



## Designation: **A576 – 90b (Reapproved 2012) A576 – 17**

# Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality<sup>1</sup>

This standard is issued under the fixed designation A576; 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—Scope\*

1.1 This specification covers hot-wrought special quality carbon steel bars. Special quality bar applications include forging, heat treating, cold drawing, machining, and many structural uses. A guide for the selection of steel bars is contained in Practice **A400**.

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 **A29/A29M**. Hot-wrought special quality carbon 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 Merchant quality hot-wrought carbon steel bars are covered in Specification **A575**.

1.4 Some end uses 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.

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

1.6 *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

**A400** Practice for Steel Bars, Selection Guide, Composition, and Mechanical Properties

**A575** Specification for Steel Bars, Carbon, Merchant Quality, M-Grades

**E45** Test Methods for Determining the Inclusion Content of Steel

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

2.2 *SAE Standard:*

**SAE J 1086** Recommended Practice for Numbering Metals and Alloys (UNS)<sup>3</sup>

## 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 carbon steel bars),

3.1.3 Dimensions,

3.1.4 ASTM specification number and date of issue,

3.1.5 Deoxidation practice (see **4.2.1**),

3.1.6 Grade designation or chemical composition limits (see **5.1** and **Table 1**),

3.1.7 Coarse or fine grain steel (**4.2.2**),

<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.

<sup>3</sup> Available from Society of Automotive Engineers—SAE International (SAE), 400 Commonwealth Drive, Dr., Warrendale, PA 15096-15096, <http://www.sae.org>.

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

**TABLE 1 Grade Designations and Chemical Requirements of Hot-Wrought Carbon Steel Bars**

NOTE 1—Grade designations and compositions correspond to the respective AISI/SAE designations and compositions.

UNS Designation <sup>A</sup>	Grade	Heat Chemical Ranges and Limits, %			
		Carbon	Manganese	Phosphorus, max	Sulfur, max <sup>B</sup>
Nonresulfurized Carbon Steels <sup>C, D, E, F, G</sup>					
Nonresulfurized Carbon Steels <sup>C, D, E, F, G</sup>					
Low Manganese 1.00 % max or less					
G10080	1008	0.10 max	0.30–0.50	0.040	0.050
G10100	1010	0.08–0.13	0.30–0.60	0.040	0.050
G10120	1012	0.10–0.15	0.30–0.60	0.040	0.050
G10150	1015	0.13–0.18	0.30–0.60	0.040	0.050
G10160	1016	0.13–0.18	0.60–0.90	0.040	0.050
G10170	1017	0.15–0.20	0.30–0.60	0.040	0.050
G10180	1018	0.15–0.20	0.60–0.90	0.040	0.050
G10190	1019	0.15–0.20	0.70–1.00	0.040	0.050
G10200	1020	0.18–0.23	0.30–0.60	0.040	0.050
G10210	1021	0.18–0.23	0.60–0.90	0.040	0.050
G10220	1022	0.18–0.23	0.70–1.00	0.040	0.050
G10230	1023	0.20–0.25	0.30–0.60	0.040	0.050
G10250	1025	0.22–0.28	0.30–0.60	0.040	0.050
G10260	1026	0.22–0.28	0.60–0.90	0.040	0.050
G10290	1029	0.25–0.31	0.60–0.90	0.040	0.050
G10300	1030	0.28–0.34	0.60–0.90	0.040	0.050
G10350	1035	0.32–0.38	0.60–0.90	0.040	0.050
G10370	1037	0.32–0.38	0.70–1.00	0.040	0.050
G10380	1038	0.35–0.42	0.60–0.90	0.040	0.050
G10390	1039	0.37–0.44	0.70–1.00	0.040	0.050
G10400	1040	0.37–0.44	0.60–0.90	0.040	0.050
G10420	1042	0.40–0.47	0.60–0.90	0.040	0.050
G10430	1043	0.40–0.47	0.70–1.00	0.040	0.050
G10440	1044	0.43–0.50	0.30–0.60	0.040	0.050
G10450	1045	0.43–0.50	0.60–0.90	0.040	0.050
G10460	1046	0.43–0.50	0.70–1.00	0.040	0.050
G10490	1049	0.46–0.53	0.60–0.90	0.040	0.050
G10500	1050	0.48–0.55	0.60–0.90	0.040	0.050
G10530	1053	0.48–0.55	0.70–1.00	0.040	0.050
G10550	1055	0.50–0.60	0.60–0.90	0.040	0.050
G10600	1060	0.55–0.65	0.60–0.90	0.040	0.050
G10700	1070	0.65–0.75	0.60–0.90	0.040	0.050
G10780	1078	0.72–0.85	0.30–0.60	0.040	0.050
G10800	1080	0.75–0.88	0.60–0.90	0.040	0.050
G10840	1084	0.80–0.93	0.60–0.90	0.040	0.050
G10900	1090	0.85–0.98	0.60–0.90	0.040	0.050
G10950	1095	0.90–1.03	0.30–0.50	0.040	0.050
High Manganese 1.65 % max or less					
G15130	1513	0.10–0.16	1.10–1.40	0.040	0.050
G15180	1518	0.15–0.21	1.10–1.40	0.040	0.050
G15220	1522	0.18–0.24	1.10–1.40	0.040	0.050
G15240	1524	0.19–0.25	1.35–1.65	0.040	0.050
G15250	1525	0.23–0.29	0.80–1.10	0.040	0.050
G15260	1526	0.22–0.29	1.10–1.40	0.040	0.050
G15270	1527	0.22–0.29	1.20–1.50	0.040	0.050
G15360	1536	0.30–0.37	1.20–1.50	0.040	0.050
G15410	1541	0.36–0.44	1.35–1.65	0.040	0.050
G15470	1547	0.43–0.51	1.35–1.65	0.040	0.050
G15480	1548	0.44–0.52	1.10–1.40	0.040	0.050
G15510	1551	0.45–0.56	0.85–1.15	0.040	0.050
G15520	1552	0.47–0.55	1.20–1.50	0.040	0.050
G15610	1561	0.55–0.65	0.75–1.05	0.040	0.050
G15660	1566	0.60–0.71	0.85–1.15	0.040	0.050
G15720	1572	0.65–0.76	1.00–1.30	0.040	0.050
Resulfurized Carbon Steels <sup>C, E, G</sup>					
Resulfurized Carbon Steels <sup>C, E, G</sup>					
G11090	1109	0.08–0.13	0.60–0.90	0.040	0.08–0.13
G11100	1110	0.08–0.13	0.30–0.60	0.040	0.08–0.13
G11160	1116	0.14–0.20	1.10–1.40	0.040	0.16–0.23
G11170	1117	0.14–0.20	1.00–1.30	0.040	0.08–0.13
G11180	1118	0.14–0.20	1.30–1.60	0.040	0.08–0.13
G11190	1119	0.14–0.20	1.00–1.30	0.040	0.24–0.33
G11320	1132	0.27–0.34	1.35–1.65	0.040	0.08–0.13
G11370	1137	0.32–0.39	1.35–1.65	0.040	0.08–0.13
G11390	1139	0.35–0.43	1.35–1.65	0.040	0.13–0.20
G11400	1140	0.37–0.44	0.70–1.00	0.040	0.08–0.13
G11410	1141	0.37–0.45	1.35–1.65	0.040	0.08–0.13
G11440	1144	0.40–0.48	1.35–1.65	0.040	0.24–0.33
G11450	1145	0.42–0.49	0.70–1.00	0.040	0.04–0.07

