Standard Specification for
Steel Bars, Alloy, Standard Grades

This standard is issued under the fixed designation A 322; 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.

ε1 Note—A correction was made to Table 1 in May 2004.

1. Scope

1.1 This specification covers hot-wrought alloy steel bars. Bar applications include forging, heat treating, cold drawing, machining and many structural components (Note 1).

Note 1—A guide for the selection of steel bars is contained in Practice A 400.

1.2 The bars shall be furnished in the grades specified in Table 1. Sections and sizes of bar steel available are covered in Specification A 29/A 29M. Hot-wrought alloy steel bars are produced in cut lengths and coils; the manufacturer should be consulted regarding sections and sizes available in coils, produced to a chemical composition.

1.3 Some applications may require superior surface quality, or special chemical restrictions, metallurgical characteristics, heat treatment, or surface finishes which the purchaser may obtain by designating one or more of the available Supplementary Requirements.

1.4 The values stated in inch-pound units are to be regarded as the standard.

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
A 304 Specification for Steel Bars, Alloy, Subject to End-Quench Hardenability Requirements
A 400 Practice for Steel Bars, Selection Guide, Composition, and Mechanical Properties
E 112 Test Methods for Determining Average Grain Size
E 381 Method of Macrotetch Testing, Inspection, and Rating Steel Products, Comprising Bars, Billets, Blooms, and Forgings

E 527 Practice for Numbering Metals and Alloys (UNS)

3. Ordering Information

3.1 Orders under this specification should include the following as required to describe adequately the desired material:
3.1.1 Quantity (weight or number of bars),
3.1.2 Name of material (hot-wrought alloy steel bars),
3.1.3 Dimensions,
3.1.4 ASTM designation,
3.1.5 Deoxidation practice (see 5.3),
3.1.6 Grade designation or chemical composition limits (see 6.1 and Table 1),
3.1.7 Grain size if required,
3.1.8 Test reports, if required (Section 8),
3.1.9 Additions to the specification and Supplementary Requirements, if required, and
3.1.10 Application.

4. General Requirements

4.1 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.

5. Materials and Manufacture

5.1 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 electro-slag 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 The steel shall be furnished as strand cast or ingot cast, unless otherwise specified.

5.3 Deoxidation—Killed steel is required.

5.3.1 The purchaser may designate that the steel be made to coarse or fine austenitic grain size. (See Supplementary Requirement S9 or S10.)

5.4 Slow Cooling—Immediatedly after hot forming, the bars shall be allowed to cool to a temperature below the critical
range under suitable conditions to prevent imperfections caused by too rapid cooling.

5.5 Thermal Treatment—Various thermal treatments such as annealing, stress relief, quench and temper, normalize, etc., are available. Such treatments must be specified as a Supplementary Requirement.

6. Chemical Composition

6.1 The heat analysis shall conform to the requirements for chemical composition in Table 1 for the grade specified.

### TABLE 1 Grade Designations and Chemical Compositions of Hot-Wrought Alloy Steel Bars

<table>
<thead>
<tr>
<th>UNS Designation C</th>
<th>Grade Designations</th>
<th>Chemical Composition, Ranges and Limits, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Carbon</td>
</tr>
<tr>
<td>G13300</td>
<td>1330</td>
<td>0.28–0.33</td>
</tr>
<tr>
<td>G13350</td>
<td>1335</td>
<td>0.33–0.38</td>
</tr>
<tr>
<td>G13400</td>
<td>1340</td>
<td>0.38–0.43</td>
</tr>
<tr>
<td>G13450</td>
<td>1345</td>
<td>0.43–0.48</td>
</tr>
<tr>
<td>G40230</td>
<td>4023</td>
<td>0.20–0.25</td>
</tr>
<tr>
<td>G40240</td>
<td>4024</td>
<td>0.20–0.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.050</td>
</tr>
<tr>
<td>G40270</td>
<td>4027</td>
<td>0.25–0.30</td>
</tr>
<tr>
<td>G40280</td>
<td>4028</td>
<td>0.25–0.30</td>
</tr>
</tbody>
</table>
### TABLE 1  
Continued

<table>
<thead>
<tr>
<th>UNS Designation C</th>
<th>Grade D</th>
<th>Chemical Composition, Ranges and Limits, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Carbon</td>
</tr>
<tr>
<td>G86450</td>
<td>8645</td>
<td>0.43–0.48</td>
</tr>
<tr>
<td>G86550</td>
<td>8655</td>
<td>0.51–0.59</td>
</tr>
<tr>
<td>G87200</td>
<td>8720</td>
<td>0.18–0.23</td>
</tr>
<tr>
<td>G87400</td>
<td>8740</td>
<td>0.38–0.43</td>
</tr>
<tr>
<td>G88220</td>
<td>8822</td>
<td>0.20–0.25</td>
</tr>
<tr>
<td>G92590</td>
<td>9259</td>
<td>0.56–0.64</td>
</tr>
<tr>
<td>G92600</td>
<td>9260</td>
<td>0.56–0.64</td>
</tr>
</tbody>
</table>

