SPECIFICATION FOR PRESSURE VESSEL PLATES, ALLOY-STEEL, CHROMIUM-MOLYBDENUM-TUNGSTEN

SA-1017/SA-1017M

(Identical with ASTM Specification A1017/A1017M-17.)

Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum-Tungsten

1. Scope

1.1 This specification covers Chromium-Molybdenum-Tungsten alloy steel plates intended primarily for welded boilers and pressure vessels designed for elevated temperature service.

1.2 Plates are available under this specification in grades having different alloy contents as follows:

Grade	Nominal Chromium Content, %	Nominal Molybdenum Content, %	Nominal Tungsten Content, %
23	2.25	0.20	1.60
911	9.00	1.00	1.00
92	9.00	0.45	1.75
122	12.00	0.40	2.00

1.3 The maximum thickness of plates is limited only by the capacity of the composition to meet the specified mechanical property requirements.

1.4 The specification is expressed in both inch-pound units and in SI units. However, unless the order specifies the applicable "M" specification designation (SI units), the material shall be furnished to inch-pound units.

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.

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*

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

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. Materials and Manufacture

4.1 *Steelmaking Practice*—The steel shall be killed.

5. Heat Treatment

5.1 Except as allowed by 5.2 and 5.3, all plates shall be normalized at 1900 to 1975°F [1040 to 1080°C]. Plates for Grades 23, 92, and 122 shall be tempered at 1350 to 1470°F [730 to 800°C]. Grade 911 plates shall be tempered at 1365 to 1435°F [740 to 780°C].

TABLE 1 Chemical Requirements

NOTE 1—Where " . . . " appears in this table there is no requirement.

Element	Composition %			
	Grade 23	Grade 911	Grade 122	Grade 92
Carbon				
Heat Analysis	0.04–0.10	0.09–0.13	0.07–0.14	0.07–0.13
Product Analysis	0.03–0.10	0.08–0.14	0.05–0.17	0.05–0.16
Manganese				
Heat Analysis	0.10–0.60	0.30–0.60	0.70 max	0.30–0.60
Product Analysis	0.09–0.66	0.25–0.66	0.77 max	0.25–0.66
Phosphorus, max.				
Heat Analysis	0.030	0.020	0.020	0.020
Product Analysis	0.030	0.025	0.025	0.025
Sulfur, max.				
Heat Analysis	0.010	0.010	0.010	0.010
Product Analysis	0.012	0.012	0.012	0.012
Silicon				
Heat Analysis	0.50 max	0.10–0.50	0.50 max	0.50 max
Product Analysis	0.50 max	0.08–0.56	0.56 max	0.50 max
Chromium				
Heat Analysis	1.90–2.60	8.5–9.5	10.0–11.5	8.5–9.5
Product Analysis	1.78–2.72	8.4–9.7	9.9–11.6	8.4–9.6
Molybdenum				
Heat Analysis	0.05–0.30	0.90–1.10	0.25–0.60	0.30–0.60
Product Analysis	0.04–0.35	0.85–1.15	0.20–0.65	0.25–0.65
Nickel, max.				
Heat Analysis	0.40	0.40	0.50	0.40
Product Analysis	0.40	0.43	0.54	0.40
Vanadium				
Heat Analysis	0.20–0.30	0.18–0.25	0.15–0.30	0.15–0.25
Product Analysis	0.18–0.33	0.16–0.27	0.13–0.32	0.13–0.27
Columbium (Niobium)[A]				
Heat Analysis	0.02–0.08	0.06–0.10	0.04–0.10	0.04–0.09
Product Analysis	0.02–0.10	0.05–0.11	0.03–0.11	0.03–0.10
Boron				
Heat Analysis	0.0010–0.006	0.0003–0.006	0.005 max	0.001–0.006
Product Analysis	0.0009–0.007	0.0002–0.007	0.006 max	0.0009–0.007
Nitrogen				
Heat Analysis	0.015 max[B]	0.04–0.09	0.04–0.10	0.030–0.070
Product Analysis	0.015 max[B]	0.035–0.095	0.03–0.11	0.025–0.075
Aluminum, max.				
Heat Analysis	0.03[C]	0.02	0.02	0.02
Product Analysis	0.04[C]	0.02	0.02	0.02
Tungsten				
Heat Analysis	1.45–1.75	0.90–1.10	1.50–2.50	1.50–2.00
Product Analysis	1.40–1.80	0.85–1.15	1.40–2.60	1.40–2.0
Copper				
Heat Analysis	. . .	. . .	0.30–1.70	. . .
Product Analysis	. . .	. . .	0.20–1.80	. . .
Titanium, max				
Heat Analysis	0.005–0.060[B]	0.01	0.01	0.01
Product Analysis	0.005–0.060[B]	0.01	0.01	0.01
Zirconium, max				
Heat Analysis	. . .	0.01	0.01	0.01
Product Analysis	. . .	0.01	0.01	0.01

[A] