Designation: A 507 – 06

Standard Specification for Drawing Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled[1]

This standard is issued under the fixed designation A 507; 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-rolled and cold-rolled drawing alloy-steel sheet and strip. Material of this quality is produced principally for applications involving severe cold plastic deformation such as deep drawn or severely formed parts. This steel is produced by a closely controlled steelmaking practice designed to assure internal soundness, relative uniformity of chemical composition, and freedom from injurious imperfections.

1.2 The material covered by this specification may be furnished in several conditions, heat treatments, surface finishes, and edges, as specified herein, in coils or cut lengths.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

A 505 Specification for Steel, Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled, General Requirements for

A 941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *capable of*—as used in this specification, means that tests need not be performed. However, if application by the purchaser establishes that the material does not meet the requirements, the material shall be subject to rejection.

3.1.2 *drawing alloy steel*—alloy-steel sheet and strip intended for applications involving severe cold plastic deformation such as deep drawn or severely formed parts.

3.1.3 *standard steels*—steel chemical compositions defined as "standard" by the Society of Automotive Engineers (SAE). See Table 1.

3.1.4 *steels other than standard*—steel chemical compositions other than those defined as "standard," and furnished to the composition limits shown in Table 2.

4. General Requirements and Ordering Information

4.1 Material supplied to this specification shall conform to Specification A 505, which includes the general requirements and establishes the rules for the ordering information that should be complied with when purchasing material to this specification.

4.2 In addition to the Ordering Information required by Specification A 505, the following shall also be included:

4.2.1 Mechanical properties, if required (show properties desired, which must be consistent with the grade and heat treatment),

4.2.2 Surface finish, if other than that normally furnished (see Section 10), and

4.2.3 Application, or end use (identification of the part to be made).

5. Manufacture

5.1 *Rolling*—The material shall be furnished either hot-rolled or cold-rolled, as specified on the order.

5.2 *Heat Treatment*—Unless otherwise specified on the order, the material shall be furnished spheroidize-annealed. (See Terminology A 941 for heat treatment terms.)

5.2.1 If the material is to be heat treated by other than the producer, the order shall so state. The material may be ordered in the as-rolled condition, in such cases.

6. *Chemical Requirements* Chemical Requirements

6.1 The heat (cast) analysis shall conform to the requirements for the grade specified on the order.

6.1.1 Standard steels listed in Table 1 are those commonly produced for drawing alloy-steel sheet and strip.

6.1.2 Nonstandard steel grades may be specified, using the ranges and limits shown in Table 2.

7. Metallurgical Structure

7.1 *Microstructure*:

[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 A01.19 on Steel Sheet and Strip.

Current edition approved March 1, 2006. Published March 2006. Originally approved in 1964. Last previous edition approved in 2005 as A 507 – 05.

[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.**

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TABLE 1 Standard Steels Commonly Produced for Drawing Alloy-Steel Sheet and Strip

UNS Designation	SAE No.	Chemical Composition Ranges and Limits, % (Heat Analysis)[A]								
		C	Mn	P	S	Si[A]	Ni	Cr	Mo	V
. . .	E3310	0.08–0.13	0.45–0.60	0.025	0.025	0.15–0.30	3.25–3.75	1.40–1.75	. . .	. . .
G40120	4012	0.09–0.14	0.75–1.00	0.025	0.025	0.15–0.30	. . .	. . .	0.15–0.25	. . .
G41180	4118	0.18–0.23	0.70–0.90	0.025	0.025	0.15–0.30	. . .	0.40–0.60	0.08–0.15	. . .
G41300	4130	0.28–0.33	0.40–0.60	0.025	0.025	0.15–0.30	. . .	0.80–1.10	0.15–0.25	. . .
G41350	4135	0.33–0.38	0.70–0.90	0.025	0.025	0.15–0.30	. . .	0.80–1.10	0.15–0.25	. . .
G41370	4137	0.35–0.40	0.70–0.90	0.025	0.025	0.15–0.30	. . .	0.80–1.10	0.15–0.25	. . .
G41400	4140	0.38–0.43	0.75–1.00	0.025	0.025	0.15–0.30	. . .	0.80–1.10	0.15–0.25	. . .
G41420	4142	0.40–0.45	0.75–1.00	0.025	0.025	0.15–0.30	. . .	0.80–1.10	0.15–0.25	. . .
G41450	4145	0.43–0.48	0.75–1.00	0.025	0.025	0.15–0.30	. . .	0.80–1.10	0.15–0.25	. . .
G41470	4147	0.45–0.50	0.75–1.00	0.025	0.025	0.15–0.30	. . .	0.80–1.10	0.15–0.25	. . .
G41500	4150	0.48–0.53	0.75–1.00	0.025	0.025	0.15–0.30	. . .	0.80–1.10	0.15–0.25	. . .
G43200	4320	0.17–0.22	0.45–0.65	0.025	0.025	0.15–0.30	1.65–2.00	0.40–0.60	0.20–0.30	. . .
G43400	4340	0.38–0.43	0.60–0.80	0.025	0.025	0.15–0.30	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	0.15–0.30	1.65–2.00	0.70–0.90	0.20–0.30	. . .
G45200	4520	0.18–0.23	0.45–0.65	0.025	0.025	0.15–0.30	. . .	. . .	0.45–0.60	. . .
G46150	4615	0.13–0.18	0.45–0.65	0.025	0.025	0.15–0.30	1.65–2.00	. . .	0.20–0.30	. . .
G46200	4620	0.17–0.22	0.45–0.65	0.025	0.025	0.15–0.30	1.65–2.00	. . .	0.20–0.30	. . .
G47180	4718	0.16–0.21	0.70–0.90	0.025	0.025	0.15–0.30	0.90–1.20	0.35–0.55	0.30–0.40	. . .
G48150	4815	0.13–0.18	0.40–0.60	0.025	0.025	0.15–0.30	3.25–3.75	. . .	0.20–0.30	. . .
G48200	4820	0.18–0.23	0.50–0.70	0.025	0.025	0.15–0.30	3.25–3.75	. . .	0.20–0.30	. . .
G50150	5015	0.12–0.17	0.30–0.50	0.025	0.025	0.15–0.30	. . .	0.30–0.50	. . .	. . .
G50460	5046	0.43–0.50	0.75–1.00	0.025	0.025	0.15–0.30	. . .	0.20–0.35	. . .	. . .
G51150	5115	0.13–0.18	0.70–0.90	0.025	0.025	0.15–0.30	. . .	0.70–0.90	. . .	. . .
G51200	5120	0.17–0.22	0.70–0.90	0.025	0.025	0.15–0.30	. . .	0.70–0.90	. . .	. . .
G51300	5130	0.28–0.33	0.70–0.90	0.025	0.025	0.15–0.30	. . .	0.80–1.10	. . .	. . .
G5132	5132	0.30–0.35	0.60–0.90	0.025	0.025	0.15–0.30	. . .	0.75–1.00	. . .	. . .
G51400	5140	0.38–0.43	0.70–0.90	0.025	0.025	0.15–0.30	. . .	0.70–0.90	. . .	. . .
G51500	5150	0.48–0.53	0.79–0.90	0.025	0.025	0.15–0.30	. . .	0.70–0.90	. . .	. . .
G51600	5160	0.55–0.65	0.75–1.00	0.025	0.025	0.15–0.30	. . .	0.70–0.90	. . .	. . .
G15116	E51100	0.95–1.10	0.25–0.45	0.025	0.025	0.15–0.30	. . .	0.90–1.15	. . .	. . .
G15216	E52100	0.95–1.10	0.25–0.45	0.025	0.025	0.15–0.30	. . .	1.30–1.60	. . .	. . .
G61500	6150	0.48–0.53	0.70–0.90	0.025	0.025	0.15–0.30	. . .	0.80–1.10	. . .	0.15 min
G61580	6158	0.55–0.62	0.70–1.10	0.025	0.015	0.15–0.30	. . .	0.90–1.20	. . .	0.10–0.20
G86150	8615	0.13–0.18	0.70–0.90	0.025	0.025	0.15–0.30	0.40–0.70	0.40–0.60	0.15–0.25	. . .
G86170	8617	0.15–0.20	0.70–0.90	0.025	0.025	0.15–0.30	0.40–0.70	0.40–0.60	0.15–0.25	. . .
G86200	8620	0.18–0.23	0.70–0.90	0.035	0.035	0.15–0.30	0.40–0.70	0.40–0.60	0.15–0.25	. . .
G86300	8630	0.28–0.33	0.70–0.90	0.025	0.025	0.15–0.30	0.40–0.70	0.40–0.60	0.15–0.25	. . .
G86400	8640	0.38–0.43	0.75–1.00	0.025	0.025	0.15–0.30	0.40–0.70	0.40–0.60	0.15–0.25	. . .
G86420	8642	0.40–0.45	0.75–1.00	0.025	0.025	0.15–0.30	0.40–0.70	0.40–0.60	0.15–0.25	. . .
G86450	8645	0.43–0.48	0.75–1.00	0.025	0.025	0.15–0.30	0.40–0.70	0.40–0.60	0.15–0.25	. . .
G86500	8650	0.48–0.53	0.75–1.00	0.025	0.025	0.15–0.30	0.40–0.70	0.40–0.60	0.15–0.25	. . .
G86550	8655	0.50–0.60	0.75–1.00	0.025	0.025	0.15–0.30	0.40–0.70	0.40–0.60	0.15–0.25	. . .
G86600	8660	0.55–0.65	0.75–1.00	0.025	0.025	0.15–0.30	0.40–0.70	0.40–0.60	0.15–0.25	. . .
G87200	8720	0.18–0.23	0.70–0.90	0.025	0.025	0.15–0.30	0.40–0.70	0.40–0.60	0.20–0.30	. . .
G87350	8735	0.33–0.38	0.75–1.00	0.025	0.025	0.15–0.30	0.40–0.70	0.40–0.60	0.20–0.30	. . .
G87400	8740	0.38–0.43	0.75–1.00	0.025	0.025	0.15–0.30	0.40–0.70	0.40–0.60	0.20–0.30	. . .
G92600	9260	0.55–0.65	0.70–1.00	0.025	0.025	1.80–2.20	. . .	. . .	. . .	. . .
G92620	9262	0.55–0.65	0.75–1.00	0.025	0.025	1.80–2.20	. . .	0.25–0.40	. . .	. . .
. . .	E9310	0.08–0.13	0.45–0.65	0.025	0.025	0.20–0.35	3.00–3.50	1.00–1.40	0.08–0.15	. . .

[A] The chemical ranges and limits shown are subject to product analysis tolerances. See Specification A 505.

7.1.1 *Requirements*—At least 75 % of the carbide microstructure shall be of the globular type.

7.1.2 *Number of Tests*—The number of tests shall be in accordance with the producer's standard quality control procedures. A specific number of tests is not required, but the material shall be produced by manufacturing practices established to assure compliance with the specified requirements. The material shall be subjected to mill tests and inspection procedures to assure such compliance. For government procurement, mill tests and inspection procedures utilized to show conformance to the microstructure requirements shall be made available on request.

8. Mechanical Requirements

8.1 *Tension and Hardness Tests*:

8.1.1 *Requirements*—When tension tests or hardness tests, or both are specified on the order, the test results shall conform to the requirements specified on the order. Yield strength, tensile strength, and elongation requirements may be specified. The tensile properties will vary depending on the chemical composition, condition, and heat treatment. Producers are frequently consulted as to grade, resultant mechanical properties, recommended heat treatment, and other information needed to establish the property parameters to meet end use requirements. Rockwell hardness requirements may be specified, providing the requirements are compatible with the tension test requirements.

8.1.2 *Number of Tests*—Two tension tests and two hardness tests, when specified, shall be taken at random from each heat (cast) and heat treatment lot.

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TABLE 2 Heat (Cast) Analysis Ranges for Other Than Standard Steel Alloy Sheet and Strip

Element	When Maximum of Specified Element Is, %	Range or Limit, %
Carbon	To 0.55 incl	0.05
	Over 0.55 to 0.70 incl	0.08
	Over 0.70 to 0.80 incl	0.10
	Over 0.80 to 0.95 incl	0.12
	Over 0.95 to 1.35 incl	0.13
Manganese	To 0.60 incl	0.20
	Over 0.60 to 0.90 incl	0.20
	Over 0.90 to 1.05 incl	0.25
	Over 1.05 to 1.90 incl	0.30
	Over 1.90 to 2.10 incl	0.40
Phosphorus	. . .	0.025 max
Sulfur	. . .	0.025 max
Silicon	To 0.15 incl	0.08
	Over 0.15 to 0.20 incl	0.10
	Over 0.20 to 0.40 incl	0.15
	Over 0.40 to 0.60 incl	0.20
	Over 0.60 to 1.00 incl	0.30
	Over 1.00 to 2.20 incl	0.40
Copper	To 0.60 incl	0.20
	Over 0.60 to 1.50 incl	0.30
	Over 1.50 to 2.00 incl	0.35
Nickel	To 0.50 incl	0.20
	Over 0.50 to 1.50 incl	0.30
	Over 1.50 to 2.00 incl	0.35
	Over 2.00 to 3.00 incl	0.40
	Over 3.00 to 5.30 incl	0.50
	Over 5.30 to 10.00 incl	1.00
Chromium	To 0.40 incl	0.15
	Over 0.40 to 0.90 incl	0.20
	Over 0.90 to 1.05 incl	0.25
	Over 1.05 to 1.60 incl	0.30
	Over 1.60 to 1.75 incl	0.35
	Over 1.75 to 2.10 incl	0.40
	Over 2.10 to 3.99 incl	0.50
Molybdenum	To 0.10 incl	0.05
	Over 0.10 to 0.20 incl	0.07
	Over 0.20 to 0.50 incl	0.10
	Over 0.50 to 0.80 incl	0.15
	Over 0.80 to 1.15 incl	0.20
Vanadium	To 0.25 incl	0.05
	Over 0.25 to 0.50 incl	0.10

9. Other Tests and Requirements

9.1 *End Use Suitability*:

9.1.1 When steel is to be furnished in the spheroidize-annealed condition, the user and producer shall review any part(s) to be produced to reach adequate agreement on capability to produce said parts.

9.1.2 Material in the spheroidize-annealed condition generally work hardens and may require stress-relief-annealing between drawing operations.

10. Workmanship, Finish, and Appearance

10.1 *Surface Finish*:

10.1.1 *Hot-Rolled*—Unless otherwise specified, hot-rolled material shall be furnished descaled and oiled. When required, the material may be specified to be furnished not oiled.

10.1.2 *Cold-Rolled*—Unless otherwise specified, cold-rolled material shall be furnished with a commercial dull matte finish and shall be oiled. When required, the material may be specified to be furnished not oiled.

10.2 *Edges*:

10.2.1 *Hot-Rolled*—Unless otherwise specified, hot-rolled material shall be furnished with Mill Edge. The material may be specified to have other types of edges, in accordance with Specification A 505.

10.2.2 *Cold-Rolled*—Unless otherwise specified, cold-rolled sheet shall be furnished with Cut Edge and cold-rolled strip shall be furnished with No. 3 Edge. The material may be specified to have other types of edges, in accordance with Specification A 505.

11. Keywords

11.1 alloy steel with improved formability; cold-rolled alloy steel; deep drawn alloy steel; drawing alloy steel sheet; drawing alloy steel strip; forming alloy steel; hot-rolled alloy steel; special soundness alloy steel

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue, A 507 – 05, that may impact the use of this standard. (Approved March 1, 2006.)

(*1*) Revised 9.1.1 and corrected a typographical error in 9.1.2.

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Committee A01 has identified the location of selected changes to this standard since the last issue, A 507 – 04, that may impact the use of this standard. (Approved Dec. 1, 2005.)

(*1*) Added all the grades in Table A1.1 to Table 1.
(*2*) Eliminated Table A1.1 and the Annex section.
(*3*) Added new grade 6158 to Table 1.
(*4*) Revised the phosphorus and sulfur requirements to 0.025 % maximum for all grades in Table 1 except grade 6158.
(*5*) Revised the phosphorus and sulfur requirements to 0.025 % maximum in Table 2.
(*6*) In Section 3.1.3, deleted reference to Table A1.1.
(*7*) Revised the wording in Section 6.1.1.
(*8*) Deleted Section 6.1.2 and renumbered Section 6.1.3 to 6.1.2.

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