**TABLE 1** *Continued*

UNS Designation <sup>A</sup>	Grade	Heat Chemical Ranges and Limits, %				
		Carbon	Manganese	Phosphorus, max	Sulfur, max <sup>B</sup>	
G11460	1146	0.42–0.49	0.70–1.00	0.040	0.08–0.13	
G11510	1151	0.48–0.55	0.70–1.00	0.040	0.08–0.13	
Rephosphorized and Resulfurized Carbon Steel <sup>EE, G, H, G, H</sup>						
Designation	Grade	Carbon	Manganese	Phosphorus	Sulfur	Lead
G12110	1211	0.13 max	0.60–0.90	0.07–0.12	0.10–0.15	...
G12120	1212	0.13 max	0.70–1.00	0.07–0.12	0.16–0.23	...
G12130	1213	0.13 max	0.70–1.00	0.07–0.12	0.24–0.33	...
G12150	1215	0.09 max	0.75–1.05	0.04–0.09	0.26–0.35	...
...	12L14	0.15 max	0.85–1.15	0.04–0.09	0.26–0.35	0.15–0.35

<sup>A</sup> New designations established in accordance with Practice E527 and SAE J 1086.

<sup>B</sup> Maximum unless otherwise indicated.

<sup>C</sup> When silicon is required, the following ranges and limits are commonly specified: 0.10 %, max, 0.10 to 0.20 %, 0.15 to 0.35 %, or 0.20 to 0.40 %.

<sup>D</sup> Copper can be specified when required as 0.20 % minimum.

<sup>E</sup> When lead is required as an added element to a standard steel, a range of 0.15 to 0.35 % incl is specified. Such a steel is identified by inserting the letter “L” between the second and third numerals of the grade designation, for example, 10 L 45. A cast or heat analysis is not determinable when lead is added to the ladle stream.

<sup>F</sup> When boron treatment is specified for killed steels, the steels can be expected to contain 0.0005 to 0.003 % boron.

<sup>G</sup> The elements bismuth, calcium, selenium, or tellurium may be added as agreed between purchaser and supplier.

<sup>H</sup> It is not common practice to produce these steels to specified limits for silicon because of its adverse effect on machinability.

3.1.8 Test reports, if required (Section 7),

3.1.9 Additions to the specification and Supplementary Requirements, if required, and

3.1.10 End use.

NOTE 1—A typical ordering description is as follows: ~~10-000-10 000~~ lb, carbon steel bars, hot rolled ~~1-000-1000~~ in. diameter by 10 ft, ASTM A576 dated \_\_\_\_, killed steel, Grade 1018, test reports required, coarse grain Supplementary Requirement S10, welded industrial fan hubs and 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, any commercially viable primary steelmaking process.~~ 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 *Deoxidation:*

4.2.1 Unless otherwise specified, the steel shall be ~~rimmed, capped, semi-killed, semi-killed~~ or killed at the manufacturer’s option.

4.2.2 If killed steel is specified, the purchaser may designate that the steel be made to coarse or fine austenitic grain size (see S10 or S11).

NOTE 2—Assured coarse grain size is not always possible since certain elements or combination of elements or certain quantities of elements such as manganese, sulfur, and lead tend to produce grain refinement.

4.3 *Quality*—The bars shall be special quality.

4.4 *Hot Forming*—The bars shall be hot wrought, as wrought.

#### 5. Chemical Composition

5.1 The heat analysis shall conform to the requirements for chemical composition specified in Table 1 for the grade specified, or to such other limits as may be specified using the ranges and limits in Table 2.

#### 6. Workmanship, Finish, and Appearance

6.1 *Descaling*—When descaled bars are required, S15 on Pickling or S16 on Blast Cleaning must be specified.

6.2 The bars shall be free of visible pipe and conditioned as necessary to remove injurious surface imperfections.

#### 7. Certification and Test Reports

7.1 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 test results for the specified elements and for copper, chromium, nickel, molybdenum, vanadium, and columbium<sup>4</sup> shall be furnished. When the amount of an element present is less than 0.02 %, the analysis may be reported as <0.02 %. The report shall include the name of the manufacturer, ASTM designation number and year date and revision letter, if any, type and grade, heat number, and size.

<sup>4</sup> Columbium (Cb) and Niobium (Nb) are alternate names for element 41 in the Periodic Table of the Elements.