Designation: A 414/A 414M – 07

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

This standard is issued under the fixed designation A 414/A 414M; 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:

	Width, in. [mm]
Thickness, 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 A 568/A 568M and A 635/A 635M. 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]

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

A 635/A 635M Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, 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 A 568/A 568M or Specification A 635/A 635M.

NOTE 1—Not all producers are capable of meeting all of the limitations of the thickness tolerance tables in Specification A 568/A 568M or Specification A 635/A 635M. 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 A 414, Grade A, Hot-Rolled Sheet, 0.100 in. [2.54 mm] by 36 in. [914.4 mm] by

[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.**

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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 A 568/A 568M or Specification A 635/A 635M unless otherwise provided herein.

7. Workmanship

7.1 The material shall be free from injurious defects (see Specifications A 568/A 568M or A 635/A 635M, as appropriate due to thickness).

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.

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.

9.2 The report shall include the purchase order number, the specification number and year date, product designation, grade, the heat number, and heat analysis and mechanical properties as indicated by the tension test.

9.3 A signature is not required on the test report. However, the document shall clearly identify the organization submitting

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.

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TABLE 3 Tensile Requirements

	Grade A	Grade B	Grade C	Grade D	Grade E	Grade F	Grade G
Tensile strength:							
min, ksi [MPa]	45 [310]	50 [345]	55 [380]	60 [415]	65 [450]	70 [485]	75 [515]
max, ksi [MPa]	60 [415]	65 [450]	70 [485]	75 [515]	85 [585]	90 [620]	95 [655]
Yield strength, min, ksi [MPa][A]	25 [170]	30 [205]	33 [230]	35 [240]	38 [260]	42 [290]	45 [310]
Elongation in 2 in. [50 mm], min, percent:							
Under 0.270 to 0.145 [Under 7.0 to 3.8]	26	24	22	20	18	16	16
Under 0.145 to 0.089 [Under 3.8 to 2.2]	24	22	20	18	16	14	14
Under 0.089 to 0.057 [Under 2.2 to 1.5]	23	21	19	17	15	13	13
Elongation in 8 in. [200 mm], min, percent:							
Under 0.270 to 0.145 [Under 7.0 to 3.8]	20	18	16	14	12	10	10

[A] Yield strength determined by the 0.2 % offset or 0.5 % extension under load methods.

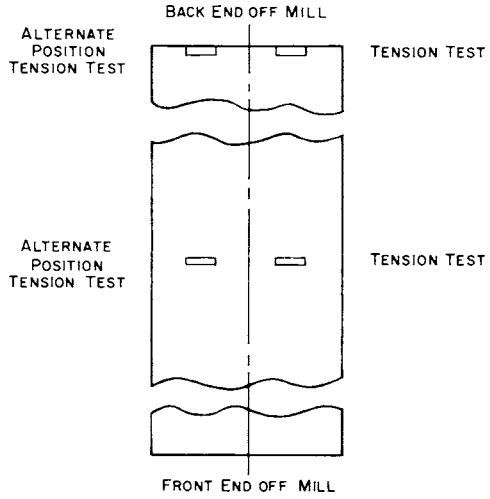


FIG. 1 Location of Test Specimens

the report. Notwithstanding the absence of a signature, the organization submitting the report is responsible for the content of the report.

9.4 A Material Test Report, Certificate of Inspection, or similar document printed from or used in electronic form from an electronic data interchange (EDI) transmission shall be regarded as having the same validity as a counterpart printed in the certifier's facility. The content of the EDI transmitted document must meet the requirements of the invoked ASTM standard and the purchaser and supplier. Notwithstanding the absence of a signature, the organization submitting the EDI transmission is responsible for the content of the report.

10. Product Marking

10.1 The name or brand of the manufacturer, heat and slab number, specification designation number, and grade shall be legibly and durably marked on each cut length sheet in two places not less than 12 in. [300 mm] from the edges. Cut length sheets, the maximum lengthwise and crosswise, dimensions of which do not exceed 72 in. [1800 mm], shall be legibly and durably marked in one place approximately midway between the center and a side edge. The manufacturer's test identification number shall be legibly and durably marked on each test specimen. Steel-die marking of sheets is prohibited on material < 0.250 in. [6 mm].

10.2 For coil product, the information required in 10.1 shall be legibly and durably marked both on each coil and on a tag affixed to each coil.

11. Keywords

11.1 carbon steel sheet; pressure vessel steels; steel sheet

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue, A 414/A 414M – 06, that may impact the use of this standard. (Approved May 15, 2007.)

(*1*) Section 1.3 revised to recognize the coils may be tested at mid-length without cutting the coil in half.
(*2*) Table of sizes in 1.3 revised to agree with changes in A 568/A 568M and A 635/A 635M.
(*3*) Reference to A 635/A 635M added to 3.1.5.1 and Note 1.
(*4*) Refernece to A 635/A 635M added to 6.1.
(*5*) Section 9 on Certification and Reports has been modified. Section 9.1 has been made into two paragraphs and new 9.3 and 9.4 added.
(*6*) Section 10.1 has been modified to allow steel-die marking on material over 0.250 in. [6 mm].

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Committee A01 has identified the location of selected changes to this standard since the last issue, A 414/A 414M – 05, that may impact the use of this standard. (Approved March 1, 2006.)

(*1*) In Table 1, silicon was changed to 0.30 max.
(*2*) In Table 1, Note A was changed.
(*3*) In Table 1, Note B was eliminated, as there are no ellipsis shown.

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