Designation: A 322 – 07

Standard Specification for Steel Bars, Alloy, Standard Grades[1]

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.

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.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

A 29/A 29M Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for

A 304 Specification for Carbon and Alloy Steel Bars 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 Macroetch Testing Steel 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 cast product remelted from a single primary heat.

5.2 The steel shall be furnished as strand cast or ingot cast, unless otherwise specified.

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

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*—Immediately 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.

[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 May 1, 2007. Published May 2007. Originally approved in 1947. Last previous edition approved in 2006 as A 322 – 06.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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

Copyright © ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States.

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

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[A,B]

UNS Designation[C]	Grade[D] Designations	Chemical Composition, Ranges and Limits, %							
		Carbon	Manganese	Phospho-rus, max	Sulfur,[E] max	Silicon[F]	Nickel	Chromium	Molybdenum
G13300	1330	0.28–0.33	1.60–1.90	0.035	0.040	0.15–0.35	...	...	...
G13350	1335	0.33–0.38	1.60–1.90	0.035	0.040	0.15–0.35	...	...	...
G13400	1340	0.38–0.43	1.60–1.90	0.035	0.040	0.15–0.35	...	...	...
G13450	1345	0.43–0.48	1.60–1.90	0.035	0.040	0.15–0.35	...	...	...
G40230	4023	0.20–0.25	0.70–0.90	0.035	0.040	0.15–0.35	...	...	0.20–0.30
G40240	4024	0.20–0.25	0.70–0.90	0.035	0.035–0.050	0.15–0.35	...	...	0.20–0.30
G40270	4027	0.25–0.30	0.70–0.90	0.035	0.040	0.15–0.35	...	...	0.20–0.30
G40280	4028	0.25–0.30	0.70–0.90	0.035	0.035–0.050	0.15–0.35	...	...	0.20–0.30
G40370	4037	0.35–0.40	0.70–0.90	0.035	0.040	0.15–0.35	..	...	0.20–0.30
G40470	4047	0.45–0.50	0.70–0.90	0.035	0.040	0.15–0.35	...	...	0.20–0.30
G41180	4118	0.18–0.23	0.70–0.90	0.035	0.040	0.15–0.35	...	0.40–0.60	0.08–0.15
G41200		0.18–0.23	0.90–1.20	0.035	0.040	0.15–0.35	...	0.40–0.60	0.13–0.20
G41210		0.18–0.23	0.75–1.00	0.035	0.040	0.15–0.35	...	0.45–0.65	0.20–0.30
G41300	4130	0.28–0.33	0.40–0.60	0.035	0.040	0.15–0.35	...	0.80–1.10	0.15–0.25
G41370	4137	0.35–0.40	0.70–0.90	0.035	0.040	0.15–0.35	...	0.80–1.10	0.15–0.25
G41400	4140	0.38–0.43	0.75–1.00	0.035	0.040	0.15–0.35	...	0.80–1.10	0.15–0.25
G41420	4142	0.40–0.45	0.75–1.00	0.035	0.040	0.15–0.35	...	0.80–1.10	0.15–0.25
G41450	4145	0.43–0.48	0.75–1.00	0.035	0.040	0.15–0.35	...	0.80–1.10	0.15–0.25
G41470	4147	0.45–0.50	0.75–1.00	0.035	0.040	0.15–0.35	...	0.80–1.10	0.15–0.25
G41500	4150	0.48–0.53	0.75–1.00	0.035	0.040	0.15–0.35	...	0.80–1.10	0.15–0.25
G41610	4161	0.56–0.64	0.75–1.00	0.035	0.040	0.15–0.35	...	0.70–0.90	0.25–0.35
G43200	4320	0.17–0.22	0.45–0.65	0.035	0.040	0.15–0.35	1.65–2.00	0.40–0.60	0.20–0.30
