Designation: A517/A517M – 10 (Reapproved 2015)

Standard Specification for Pressure Vessel Plates, Alloy Steel, High-Strength, Quenched and Tempered[1]

This standard is issued under the fixed designation A517/A517M; 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 U.S. Department of Defense.

1. Scope

1.1 This specification[2] covers high-strength quenched and tempered alloy steel plates intended for use in fusion welded boilers and other pressure vessels.

1.2 This specification includes a number of grades as manufactured by different producers, but all having the same mechanical properties and general characteristics.

1.3 The maximum thickness of plates furnished under this specification shall be as follows:

Grade	Thickness
A, B	1.25 in. [32 mm]
H, S	2 in. [50 mm]
P	4 in. [100 mm]
F	2.50 in. [65 mm]
E, Q	6 in. [150 mm]

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 is to be used independently of the other without combining values in any way.

2. Referenced Documents

2.1 *ASTM Standards:*[3]

A20/A20M Specification for General Requirements for Steel Plates for Pressure Vessels

A435/A435M Specification for Straight-Beam Ultrasonic Examination of Steel Plates

A577/A577M Specification for Ultrasonic Angle-Beam Examination of Steel Plates

A578/A578M Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications

3. General Requirements and Ordering Information

3.1 Plates furnished 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.

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 Except as allowed by section 5.2, the plates shall be heat treated by heating to not less than 1650°F [900°C], quenching in water or oil and tempering at not less than 1150°F [620°C].

5.2 Plates ordered without the heat treatment specified in section 5.1 shall be stress relieved by the manufacturer, and subsequent heat treatment of the plates to conform to section 5.1 shall be the responsibility of the purchaser.

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 S17, Vacuum Carbon-Deoxidized Steel, in Specification A20/A20M for grades other than Grade A.

[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.

Current edition approved Sept. 1, 2015. Published September 2015. Originally approved in 1964. Last previous edition approved in 2010 as A517/A517M – 10. DOI: 10.1520/A0517_A0517M-10R15.

[2] For ASME Boiler and Pressure Vessel Code applications, see related Specification SA-517/SA-517M 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.

TABLE 1 Chemical Requirements

NOTE 1—Where " … " appears there is no requirement.

Elements	Composition, %							
	Grade A	Grade B	Grade E	Grade F	Grade H	Grade P	Grade Q	Grade S
Carbon:								
Heat analysis	0.15–0.21	0.15–0.21	0.12–0.20	0.10–0.20	0.12–0.21	0.12–0.21	0.14–0.21	0.10–0.20
Product analysis	0.13–0.23	0.13–0.23	0.10–0.22	0.08–0.22	0.10–0.23	0.10–0.23	0.12–0.23	0.10–0.22
Manganese:								
Heat analysis	0.80–1.10	0.70–1.00	0.40–0.70	0.60–1.00	0.95–1.30	0.45–0.70	0.95–1.30	1.10–1.50
Product analysis	0.74–1.20	0.64–1.10	0.35–0.78	0.55–1.10	0.87–1.41	0.40–0.78	0.87–1.41	1.02–1.62
Phosphorus, max[A]	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Sulfur, max[A]	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Silicon:								
Heat analysis	0.40–0.80	0.15–0.35	0.10–0.40	0.15–0.35	0.15–0.35	0.20–0.35	0.15–0.35	0.15–0.40
Product analysis	0.34–0.86	0.13–0.37	0.08–0.45	0.13–0.37	0.13–0.37	0.18–0.37	0.13–0.37	0.13–0.45
Nickel:								
Heat analysis	. . .	. . .	. . .	0.70–1.00	0.30–0.70	1.20–1.50	1.20–1.50	. . .
Product analysis	. . .	. . .	. . .	0.67–1.03	0.27–0.73	1.15–1.55	1.15–1.55	. . .
Chromium:								
Heat analysis	0.50–0.80	0.40–0.65	1.40–2.00	0.40–0.65	0.40–0.65	0.85–1.20	1.00–1.50	. . .
Product analysis	0.46–0.84	0.36–0.69	1.34–2.06	0.36–0.69	0.36–0.69	0.79–1.26	0.94–1.56	. . .
Molybdenum:								
Heat analysis	0.18–0.28	0.15–0.25	0.40–0.60	0.40–0.60	0.20–0.30	0.45–0.60	0.40–0.60	0.10–0.35
Product analysis	0.15–0.31	0.12–0.28	0.36–0.64	0.36–0.64	0.17–0.33	0.41–0.64	0.36–0.64	0.10–0.38
Boron	0.0025 max	0.0005–0.005	0.001–0.005	0.0005–0.006	0.0005 min	0.001–0.005	. . .	. . .
Vanadium:								
Heat analysis	. . .	0.03–0.08	[B]	0.03–0.08	0.03–0.08	. . .	0.03–0.08	. . .
Product analysis	. . .	0.02–0.09	. . .	0.02–0.09	0.02–0.09	. . .	0.02–0.09	. . .
Titanium:								
Heat analysis	. . .	0.01–0.04	0.01–0.10	0.10 max	0.10 max	0.10 max	. . .	0.06 max
Product analysis	. . .	0.01–0.05	0.005–0.11	0.11 max	0.11 max	0.11 max	. . .	0.07 max
Zirconium:								
Heat analysis	0.05–0.15[C]	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Product analysis	0.04–0.16	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Copper:								
Heat analysis	. . .	. . .	. . .	0.15–0.50	. . .	. . .	. . .	. . .
Product analysis	. . .	. . .	. . .	0.12–0.53	. . .	. . .	. . .	. . .
Columbium, max								
Heat analysis	. . .	. . .	. . .	. . .	. . .	. . .	. . .	0.06
Product analysis	. . .	. . .	. . .	. . .	. . .	. . .	. . .	0.07

