Designation: A414/A414M – 07

Standard Specification for Steel, Sheet, Carbon, for Pressure Vessels[1]

This standard is issued under the fixed designation A414/A414M; 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.

1. Scope*

1.1 This specification[2] covers hot-rolled carbon steel sheet for pressure vessels involving fusion welding or brazing. Welding and brazing technique is of fundamental importance and shall be in accordance with commercial practices.

1.2 The following grades are included in this specification:

Mechanical Requirements

Grade	Yield Strength, min		Tensile Strength, min	
	ksi	MPa	ksi	MPa
A	25	170	45	310
B	30	205	50	345
C	33	230	55	380
D	35	240	60	415
E	38	260	65	450
F	42	290	70	485
G	45	310	75	515

1.3 Hot-rolled carbon steel sheet is generally furnished in cut lengths and to decimal thickness only. Coils may be furnished, provided tension test specimens are taken to represent the middle of the slab as required by 5.1.4. The purchaser should recognize this may require cutting the coils to obtain test samples and results in half-size coils. The sheet is furnished to the following size limits:

Thickness, in. [mm]	Width, in. [mm] Over 12 [Over 300]
0.270 to 0.230 [7.0 to 6.0]	sheet (coils only)
Under 0.230 to 0.057 [6.0 to 1.5]	sheet

1.4 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

1.5 Tolerances are found in General Requirements Specifications A568/A568M and A635/A635M. The appropriate General Requirements specification is applied based on the thickness and width of the product ordered.

2. Referenced Documents

2.1 *ASTM Standards:*[3]

A568/A568M Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for

A635/A635M Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for

3. Ordering Information

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

3.1.1 Designation or specification number, date of issue, and grade,

3.1.2 Copper bearing steel, when required,

3.1.3 Special requirements, if required,

3.1.4 Condition—pickled (or blast cleaned), if required (material so ordered will be oiled unless ordered dry), and

3.1.5 Dimensions, including type of edges.

3.1.5.1 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 A568/A568M or Specification A635/A635M.

NOTE 1—Not all producers are capable of meeting all of the limitations of the thickness tolerance tables in Specification A568/A568M or Specification A635/A635M. The purchaser should contact the producer regarding possible limitations prior to placing an order.

3.1.6 Cast or heat analysis, or test report request, or both, if required.

NOTE 2—A typical ordering description is as follows: "ASTM A414,

[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.

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[2] For ASME Boiler and Pressure Vessel Code applications see related Specification SA-414 in Section 11 of that Code.

[3] 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.**

Grade A, Hot-Rolled Sheet, 0.100 in. [2.54 mm] by 36 in. [914.4 mm] by 96 in. [2438 mm], cut edges."

4. Chemical Requirements

4.1 *Cast or Heat Analysis*—The analysis of the steel shall conform to the requirements prescribed in Table 1.

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

4.1.1.1 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 %."

4.2 *Product, Check, or Verification Analysis*—Analyses may be made by the purchaser from finished material representing each heat.

4.3 *Deoxidation*—For all grades, killed steel is required. See Table 1 and footnotes A and B.

5. Mechanical Property Requirements

5.1 *Tensile Strength*:

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

5.1.2 *Number of Tests*—Two tensile tests shall be made from the product of each slab as rolled.

5.1.3 *Location and Orientation* (see Fig. 1):

5.1.3.1 Tensile test specimens shall be taken at locations representing the middle and back end of each slab as rolled.

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

5.1.3.3 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.

5.1.3.4 Tensile test specimens shall be taken with the axis of the test specimen perpendicular to the rolling direction (transverse test).

5.1.4 *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. General Requirements for Delivery

6.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification A568/A568M or Specification A635/A635M unless otherwise provided herein.

TABLE 2 Limits on Unspecified Elements (See 4.1.1)

Copper, max %[A]	Heat analysis	0.40
	Product analysis	0.43
Nickel, max %[A]	Heat analysis	0.40
	Product analysis	0.43
Chromium, max %[A,B]	Heat analysis	0.30
	Product analysis	0.34
Molybdenum, max %[A,B]	Heat analysis	0.12
	Product analysis	0.13
Vanadium, max %[C]	Heat analysis	0.03
	Product analysis	0.04
Columbium, max %[C]	Heat analysis	0.02
	Product analysis	0.03

[A] The sum of copper, nickel, chromium, and molybdenum shall not exceed 1.00 % 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.

[B] The sum of chromium and molybdenum shall not exceed 0.32 % 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.

[C] By agreement, the heat analysis limits for vanadium or columbium, or both, may be increased up to 0.10 % and 0.05 %, respectively.

7. Workmanship

7.1 The material shall be free from injurious defects (see Specifications A568/A568M or A635/A635M, as appropriate due to thickness).

8. Finish and Appearance

8.1 *Surface Finish*:

8.1.1 Unless otherwise specified, the material shall be furnished without removing the hot-rolled oxide or scale.

8.1.2 When required, the material may be specified to be pickled or blast cleaned.

8.2 *Oiling*:

8.2.1 Unless otherwise specified, the material shall be furnished not oiled.

8.2.2 When specified to be pickled or blast cleaned, the material shall be furnished oiled. When required, pickled or blast-cleaned material may be specified to be furnished dry.

8.3 *Edges*—Unless otherwise specified, mill edges shall be furnished on material that has not had the hot-rolled oxide or scale removed and cut edges shall be furnished on material that has had the hot-rolled oxide or scale removed.

9. Certification and Reports

9.1 The manufacturer or processor shall furnish copies of a test report showing the results of the heat analysis and mechanical property tests made to determine compliance with this specification.

TABLE 1 Chemical Requirements

Element	Composition — Weight % Heat Analysis						
	Grade A	Grade B	Grade C	Grade D	Grade E	Grade F	Grade G
Carbon, max	0.15	0.22	0.25	0.25	0.27	0.31	0.31
Manganese, max	0.90	0.90	0.90	1.20	1.20	1.20	1.35
Phosphorus, max	0.035	0.035	0.035	0.035	0.035	0.035	0.035
Sulfur, max	0.035	0.035	0.035	0.035	0.035	0.035	0.035
Aluminum[A]	0.02–0.08	0.02–0.08	0.02–0.08	0.02–0.08	0.02–0.08	0.02–0.08	0.02–0.08
Silicon, max[A]	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Copper, when copper steel is specified, min	0.20	0.20	0.20	0.20	0.20	0.20	0.20

[A] The steel shall be considered aluminum-silicon killed when the silicon is between 0.15 and 0.30, otherwise it shall be considered aluminum killed.