



Designation: A304 – 20

## Standard Specification for Carbon and Alloy Steel Bars Subject to End-Quench Hardenability Requirements<sup>1</sup>

This standard is issued under the fixed designation A304; 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 ( $\epsilon$ ) 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-worked alloy, carbon, and carbon-boron steels in a variety of compositions and sizes, which may attain specified depth of hardening in the end quench test. These steel compositions are identified by the suffix letter “H” added to the conventional grade number.

1.2 This specification provides for analyses other than those listed under **Tables 1 and 2**. Special hardenability limits are also permissible when approved by the purchaser and manufacturer.

1.3 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 *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:<sup>2</sup>

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

**A108** Specification for Steel Bar, Carbon and Alloy, Cold-Finished

**A255** Test Methods for Determining Hardenability of Steel

**E112** Test Methods for Determining Average Grain Size

<sup>1</sup> 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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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

**E527** Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

2.2 *Society of Automotive Engineers (SAE) Standard:*<sup>3</sup>

**J 1086** Numbering Metals and Alloys

### 3. Terminology

#### 3.1 Definitions of Terms Specific to This Standard:

3.1.1 *hardenability*—the relative ability of a steel to harden under heat treatment becomes apparent in the degree to which the material hardens when quenched at different cooling rates. It is measured quantitatively, usually by noting the extent or depth of hardening of a standard size and shape test specimen in a standardized quench. In the “end-quench” test the “depth of hardening” is the distance along the specimen from the quenched end to a given hardness.

### 4. Ordering Information

4.1 Orders for material under this specification should include the following information, in proper sequence:

4.1.1 Quantity (weight);

4.1.2 Name of material (alloy, carbon, or carbon-boron steel);

4.1.3 Cross-sectional shape;

4.1.4 Size;

4.1.5 Length;

4.1.6 Grade;

4.1.7 End-quenched hardenability (see Section 9);

4.1.8 Report of heat analysis, if desired (see Section 7);

4.1.9 Special straightness, if required;

4.1.10 ASTM designation and date of issue;

4.1.11 End use or special requirements; and

4.1.12 Leaded steel, when required.

NOTE 1—A typical ordering description is as follows: 10 000 lb, alloy bars, round, 4.0 in. dia by 10 ft, Grade 1340H, J 40/56 =  $\frac{9}{16}$  in., heat analysis required, ASTM A304, dated \_\_\_\_\_, worm gear.

4.2 The purchaser shall specify the desired grade, including the suffix letter “H,” in accordance with **Table 1** or **Table 2**.

<sup>3</sup> Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096, <http://www.sae.org>.

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

**TABLE 1 Chemical Requirements of Alloy H Steels<sup>A</sup>**

NOTE 1—Phosphorus and sulfur designated by the prefix letter “E” is 0.025 %, max.

NOTE 2—Small quantities of certain elements are present in alloy steels that are not specified or required. These elements are considered as incidental and may be present to the following maximum amounts: copper, 0.35 %; nickel, 0.25 %; chromium, 0.20 %; molybdenum, 0.06 %.

NOTE 3—Chemical ranges and limits shown in this table are subject to the permissible variation for product analysis shown in Specification **A29/A29M**.

NOTE 4—Standard “H” Steels can be produced with a lead range of 0.15 to 0.35 %. Such steels are identified by inserting the letter “L” between the second and third numerals of the grade designation, for example, 41L40 H. Lead is generally reported as a range of 0.15 to 0.35 %.

