



Standard Specification for Steel Bars, Carbon, Quenched and Tempered¹

This standard is issued under the fixed designation A 321; 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 hot-rolled, quenched, and tempered carbon steel bars, of the following sections and size ranges:

1.1.1 *Rounds*, $\frac{1}{4}$ to $9\frac{1}{2}$ in. (6.35 to 241.3 mm) incl. in diameter.

1.1.2 *Squares*, $\frac{1}{4}$ to $5\frac{1}{2}$ in. (6.35 to 139.7 mm) incl. between parallel surfaces.

1.1.3 *Hexagons*, $\frac{1}{4}$ in. (6.35 mm) and over between parallel surfaces.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Documents

2.1 ASTM Standards:

A 29/A29M Specification for Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished, General Requirements for²

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products³

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,

3.1.3 Stress relief anneal (if required),

3.1.4 Finish (specify descaled and oiled if required),

3.1.5 Dimensions (cross sectional shape, size, and length),

3.1.6 Straightness (if other than standard is required),

3.1.7 Leaded steel (if required),

3.1.8 Heat analysis or test report (if required),

3.1.9 ASTM designation and date of issue, and

3.1.10 Additional requirements, if any.

NOTE 1—A typical ordering description is as follows: 10 000 lb,

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.

Current edition approved Jan. 26, 1990. Published March 1990. Originally published as A 321 – 49 T. Last previous edition A 321 – 89.

² *Annual Book of ASTM Standards*, Vol 01.05.

³ *Annual Book of ASTM Standards*, Vol 01.03.

hot-rolled bars quenched and tempered, straightened, stress relieved, descaled, 1.000 in. diameter by 10 ft long, heat analysis required, ASTM A 321, dated ____.

4. 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 (from each ingot, when ingot cast) to secure freedom from injurious piping and undue segregation.

4.3 Heat Treatment:

4.3.1 *Cooling*—Immediately after rolling, the bars shall be allowed to cool to a temperature below the critical range under suitable conditions to prevent injury by too rapid cooling.

4.3.2 *Quenching and Tempering*—The material shall be uniformly heated to the austenitizing temperature, soaked for a sufficient length of time to produce the desired change in structure (a group thus heated being known as a “quenching charge”), and quenched in some medium under substantially uniform conditions for each quenching charge. The material shall then be uniformly reheated to the proper temperature for tempering (a group thus reheated being known as a “tempering charge”), and allowed to cool uniformly. The temperature selected for tempering shall not be less than 800°F (427°C).

4.3.3 *Stress Relieving*—When it is desirable to minimize internal stresses introduced by straightening, the purchaser may specify a stress relief anneal as a final operation.

5. Chemical Composition

5.1 *Chemical Composition*—The steel shall conform to the requirements for chemical composition specified in Table 1.

5.2 *Leaded Steel*—When required, lead may be specified as an added element. A range from 0.15 to 0.35 %, inclusive, is commonly specified. Heat analysis for lead is not determinable since lead is added to the ladle stream while each ingot is poured.

TABLE 1 Chemical Requirements (Heat Analysis)

Element	Composition, %
Carbon, max	0.55
Manganese	0.60 to 0.90
Phosphorus, max	0.040
Sulfur, max	0.050
Silicon	0.15 to 0.35
Lead	^A

^AWhen required, lead may be specified as an added element. See 6.2.

6. Grain Size Requirements

6.1 The steel shall conform to the fine austenitic grain size requirement of Specification A 29/A 29M.

7. Mechanical Properties

7.1 *Tensile Properties*—The material, after final heat treatment and straightening, shall conform to the requirements as to tensile properties specified in Table 2.

7.2 Test Specimens:

7.2.1 Test specimens shall be prepared for testing from the material in the quenched and tempered condition.

7.2.2 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 Figs. 6 of Test Methods and Definitions A 370. If test specimens are selected conforming to the dimensions of Fig. 6 for sizes 1½ in. (38.1 mm) and larger in diameter or distance between parallel faces, they shall be machined from a position midway between the center and the

TABLE 2 Tensile Requirements

Diameter or Distance Between Parallel Faces, in. (mm)	Yield Point, min, ksi (MPa)	Tensile Strength, min, ksi (MPa)	Elongation or 50 mm, %	Reduction of Area, min, %
1 (25.4) and under	75 (520)	110 (760)	18	45
Over 1 to 2½ (25.4 to 63.5), incl	70 (485)	105 (720)	18	45
Over 2½ to 4 (63.5 to 101.6), incl	65 (450)	95 (660)	18	45
Over 4 to 6 (101.6 to 152.4), incl	60 (415)	90 (620)	18	40
Over 6 to 9½ (152.4 to 241.3), incl	50 (345)	85 (590)	18	35

surface of the bar. If test specimens are selected conforming to the dimensions of Fig. 6 for sizes under 1½ in. in diameter or distance between parallel faces, they shall be machined from the center of the bar.

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 of treatment, one tension test shall be made for each 25 tons (23 Mg) of each heat or size.

7.4 *Test Methods*—Tension tests shall be made in accordance with Test Methods and Definitions A 370. The yield point shall be determined by the drop of the beam or halt in the gage of the testing machine, or by the use of dividers, as covered in Section 12 of Test Methods and Definitions A 370.

8. Permissible Variations of Dimensions

8.1 *Straightness*—Unless otherwise specified, all material shall be supplied to a straightness tolerance of ⅛ in. (3.2 mm) in any 5 ft (1.52 m) but it may not exceed the following:

$$\text{Maximum straightness deviation, in. (mm)} = \frac{1}{8} (3.2 \text{ mm}) \times \text{length in feet (or metres)} / 5 \text{ (or 1.52)}$$

9. Workmanship, Finish, and Appearance

9.1 *Descaling*—Unless otherwise specified, the bars shall be furnished not descaled. When required, the bars may be specified to be descaled and shall be oiled as a protection from rust during shipment.

10. General Requirements

10.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification A 29/A 29M unless otherwise provided herein.

11. Keywords

11.1 carbon steel bars; quenched and tempered steel bars; steel bars

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