G43400	4340	0.38–0.43	0.60–0.80	0.035	0.040	0.15–0.35	1.65–2.00	0.70–0.90	0.20–0.30
G43406	E4340	0.38–0.43	0.65–0.85	0.025	0.025	0.15–0.35	1.65–2.00	0.70–0.90	0.20–0.30
G46150	4615	0.13–0.18	0.45–0.65	0.035	0.040	0.15–0.35	1.65–2.00	...	0.20–0.30
G46200	4620	0.17–0.22	0.45–0.65	0.035	0.040	0.15–0.35	1.65–2.00	...	0.20–0.30
G46210	4621	0.18–0.23	0.70–0.90	0.035	0.040	0.15–0.35	1.65–2.00	...	0.20–0.30
G46260	4626	0.24–0.29	0.45–0.65	0.035	0.040	0.15–0.35	0.70–1.00	...	0.15–0.25
G47150		0.13–0.18	0.70–0.90	0.035	0.040	0.15–0.35	0.70–1.00	0.45–0.65	0.45–0.60
G47200	4720	0.17–0.22	0.50–0.70	0.035	0.040	0.15–0.35	0.90–1.20	0.35–0.55	0.15–0.25
G48150	4815	0.13–0.18	0.40–0.60	0.035	0.040	0.15–0.35	3.25–3.75	...	0.20–0.30
G48170	4817	0.13–0.20	0.40–0.60	0.035	0.040	0.15–0.35	3.25–3.75	...	0.20–0.30
G48200	4820	0.18–0.23	0.50–0.70	0.035	0.040	0.15–0.35	3.25–3.75	...	0.20–0.30
G51170	5117	0.15–0.20	0.70–0.90	0.035	0.040	0.15–0.35	...	0.70–0.90	...
G51200	5120	0.17–0.22	0.70–0.90	0.035	0.040	0.15–0.35	...	0.70–0.90	...
G51300	5130	0.28–0.33	0.70–0.90	0.035	0.040	0.15–0.35	...	0.80–1.10	...
G51320	5132	0.30–0.35	0.60–0.80	0.035	0.040	0.15–0.35	...	0.75–1.00	...
G51350	5135	0.33–0.38	0.60–0.80	0.035	0.040	0.15–0.35	...	0.80–1.05	...
G51400	5140	0.38–0.43	0.70–0.90	0.035	0.040	0.15–0.35	...	0.70–0.90	...
G51500	5150	0.48–0.53	0.70–0.90	0.035	0.040	0.15–0.35	...	0.70–0.90	...
G51550	5155	0.51–0.59	0.70–0.90	0.035	0.040	0.15–0.35	...	0.70–0.90	...
G51600	5160	0.56–0.64	0.75–1.00	0.035	0.040	0.15–0.35	...	0.70–0.90	...
G51986	E51100	0.98–1.10	0.25–0.45	0.025	0.025	0.15–0.35	...	0.90–1.15	...
G52986	E52100	0.98–1.10	0.25–0.45	0.025	0.025	0.15–0.35	...	1.30–1.60	...
									Vanadium
G61180	6118	0.16–0.21	0.50–0.70	0.035	0.040	0.15–0.35	...	0.50–0.70	0.10–0.15
G61500	6150	0.48–0.53	0.70–0.90	0.035	0.040	0.15–0.35	...	0.80–1.10	0.15 min
									Molybdenum
G86150	8615	0.13–0.18	0.70–0.90	0.035	0.04	0.15–0.35	0.40–0.70	0.40–0.60	0.15–0.25
G86170	8617	0.15–0.20	0.70–0.90	0.035	0.040	0.15–0.35	0.40–0.70	0.40–0.60	0.15–0.25
G86200	8620	0.18–0.23	0.70–0.90	0.035	0.04	0.15–0.35	0.40–0.70	0.40–0.60	0.15–0.25
G86220	8622	0.20–0.25	0.70–0.90	0.035	0.040	0.15–0.35	0.40–0.70	0.40–0.60	0.15–0.25
G86250	8625	0.23–0.28	0.70–0.90	0.035	0.040	0.15–0.35	0.40–0.70	0.40–0.60	0.15–0.25
G86270	8627	0.25–0.30	0.70–0.90	0.035	0.040	0.15–0.35	0.40–0.70	0.40–0.60	0.15–0.25
G86300	8630	0.28–0.33	0.70–0.90	0.035	0.040	0.15–0.35	0.40–0.70	0.40–0.60	0.15–0.25
G86370	8637	0.35–0.40	0.75–1.00	0.035	0.040	0.15–0.35	0.40–0.70	0.40–0.60	0.15–0.25
G86400	8640	0.38–0.43	0.75–1.00	0.035	0.040	0.15–0.35	0.40–0.70	0.40–0.60	0.15–0.25
G86420	8642	0.40–0.45	0.75–1.00	0.035	0.040	0.15–0.35	0.40–0.70	0.40–0.60	0.15–0.25
G86450	8645	0.43–0.48	0.75–1.00	0.035	0.040	0.15–0.35	0.40–0.70	0.40–0.60	0.15–0.25
G86550	8655	0.51–0.59	0.75–1.00	0.035	0.040	0.15–0.35	0.40–0.70	0.40–0.60	0.15–0.25
G87200	8720	0.18–0.23	0.70–0.90	0.035	0.040	0.15–0.35	0.40–0.70	0.40–0.60	0.20–0.30
G87400	8740	0.38–0.43	0.75–1.00	0.035	0.040	0.15–0.35	0.40–0.70	0.40–0.60	0.20–0.30