| UNS Designation <sup>A</sup> | Grade Designation    | Chemical Composition, % <sup>B</sup> |           |            |             |           |           |           |            |
|------------------------------|----------------------|--------------------------------------|-----------|------------|-------------|-----------|-----------|-----------|------------|
|                              |                      | Carbon                               | Manganese | Phosphorus | Sulfur      | Silicon   | Nickel    | Chromium  | Molybdenum |
| H 13300                      | 1330 H               | 0.27–0.33                            | 1.45–2.05 | 0.035      | 0.040       | 0.15–0.35 | ...       | ...       | ...        |
| H 13350                      | 1335 H               | 0.32–0.38                            | 1.45–2.05 | 0.035      | 0.040       | 0.15–0.35 | ...       | ...       | ...        |
| H 13400                      | 1340 H               | 0.37–0.44                            | 1.45–2.05 | 0.035      | 0.040       | 0.15–0.35 | ...       | ...       | ...        |
| H 13450                      | 1345 H               | 0.42–0.49                            | 1.45–2.05 | 0.035      | 0.040       | 0.15–0.35 | ...       | ...       | ...        |
| H 40270                      | 4027 H               | 0.24–0.30                            | 0.60–1.00 | 0.035      | 0.040       | 0.15–0.35 | ...       | ...       | 0.20–0.30  |
| H 40280                      | 4028 H               | 0.24–0.30                            | 0.60–1.00 | 0.035      | 0.035–0.050 | 0.15–0.35 | ...       | ...       | 0.20–0.30  |
| H 40320                      | 4032 H               | 0.29–0.35                            | 0.60–1.00 | 0.035      | 0.040       | 0.15–0.35 | ...       | ...       | 0.20–0.30  |
| H 40370                      | 4037 H               | 0.34–0.41                            | 0.60–1.00 | 0.035      | 0.040       | 0.15–0.35 | ...       | ...       | 0.20–0.30  |
| H 40420                      | 4042 H               | 0.39–0.46                            | 0.60–1.00 | 0.035      | 0.040       | 0.15–0.35 | ...       | ...       | 0.20–0.30  |
| H 40470                      | 4047 H               | 0.44–0.51                            | 0.60–1.00 | 0.035      | 0.040       | 0.15–0.35 | ...       | ...       | 0.20–0.30  |
| H 41180                      | 4118 H               | 0.17–0.23                            | 0.60–1.00 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.30–0.70 | 0.08–0.15  |
| H 41300                      | 4130 H               | 0.27–0.33                            | 0.30–0.70 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.75–1.20 | 0.15–0.25  |
| H 41350                      | 4135 H               | 0.32–0.38                            | 0.60–1.00 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.75–1.20 | 0.15–0.25  |
| H 41370                      | 4137 H               | 0.34–0.41                            | 0.60–1.00 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.75–1.20 | 0.15–0.25  |
| H 41400                      | 4140 H               | 0.37–0.44                            | 0.65–1.10 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.75–1.20 | 0.15–0.25  |
| H 41420                      | 4142 H               | 0.39–0.46                            | 0.65–1.10 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.75–1.20 | 0.15–0.25  |
| H 41450                      | 4145 H               | 0.42–0.49                            | 0.65–1.10 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.75–1.20 | 0.15–0.25  |
| H 41470                      | 4147 H               | 0.44–0.51                            | 0.65–1.10 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.75–1.20 | 0.15–0.25  |
| H 41500                      | 4150 H               | 0.47–0.54                            | 0.65–1.10 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.75–1.20 | 0.15–0.25  |
| H 41610                      | 4161 H               | 0.55–0.65                            | 0.65–1.10 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.65–0.95 | 0.25–0.35  |
| H 43200                      | 4320 H               | 0.17–0.23                            | 0.40–0.70 | 0.035      | 0.040       | 0.15–0.35 | 1.55–2.00 | 0.35–0.65 | 0.20–0.30  |
| H 43400                      | 4340 H               | 0.37–0.44                            | 0.55–0.90 | 0.035      | 0.040       | 0.15–0.35 | 1.55–2.00 | 0.65–0.95 | 0.20–0.30  |
| H 43406                      | E4340 H              | 0.37–0.44                            | 0.60–0.95 | 0.035      | 0.040       | 0.15–0.35 | 1.55–2.00 | 0.65–0.95 | 0.20–0.30  |
| H 44190                      | 4419 H               | 0.17–0.23                            | 0.35–0.75 | 0.035      | 0.040       | 0.15–0.35 | ...       | ...       | 0.45–0.60  |
| H 46200                      | 4620 H               | 0.17–0.23                            | 0.35–0.75 | 0.035      | 0.040       | 0.15–0.35 | 1.55–2.00 | ...       | 0.20–0.30  |
| H 46210                      | 4621 H               | 0.17–0.23                            | 0.60–1.00 | 0.035      | 0.040       | 0.15–0.35 | 1.55–2.00 | ...       | 0.20–0.30  |
| H 46260                      | 4626 H               | 0.23–0.29                            | 0.40–0.70 | 0.035      | 0.040       | 0.15–0.35 | 0.65–1.05 | ...       | 0.15–0.25  |
| H 47180                      | 4718 H               | 0.15–0.21                            | 0.60–0.95 | 0.035      | 0.040       | 0.15–0.35 | 0.85–1.25 | 0.30–0.60 | 0.30–0.40  |
| H 47200                      | 4720 H               | 0.17–0.23                            | 0.45–0.75 | 0.035      | 0.040       | 0.15–0.35 | 0.85–1.25 | 0.30–0.60 | 0.15–0.25  |
| H 48150                      | 4815 H               | 0.12–0.18                            | 0.30–0.70 | 0.035      | 0.040       | 0.15–0.35 | 3.20–3.80 | ...       | 0.20–0.30  |
| H 48170                      | 4817 H               | 0.14–0.20                            | 0.30–0.70 | 0.035      | 0.040       | 0.15–0.35 | 3.20–3.80 | ...       | 0.20–0.30  |
| H 48200                      | 4820 H               | 0.17–0.23                            | 0.40–0.80 | 0.035      | 0.040       | 0.15–0.35 | 3.20–3.80 | ...       | 0.20–0.30  |
| H 50401                      | 50B40 H <sup>C</sup> | 0.37–0.44                            | 0.65–1.10 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.30–0.70 | ...        |
| H 50441                      | 50B44 H <sup>C</sup> | 0.42–0.49                            | 0.65–1.10 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.30–0.70 | ...        |
| H 50460                      | 5046 H               | 0.43–0.50                            | 0.65–1.10 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.13–0.43 | ...        |
| H 50461                      | 50B46 H <sup>C</sup> | 0.43–0.50                            | 0.65–1.10 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.13–0.43 | ...        |
| H 50501                      | 50B50 H <sup>C</sup> | 0.47–0.54                            | 0.65–1.10 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.30–0.70 | ...        |
| H 50601                      | 50B60 H <sup>C</sup> | 0.55–0.65                            | 0.65–1.10 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.30–0.70 | ...        |
| H 51200                      | 5120 H               | 0.17–0.23                            | 0.60–1.00 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.60–1.00 | ...        |
| H 51300                      | 5130 H               | 0.27–0.33                            | 0.60–1.00 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.75–1.20 | ...        |
| H 51320                      | 5132 H               | 0.29–0.35                            | 0.50–0.90 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.65–1.10 | ...        |
| H 51350                      | 5135 H               | 0.32–0.38                            | 0.50–0.90 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.70–1.15 | ...        |
| H 51400                      | 5140 H               | 0.37–0.44                            | 0.60–1.00 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.60–1.00 | ...        |
| H 51450                      | 5145 H               | 0.42–0.49                            | 0.60–1.00 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.60–1.00 | ...        |
| H 51470                      | 5147 H               | 0.45–0.52                            | 0.60–1.05 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.80–1.25 | ...        |
| H 51500                      | 5150 H               | 0.47–0.54                            | 0.60–1.00 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.60–1.00 | ...        |
| H 51550                      | 5155 H               | 0.50–0.60                            | 0.60–1.00 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.60–1.00 | ...        |
| H 51600                      | 5160 H               | 0.55–0.65                            | 0.65–1.10 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.60–1.00 | ...        |
| H 51601                      | 51B60H <sup>C</sup>  | 0.55–0.65                            | 0.65–1.10 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.60–1.00 | ...        |
| H 61180                      | 6118 H <sup>D</sup>  | 0.15–0.21                            | 0.40–0.80 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.40–0.80 | ...        |
| H 61500                      | 6150 H <sup>E</sup>  | 0.47–0.54                            | 0.60–1.00 | 0.035      | 0.040       | 0.15–0.35 | ...       | 0.75–1.20 | ...        |
| H 81451                      | 81B45 H <sup>C</sup> | 0.42–0.49                            | 0.70–1.05 | 0.035      | 0.040       | 0.15–0.35 | 0.15–0.45 | 0.30–0.60 | 0.08–0.15  |
| H 86170                      | 8617 H               | 0.14–0.20                            | 0.60–0.95 | 0.035      | 0.040       | 0.15–0.35 | 0.35–0.75 | 0.35–0.65 | 0.15–0.25  |