



Designation: A738/A738M – 12a

# Standard Specification for Pressure Vessel Plates, Heat-Treated, Carbon-Manganese- Silicon Steel, for Moderate and Lower Temperature Service<sup>1</sup>

This standard is issued under the fixed designation A738/A738M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This specification<sup>2</sup> covers heat-treated carbon-manganese-silicon steel plates intended for use in welded pressure vessels at moderate and lower temperature service.

1.2 Material under this specification is available in four strength levels, 75 ksi [515 MPa], 85 ksi [585 MPa], 80 ksi [550 MPa], and 90 ksi [620 MPa] minimum ultimate tensile strengths.

1.3 The maximum thickness of plates for Grades A, B, and C is limited only by the capacity of the chemical composition and heat treatment to meet the specified mechanical property requirements; however, current practice normally limits the maximum thickness of plates furnished under this specification to 6 in. [150 mm] for Grade A, 4 in. [100 mm] for Grade B, and 6 in. [150 mm] for Grade C. The maximum permitted nominal thickness is 1.5 in. [40 mm] for Grade D and 2 in. [50 mm] for Grade E.

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

## 2. Referenced Documents

2.1 *ASTM Standards*:<sup>3</sup>

[A20/A20M Specification for General Requirements for Steel Plates for Pressure Vessels](#)

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.11 on Steel Plates for Boilers and Pressure Vessels.

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<sup>2</sup> For ASME Boiler and Pressure Vessel Code applications see related Specification SA-738/SA-738M in Section II of that Code.

<sup>3</sup> 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.

## 3. General Requirements and Ordering Information

3.1 Material supplied to this material specification shall conform to Specification [A20/A20M](#). These requirements outline the testing and retesting methods and procedures, permitted variations in dimensions, and mass, quality and repair of defects, marking, loading, and ordering information.

3.2 In addition to the basic requirements of this specification, certain supplementary requirements are available when additional control, testing, or examination is required to meet end use requirements. The purchaser is referred to the listed supplementary requirements in this specification and to the detailed requirements in Specification [A20/A20M](#).

3.3 If the requirements of this specification are in conflict with the requirements of Specification [A20/A20M](#), the requirements of this specification shall prevail.

## 4. Manufacture

4.1 *Steelmaking Practice*—The steel shall be killed and shall conform to the fine austenitic grain size requirement of Specification [A20/A20M](#).

## 5. Heat Treatment

5.1 Grade A plates 2.5 in. [65 mm] and under in thickness shall be supplied in the normalized condition or in the quenched and tempered condition at the option of the manufacturer.

5.2 Grade A plates over 2.5 in. [65 mm] in thickness and Grade B, Grade C, Grade D, and Grade E plates in all thicknesses shall be quenched-and-tempered.

5.3 When plates are tempered, the minimum tempering temperature shall be 1100°F [595°C].

## 6. Chemical Requirements

6.1 The steel shall conform to the chemical requirements shown in [Table 1](#) unless otherwise modified in accordance with Supplementary Requirement S 17, Vacuum Carbon-Deoxidized Steel in Specification [A20/A20M](#).

## 7. Mechanical Requirements

7.1 *Tension Test Requirements*—The plates as represented by the tension test specimens shall conform to the requirements of [Table 2](#).