[A] Applied to both heat and product analyses.
[B] May be substituted for part or all of titanium content on a one for one basis.
[C] Zirconium may be replaced by cerium. When cerium is added, the cerium/sulfur ratio should be approximately 1.5 to 1, based on heat analysis.

TABLE 2 Tensile Requirements

	2.50 in. [65 mm] and Under	Over 2.50 to 6 in. [65 to 150 mm]
Tensile strength, ksi [MPa]	115–135 [795–930]	105–135 [725–930]
Yield strength, min, ksi [MPa]	100 [690]	90 [620]
Elongation in 2 in. [50 mm], min, %[A]	16	14
Reduction of area, min, %:		
Rectangular specimens	35	. . .
Round specimens	45	45

[A] See Specification A20/A20M for elongation adjustment.

7. Mechanical Requirements

7.1 *Tension Tests:*

7.1.1 *Requirements*—The plates as represented by the tension-test specimens shall conform to the requirements given in Table 2.

7.1.2 *Test Methods:*

7.1.2.1 The yield strength may be determined by the 0.2 % offset method or by the total extension under load of 0.5 % method.

7.1.2.2 For plates ¾ in. [20 mm] and under in thickness, the test specimen shall be the 1½ in. [40 mm] wide rectangular-test specimen.

7.1.2.3 For plates over ¾ in. [20 mm], either the full thickness rectangular-test specimen or the ½ in. [12.5 mm] round-test specimen may be used.

7.1.2.4 When the 1½ in. [40 mm] wide rectangular-test specimen is used, the elongation is measured in a 2 in. or [50 mm] gage length which includes the fracture.

7.2 *Impact Properties Requirements:*

7.2.1 Transverse Charpy V-notch impact test specimens shall have a lateral expansion opposite the notch of not less than 0.015 in. [0.38 mm].

7.2.2 The test temperature shall be agreed upon between the manufacturer and the purchaser, but shall not be higher than 32°F [0°C].

8. Keywords

8.1 alloy steel; boilers; high-strength; impact tested; plates; pressure vessels; quenched; tempered

SUPPLEMENTARY REQUIREMENTS

Supplementary requirements shall not apply unless specified in the order.

A list of standardized supplementary requirements for use at the option of the purchaser are included in Specification A20/A20M. 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,

S5. Charpy V-Notch Impact Test,

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

S7. High-Temperature Tension Test,

S8. Ultrasonic Examination in accordance with Specification A435/A435M,

S9. Magnetic Particle Examination,

S11. Ultrasonic Examination in accordance with Specification A577/A577M,

S12. Ultrasonic Examination in accordance with Specification A578/A578M, and

S17. Vacuum Carbon-Deoxidized Steel.