**Standard Boron Steels**

<table>
<thead>
<tr>
<th>UNS Designation C</th>
<th>Grade D</th>
<th>Chemical Composition, Ranges and Limits, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Carbon</td>
</tr>
<tr>
<td>G50441</td>
<td>50B44</td>
<td>0.43–0.48</td>
</tr>
<tr>
<td>G50461</td>
<td>50B46</td>
<td>0.44–0.49</td>
</tr>
<tr>
<td>G50501</td>
<td>50B50</td>
<td>0.48–0.53</td>
</tr>
<tr>
<td>G50601</td>
<td>50B60</td>
<td>0.56–0.64</td>
</tr>
<tr>
<td>G51601</td>
<td>51B60</td>
<td>0.56–0.64</td>
</tr>
<tr>
<td>G81451</td>
<td>81B45</td>
<td>0.43–0.48</td>
</tr>
<tr>
<td>G94171</td>
<td>94B17</td>
<td>0.15–0.20</td>
</tr>
<tr>
<td>G94301</td>
<td>94B30</td>
<td>0.28–0.33</td>
</tr>
</tbody>
</table>

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A Small quantities of certain elements are present in alloy steels which 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 %, and molybdenum 0.06 %.

B Standard alloy 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 number, that is, 41L40. A cast or heat analysis is not determinable when lead is added to the ladle stream.

C New designation established in accordance with Practice E 527.

D Grade designations correspond to the respective AISI and SAE designations. Grade compositions correspond to the respective AISI compositions.

E Where minimum and maximum sulfur contents are shown, it is indicative of resulfurized steel.

F Silicon may be specified by the purchaser as 0.10 % maximum. The need for 0.10 % maximum generally relates to severely cold-formed parts.

G These steels can be expected to contain 0.0005 to 0.003 boron %. If the usual titanium additive is not permitted, the steels can be expected to contain up to 0.005% boron.

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6.2 The composition of the steel furnished under this specification may be other than listed in Table 1 when agreed upon between the manufacturer and the purchaser as outlined in Specification A 29/A 29M (Table on Heat Analysis Chemical Ranges and Limits of Alloy Steel Bars).

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 **Descaling**—When descaled bars are required, Supplementary Requirement S12 on Pickling or S13 on Blast Cleaning must be specified.

### SUPPLEMENTARY REQUIREMENTS

One or more of the following Supplementary Requirements shall apply when specified by the purchaser.

**S1. Axle Shaft Quality**

S1.1 Axle shaft quality applies to hot-rolled steel bars intended for the manufacture of power-driven axle shafts of the automotive or truck type, which by their design or method of manufacture are not machined all over or have less than recommended stock removed for the proper clean-up of normal surface imperfections.

**S2. Ball and Roller Bearing Quality and Bearing Quality**

S2.1 This quality applies to steel intended for antifriction bearings.

**S3. Cold Shearing Quality**

S3.1 When the bar size exceeds certain limits, it is recommended that cold shearing quality steel be ordered. This quality...
will provide characteristics which permit cold shearing without cracking. The producer should be consulted in establishing the proper practice.

S4. Cold Working Quality

S4.1 This classification encompasses bars subject to severe cold plastic deformation such as, but not limited to, upsetting, heading, forging, forward or backward extrusion.

S4.2 If the type of steel or chemical composition does not have adequate cold working characteristics, appropriate thermal treatments should be specified.

S4.3 When Supplementary Requirement S1 is specified, the bars shall be produced by manufacturing practices and subjected 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.

S5. Aircraft Quality or Magnaflux Quality

S5.1 These quality designations apply to alloy steels for important or highly stressed parts of aircraft and for other similar or corresponding purposes involving additional stringent requirements, such as: magnetic particle inspection; additional discard; macroetch tests (see Method E 381); and hardenability control (see Specification A 304).

S6. Annealing

S6.1 The steel shall be furnished annealed.

S7. Spheroidize Annealing

S7.1 The steel shall be spheroidize annealed.

S8. Stress Relieving

S8.1 The steel shall be stress relieved by heating to a temperature specified by the purchaser or to a temperature selected by the manufacturer.

S9. Grain Size (Coarse)

S9.1 The steel shall conform to the coarse austenitic grain size requirement of Specification A 29/A 29M.

S10. Grain Size (Fine)

S10.1 The steel shall be killed and shall have austenitic grain size of 5 to 8 and finer (fine grain), to be determined in accordance with the comparison procedure in Test Methods E 112. The grain structure shall be considered satisfactory when a minimum of the rated grains are 70% within the specified size limits.

S11. Special Straightness

S11.1 The bars shall be produced with special straightness (see Specification A 29/A 29M for tolerances).

S12. Pickling

S12.1 The surface of the bars shall be descaled by pickling.

S13. Cleaning

S13.1 The surface of the bars shall be descaled by blast cleaning or other mechanical methods.

S14. Coating

S14.1 The bars shall be oiled, limed, or phosphate-coated as specified by the purchaser. The purchaser shall also specify the method of cleaning (Supplementary Requirement S12 or S13); otherwise, the bars shall be descaled by pickling or blasting at the manufacturer’s option.