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

**TABLE 1 Chemical Requirements**

Element	Composition, %				
	Grade A	Grade B	Grade C	Grade D	Grade E
Carbon, max <sup>A</sup>	0.24	0.20	0.20	0.10	0.12 <sup>B</sup>
Manganese:					
Heat analysis					
1.5 in. [40 mm] and under	1.50 max	0.90–1.50	1.50 max	1.00–1.60	1.10–1.60 <sup>B</sup>
Over 1.5 to 2.0 in. [40 to 50 mm]	1.50 max	0.90–1.50	1.50 max	<sup>C</sup>	1.10–1.60 <sup>B</sup>
Over 2.0 to 2.5 in. [50 to 65 mm], incl	1.50 max	0.90–1.50	1.50 max	<sup>C</sup>	<sup>C</sup>
Over 2.5 in. [65 mm]	1.60 max	0.90–1.60	1.60 max	<sup>C</sup>	<sup>C</sup>
Product analysis					
1.5 in. [40 mm] and under	1.62 max	0.84–1.62	1.62 max	0.92–1.72	1.02–1.72 <sup>B</sup>
Over 1.5 to 2.0 in. [40 to 50 mm], incl	1.62 max	0.84–1.62	1.62 max	<sup>C</sup>	1.02–1.72 <sup>B</sup>
Over 2.0 to 2.5 in. [50 to 65 mm], incl	1.62 max	0.84–1.62	1.62 max	<sup>C</sup>	<sup>C</sup>
Over 2.5 in. [65 mm]	1.72 max	0.84–1.72	1.72 max	<sup>C</sup>	<sup>C</sup>
Phosphorus, max <sup>A</sup>	0.025	0.025	0.025	0.015	0.015
Sulfur, max <sup>A</sup>	0.025	0.025	0.025	0.006	0.006
Silicon:					
Heat analysis	0.15–0.50	0.15–0.55	0.15–0.50	0.15–0.50	0.15–0.50
Product analysis	0.13–0.55	0.13–0.60	0.13–0.55	0.13–0.55	0.13–0.55
Copper, max:					
Heat analysis	0.35	0.35	0.35	0.35	0.35
Product analysis	0.38	0.38	0.38	0.38	0.38
Nickel, max:					
Heat analysis	0.50	0.60	0.50	0.60	0.70
Product analysis	0.53	0.63	0.53	0.63	0.73
Chromium, max:					
Heat analysis	0.25	0.30	0.25	0.25	0.30
Product analysis	0.29	0.34	0.29	0.29	0.34
Molybdenum, max:					
Heat analysis					
1.5 in. [40 mm] and under	0.08	0.20	0.08	0.30	0.35
Over 1.5 in. [40 mm]	0.08	0.30	0.08	<sup>C</sup>	<sup>C</sup>
Product analysis					
1.5 in. [40 mm] and under	0.09	0.21	0.09	0.33	0.38
Over 1.5 in. [40 mm]	0.09	0.33	0.09	<sup>C</sup>	<sup>C</sup>
Vanadium, max:					
Heat analysis	0.07 <sup>D</sup>	0.07	0.05	0.08	0.09
Product analysis	0.08 <sup>D</sup>	0.08	0.05	0.09	0.10
Columbium, max:					
Heat analysis	0.04 <sup>D</sup>	0.04	<sup>E</sup>	0.05	0.05
Product analysis	0.05 <sup>D</sup>	0.05	<sup>E</sup>	0.06	0.06
Columbium plus Vanadium, max:					
Heat analysis	0.08 <sup>D</sup>	0.08	<sup>E</sup>	0.11	0.12
Product analysis	0.10 <sup>D</sup>	0.10	<sup>E</sup>	0.12	0.13
Titanium, max <sup>A</sup>	...	...	...	<sup>F</sup>	<sup>G</sup>
Boron, max <sup>A</sup>	...	...	...	0.0007	0.0007
Aluminum, min <sup>A</sup>	...	...	...	0.020 total or 0.015 acid soluble <sup>F</sup>	0.020 total or 0.015 acid soluble <sup>G</sup>

<sup>A</sup> Applies to both heat and product analyses.

<sup>B</sup> For each reduction of 0.01 percentage point below the specified maximum for carbon, an increase of 0.06 percentage point above the specified maximum for manganese is permitted, up to a maximum of 1.85 % by heat analysis, and 1.99 % by product analysis.

<sup>C</sup> Not applicable.

<sup>D</sup> Vanadium and columbium may be added only by agreement between the manufacturer and the purchaser.

<sup>E</sup> For Grade C, columbium is an unspecified element.

<sup>F</sup> By agreement between the manufacturer and the purchaser, the steel may be produced with titanium, in which case the minimum aluminum content shall not apply. If this option is exercised, the titanium content, by heat analysis, shall be 0.006 % to 0.03 %, and the titanium content for the heat and product analyses shall be reported on the test report.

<sup>G</sup> By agreement between the manufacturer and the purchaser, the steel may be produced with titanium, in which case the minimum aluminum content shall not apply. If this option is exercised, the titanium content, by heat analysis, shall be 0.006 % to 0.03 % inclusive and the titanium content for the heat and product analyses shall be reported on the test report.