Designation: A 607 – 98

Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled[1]

This standard is issued under the fixed designation A 607; 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 high-strength, low-alloy columbium, or vanadium hot-rolled sheet and strip, or cold-rolled sheet, or combinations thereof, in either cut lengths or coils, intended for applications where greater strength and savings in weight are important. The material is available as two classes. They are similar in strength level except that Class 2 offers improved weldability and more formability than Class 1. Atmospheric corrosion resistance of these steels is equivalent to plain carbon steels. With copper specified, the atmospheric corrosion resistance is twice that of plain carbon steel.

1.2 The value stated in inch-pound units are to be regarded as the standard.

1.3 Class 1 material was previously A 607 without a class designation.

2. Referenced Documents

2.1 *ASTM Standards:*

A 568/A 568M Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for[2]

A 749/A 749M Specification for Steel, Strip, Carbon and High-Strength, Low-Alloy, Hot-Rolled, General Requirements for[2]

3. Ordering Information

3.1 Orders for material under this specification shall include the following information, as required, to describe adequately the desired material:

3.1.1 ASTM specification number and year of issue, grade, type, and class. When a class is not specified Class 1 will be furnished,

3.1.2 Name of material (high-strength low-alloy hot-rolled steel sheet or strip and cold-rolled steel sheet),

3.1.3 Copper bearing steel (when required),

3.1.4 Finish (cold-rolled)—indicate exposed (E) or unexposed (U). Matte (dull) finish will be supplied unless otherwise specified (see 7.3.2),

3.1.5 Condition (specify oiled or dry, as required) (see 7.2),

3.1.6 Edges (must be specified for hot-rolled sheet and strip), and

3.1.7 Dimensions (thickness, width, and whether cut lengths or coils).

3.1.7.1 As agreed upon between the purchaser and the producer, material ordered to this specification will be supplied to meet the appropriate standard or restricted thickness tolerance table shown in Specification A 568/A 568M.

NOTE 1—Not all producers are capable of meeting all of the limitations of the thickness tolerance tables in Specification A 568/A 568M. The purchaser should contact the producer regarding possible limitations prior to placing an order.

3.1.8 Coil size and weight requirements (must include inside diameter, outside diameter, and maximum weight),

3.1.9 Application (show part identification and description), and

3.1.10 Special requirements (if required) or supplementary requirements of S1.

NOTE 2—A typical ordering description is as follows: "ASTM A 607 – XX, Grade 45 Type I Class 2 hot-rolled high-strength low-alloy steel sheet, dry, mill edge, 0.075 by 36 by 96 in. for tote box frame members."

4. Materials and Manufacture

4.1 High-strength low-alloy columbium and/or vanadium hot-rolled sheet and strip, and cold-rolled sheet are ordinarily produced from capped or semi-killed steel. Should fully killed steel be required, the order should so indicate.

4.2 The material shall be furnished hot-rolled or cold-rolled as specified on the purchase order.

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[1] This specification is under the jurisdiction of ASTM Committee A-1 on Steel, Stainless Steel, and Related Alloys and is the direct responsibility of Subcommittee A01.19 on Steel Sheet and Strip.

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[2] *Annual Book of ASTM Standards*, Vol 01.03.

5. Chemical Composition

5.1 The steel shall conform to the requirements as to chem ical composition prescribed in Table 1 for the class specified.

5.1.1 Unspecified elements may be present. Limits on elements shall be as stated in Table 2.

5.1.1.1 Each of the elements listed in Table 2 shall be included in the report of the heat analysis. When the amount of an element present is less than 0.02 %, the analysis may be reported as "<0.02 %."

5.2 When the steel is used in welded applications, welding procedure shall be suitable for the steel chemistry and the intended service.

5.3 When a class is not specified, Class 1 will be furnished.

TABLE 2 Limits on Unspecified Elements (see 5.1.1)

Copper, max %[A]	Heat analysis	0.20
	Product analysis	0.23
Nickel, max %[A]	Heat analysis	0.20
	Product analysis	0.23
Chromium, max %[A]	Heat analysis	0.15
	Product analysis	0.19
Molybdenum, max %[A]	Heat analysis	0.06
	Product analysis	0.07

[A] The sum of copper, nickel, chromium, and molybdenum shall not exceed 0.50 % on heat analysis. When one or more of these elements are specified, the sum does not apply; in which case, only the individual limits on the remaining unspecified elements will apply.