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

TABLE 1 *Continued*

UNS Designation[C]	Grade[D] Designations	Chemical Composition, Ranges and Limits, %							
		Carbon	Manganese	Phosphorus, max	Sulfur,[E] max	Silicon[F]	Nickel	Chromium	Molybdenum
G88220	8822	0.20–0.25	0.75–1.00	0.035	0.040	0.15–0.35	0.40–0.70	0.40–0.60	0.30–0.40
G92590	9259	0.56–0.64	0.75–1.00	0.035	0.040	0.70–1.10	...	0.45–0.65	...
G92600	9260	0.56–0.64	0.75–1.00	0.035	0.040	1.80–2.20	...	...	...
		Standard Boron Steels[G]							
G50441	50B44	0.43–0.48	0.75–1.00	0.035	0.040	0.15–0.35	...	0.20–0.60	...
G50461	50B46	0.44–0.49	0.75–1.00	0.035	0.040	0.15–0.35	...	0.20–0.35	...
G50501	50B50	0.48–0.53	0.75–1.00	0.035	0.040	0.15–0.35	...	0.40–0.60	...
G50601	50B60	0.56–0.64	0.75–1.00	0.035	0.040	0.15–0.35	...	0.40–0.60	...
G51601	51B60	0.56–0.64	0.75–1.00	0.035	0.040	0.15–0.35	...	0.70–0.90	...
G81451	81B45	0.43–0.48	0.75–1.00	0.035	0.040	0.15–0.35	0.20–0.40	0.35–0.55	0.08–0.15
G94171	94B17	0.15–0.20	0.75–1.00	0.035	0.040	0.15–0.35	0.30–0.60	0.30–0.50	0.08–0.15
G94301	94B30	0.28–0.33	0.75–1.00	0.035	0.040	0.15–0.35	0.30–0.60	0.30–0.50	0.08–0.15

[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.

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 out-lined 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 Cleaning must be specified.

8. Certification and Test Reports

8.1 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 cast or heat analysis test results for the specified elements, shall be furnished. The report shall include the name of the manufacturer, ASTM designation and year date and revision letter, if any, type and grade, heat number, and size.

8.2 When Supplementary Requirements are specified, the report shall include a statement of compliance with the requirement of the results of tests when the requirement involves measured test values.

9. Keywords

9.1 alloy steel bars; hot-wrought steel bars; steel bars

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.

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale

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 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.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A 322 – 06) that may impact the use of this standard. (Approved May 1, 2007.)

(*1*) Updated Section 5.

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).

Copyright ASTM International
Provided by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale