Designation: A 738/A 738M – 07

Standard Specification for Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service[1]

This standard is issued under the fixed designation A 738/A 738M; 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 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 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. For Grades D and E, the maximum permitted nominal thickness is 1.5 in. [40 mm].

1.4 Grade A is the material that, prior to 1984, was covered by Specification A 738 without a grade designation.

1.5 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:* [3]

A 20/A 20M Specification for General Requirements for Steel Plates for Pressure Vessels

3. General Requirements and Ordering Information

3.1 Plates supplied to this product specification shall conform to the requirements of Specification A 20/A 20M, which outlines the testing and retesting methods and procedures, permissible variations in dimensions and mass, quality, repair of defects, marking, loading, etc.

3.2 Specification A 20/A 20M also establishes the rules for compliance to the ordering information when purchasing material to this specification.

3.3 In addition to the basic requirements of this specification, certain supplementary requirements are available when additional control, testing, or examination is required to meet the end use requirements.

3.4 The purchaser is referred to the listed supplementary requirements in this specification and to the supplementary requirements in Specification A 20/A 20M.

4. Manufacture

4.1 *Steelmaking Practice*—The steel shall be killed and shall conform to the fine austenitic grain size requirement of Specification A 20/A 20M.

5. Heat Treatment

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

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 A 20/A 20M.

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.

7.1.1 For nominal plate thicknesses of ¾ in. [20 mm] and under, the 1.5-in. [40-mm] wide rectangular specimen may be used for the tension test and the elongation may be determined

[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 A01.11 on Steel Plates for Boilers and Pressure Vessels.

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[2] For ASME Boiler and Pressure Vessel Code applications see related Specification SA-738/SA-738M in Section II 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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TABLE 1 Chemical Requirements

Element	Composition, %				
	Grade A	Grade B	Grade C	Grade D	Grade E
Carbon, max[A]	0.24	0.20	0.20	0.10	0.12[B]
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[B]
Over 1.5 to 2.5 in. [40 to 65 mm], incl	1.50 max	0.90–1.50	1.50 max	[C]	[C]
Over 2.5 in. [65 mm]	1.60 max	0.90–1.60	1.60 max	[C]	[C]
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[B]
Over 1.5 to 2.5 in. [40 to 65 mm], incl	1.62 max	0.84–1.62	1.62 max	[C]	[C]
Over 2.5 in. [65 mm]	1.72 max	0.84–1.72	1.72 max	[C]	[C]
Phosphorus, max[A]	0.035	0.030	0.025	0.015	0.015
Sulfur, max[A]	0.035	0.030	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	[C]	[C]
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	[C]	[C]
Vanadium, max:					
Heat analysis	0.07[D]	0.07	0.05	0.08	0.09
Product analysis	0.08[D]	0.08	0.05	0.09	0.10
Columbium, max:					
Heat analysis	0.04[D]	0.04	[E]	0.05	0.05
Product analysis	0.05[D]	0.05	[E]	0.06	0.06
Columbium plus Vanadium, max:					
Heat analysis	0.08[D]	0.08	[E]	0.11	0.12
Product analysis	0.10[D]	0.10	[E]	0.12	0.13
Titanium, max[A]	...	...	...	[F]	[G]
Boron, max[A]	...	...	...	0.0007	0.0007
Aluminum, min[A]	...	...	...	0.020 total or 0.015 acid soluble[F]	0.020 total or 0.015 acid soluble[G]

[A] Applies to both heat and product analyses.

[B] 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.

[C] Not applicable.

[D] Vanadium and columbium may be added only by agreement between the manufacturer and the purchaser.

[E] For Grade C, columbium is an unspecified element.

[F] 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.

[G] 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.

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TABLE 2 Tensile Requirements

NOTE—*t* = plate nominal thickness.

	Grade A	Grade B	Grade C	Grade D	Grade E
Tensile strength, ksi [MPa]					
1.5 in. [40 mm] and under	75–95 [515–655]	85–102 [585–705]	80–100 [550–690]	85–105 [585–724]	90–110 [620–760]
Over 1.5 to 2.5 in. [40 to 65 mm], incl	75–95 [515–655]	85–102 [585–705]	80–100 [550–690]	[A]	[A]
Over 2.5 to 4 in. [65 to 100 mm], incl	75–95 [515–655]	85–102 [585–705]	75–95 [515–655]	[A]	[A]
Over 4 in. [100 mm]	75–95 [515–655]	85–102 [585–705]	70–90 [485–620]	[A]	[A]
Yield strength, min, ksi [MPa]					
1.5 in. [40 mm] and under	45 [310]	60 [415]	60 [415]	70 [485]	75 [515]
Over 1.5 to 2.5 in. [40 to 65 mm], incl	45 [310]	60 [415]	60 [415]	[A]	[A]
Over 2.5 to 4 in. [65 to 100 mm], incl	45 [310]	60 [415]	55 [380]	[A]	[A]
Over 4 in. [100 mm]	45 [310]	60 [415]	46 [315]	[A]	[A]
Elongation in 2 in. [50 mm], min, %[B]					
1.5 in. [40 mm] and under	20	20	22	20	20
Over 1.5 to 4 in. [40 to 100 mm], incl	20	20	22	[A]	[A]
Over 4 in. [100 mm]	20	20	20	[A]	[A]

[A] Not applicable.
[B] See Specification A 20/A 20M for elongation requirement adjustments.

in a 2-in. [50-mm] gage length that includes the fracture and shows the greatest elongation.

8. Keywords

8.1 pressure-containing parts; pressure vessel steel; steel plates; steel plates for pressure vessel applications

SUPPLEMENTARY REQUIREMENTS

Supplementary requirements shall not apply unless specified in the purchase order. A list of standardized supplementary requirements for use at the option of the purchaser is included in Specification A 20/A 20M. Several of those considered suitable for use with this specification are listed by title. Other tests may be performed by agreement between the supplier and the purchaser:

S1. Vacuum Treatment

S2. Product Analysis.

S3. Simulated Post-Weld Heat Treatment of Mechanical Test Coupons.

S4. Additional Tension Test.

S5. Charpy V-Notch Impact Test.

S6. Drop Weight Test (for Material 0.625 in. [16 mm] and Over in Thickness).

S9. Magnetic Particle Examination.

S12. Ultrasonic Examination in accordance with Specification A 578/A 578M.

S20. Maximum Carbon Equivalent for Weldability

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APPENDIX

(Nonmandatory Information)

X1. CHARPY V-NOTCH IMPACT TEST

X1.1 The energy values below are shown only for information as to the guarantees that are generally available. Mandatory conformance to any of the values listed is a matter of agreement between the purchaser and the manufacturer.

X1.1.1 *Longitudinal*
20 ft·lbf [27 J] at −50°F [–45°C].
X1.1.2 *Transverse*
20 ft·lbf [27 J] at −20°F [–30°C].

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A 738/A 738M–05) that may impact the use of this standard.

(*1*) Removed Supplementary Requirement S17.
(*2*) Added Supplementary Requirement S1.
(*3*) Corrected two missing minus signs in Appendix X1.

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