6. Mechanical Property Requirements

6.1 *Tensile Tests*:

6.1.1 *Requirements*—Material as represented by the test specimen shall conform to the tensile requirements specified in Table 3.

6.1.2 *Number of Tests*—Two tensile tests shall be made from each heat or from each lot of 50 tons (45 Mg). When the amount of finished material from a heat or lot is less than 50 tons (45 Mg), one test shall be made. When material rolled from one heat differs 0.050 in. (1.27 mm) or more in thickness, one tensile test shall be made from the thickest and thinnest material regardless of the weight represented.

6.1.3 *Location and Orientation*:

6.1.3.1 Tensile test specimens shall be taken at a point immediately adjacent to the material to be qualified.

6.1.3.2 Tensile test samples shall be taken from the full thickness of the sheet as rolled.

6.1.3.3 Tensile test specimens shall be taken from a location approximately halfway between the center of the sheet and the edge of the material as-rolled.

6.1.3.4 Tensile test specimens shall be taken with the axis of the test specimen parallel to the rolling direction (longitudinal test).

6.1.4 *Test Method*—Yield strength shall be determined by either the 0.2 % offset method or by the 0.5 % extension under load method unless otherwise specified.

6.2 *Bending Properties*—The minimum forming radius (radii) which steel covered by this specification can be expected to sustain is listed in Appendix X1, Table , and is discussed in more detail in Specifications A 568/A 568M and A 749/A 749M. Where tighter bend radii are required, where curved or offset bends are involved, or where stretching or drawing are also a consideration, the producers should be consulted.

7. Workmanship, Finish, and Appearance

7.1 *Edges*:

7.1.1 *Hot-Rolled*—In the as-rolled condition the material has mill edges. Pickled or blast-cleaned material has cut edges. When required, as-rolled material may be specified to have cut edges. If mill edge material is required it must be specified.

7.1.2 *Cold-Rolled*—Cold-rolled material shall have cut edges only.

7.2 *Oiling*:

7.2.1 *Hot-Rolled*—Unless otherwise specified, hot-rolled as-rolled material shall be furnished dry, and hot-rolled pickled or blast-cleaned material shall be furnished oiled. When required, pickled or blast-cleaned material may be specified to be furnished dry, and as-rolled material may be specified to be furnished oiled.

7.2.2 *Cold-Rolled*—Unless otherwise specified, cold-rolled material shall be oiled. When required, cold-rolled material may be specified to be furnished dry, but is not recommended due to the increased possibility of rusting.

7.3 *Surface Finish*:

TABLE 1 Chemical Requirements, Composition, %[A]

NOTE 1—Class 2 requirements for manganese, phosphorus, sulfur, columbium, and vanadium are the same as shown for Class 1.

Element	Grade 45		Grade 50		Grade 55		Grade 60		Grade 65		Grade 70	
	Heat or Cast Analysis	Product Analysis	Heat or Cast Analysis	Product Analysis	Heat or Cast Analysis	Product Analysis	Heat or Cast Analysis	Product Analysis	Heat or Cast Analysis	Product Analysis	Heat or Cast Analysis	Product Analysis
Class I												
Carbon, max	0.22	0.26	0.23	0.27	0.25	0.29	0.26	0.30	0.26	0.30	0.26	0.30
Manganese, max	1.35	1.40	1.35	1.40	1.35	1.40	1.50	1.55	1.50	1.55	1.65	1.70
Phosphorus, max	0.04	0.05	0.04	0.05	0.04	0.05	0.04	0.05	0.04	0.05	0.04	0.05
Sulfur, max	0.04	0.06	0.04	0.06	0.04	0.06	0.04	0.06	0.04	0.06	0.04	0.06
Columbium or vanadium, min	Cb 0.005 V 0.01	0.004 0.005	Cb 0.005 V 0.01	0.004 0.005	Cb 0.005 V 0.01	0.004 0.005	Cb 0.005 V 0.01	0.004 0.005	Cb 0.005 V 0.01	0.004 0.005	Cb 0.005 V 0.01	0.004 0.005
Nitrogen, max	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	0.012	0.015	0.012	0.015
Class 2												
Carbon, max	0.15	0.18	0.15	0.18	0.15	0.18	0.15	0.18	0.15	0.18	0.15	0.18
Nitrogen, max	. . .	. . .	. . .	. . .	. . .	. . .	0.020	0.024	0.020	0.024	0.020	0.024

[A] Copper, when specified, shall have a minimum content of 0.20 % by heat or cast analysis (0.18 % by product analysis).

TABLE 3 Tensile Requirements[A]

ksi (MPa)	Grade 45	Grade 50	Grade 55	Grade 60	Grade 65	Grade 70
Class I						
Tensile strength, min	60 (410)	65 (450)	70 (480)	75 (520)	80 (550)	85 (590)
Yield strength, min	45 (310)	50 (340)	55 (380)	60 (410)	65 (450)	70 (480)
Elongation in 2 in., or 50 mm, min, %:						
Hot-Rolled over 0.097 (2.46 mm)	25.0	22.0	20.0	18.0	16.0	14.0
Up to 0.097 (2.46 mm) incl	23.0	20.0	18.0	16.0	14.0	12.0
Cold-Rolled	22.0	20.0	18.0	16.0	15.0	14.0
Class 2						
Tensile strength, min	55 (380)	60 (410)	65 (450)	70 (480)	75 (520)	80 (550)
Yield strength, min	45 (310)	50 (340)	55 (380)	60 (410)	65 (450)	70 (480)
Elongation in 2 in., % min:						
Hot-Rolled over 0.097 (2.46 mm)	25.0	22.0	20.0	18.0	16.0	14.0
Up to 0.097 (2.46 mm) incl	23.0	20.0	18.0	16.0	14.0	12.0
Cold-Rolled	22.0	20.0	18.0	16.0	15.0	14.0

[A] For coil products, testing by the producer is limited to the end of the coil. Results of such tests must comply with the specified values. Tensile properties throughout the balance of the coil must not be less than 90 % of the minimum values specified.

7.3.1 *Hot-Rolled*—Unless otherwise specified, hot-rolled material shall have an as-rolled, not pickled surface finish. When required, material may be specified to be pickled or blast-cleaned.

7.3.2 *Cold-Rolled*—Unless otherwise specified cold-rolled material shall have a matte (dull) finish.

8. General Requirements for Delivery

8.1 Material furnished under this specification shall conform to the applicable requirements of the current editions of Specifications A 568/A 568M or A 749/A 749M unless otherwise provided herein.

9. Retests

9.1 If the results on an original tensile specimen are within 2000 psi (14 MPa) of the required tensile strength, within 1000 psi (7 MPa) of the required yield point, or within 2 % of the required elongation, a retest shall be permitted for which one random specimen from the heat or test lot shall be used. If the results on this retest specimen meet the specified mechanical requirements, the heat or lot will be accepted.

10. Certification and Reports

10.1 The manufacturer shall furnish copies of a test report showing the results of the heat or cast analysis and the mechanical property tests to determine compliance with this specification. The report shall include the purchase order number, ASTM designation number, and the heat or lot number correlating the test results with the material represented.

11. Keywords

11.1 alloy steel sheet; alloy steel strip; cold rolled steel sheet; cold rolled steel strip; high strength low alloy steel; hot rolled steel sheet; hot rolled steel strip; steel sheet; steel strip

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall apply when specified in the order or contract:

S1. Types

S1.1 When a purchaser prefers to designate the specific elements (columbium, vanadium, nitrogen, or combinations thereof), one of the types listed below shall be specified. The type in addition to the grade must be shown on the order (see 3.1.1).

Type 1—Columbium

Type 2—Vanadium

Type 3—Columbium and vanadium

Type 4—Vanadium and nitrogen

S1.2 The composition limits of Section 5 shall apply for any of these types.

APPENDIX

(Nonmandatory Information)

X1. BENDING PROPERTIES

TABLE Suggested Minimum Inside Radii for Cold Bending[A]

NOTE 1—(*t*) equals a radius equivalent to the steel thickness.
NOTE 2—The suggested radii should be used as minimums for 90° bends in actual shop practice.

Grade	Class 1	Class 2
45	1½ *t*	1½ *t*
50	2	1½
55	2	2
60	2 1/2	2
65	3	2½
70	3 1/2	3

[A] Material that does not perform satisfactorily, when fabricated in accordance with the above requirements, may be subject to rejection pending negotiation with the steel supplier.