden it before being polished to avoid polishing pits. The specimen is examined at 100 diameters. Methods for determining the nonmetallic inclusion content of steel are described in Practice E 45.

S2.2 For resulfurized steels, much of the sulfur is present as sulfide inclusions. For this reason, those steels are not generally produced to inclusion rating.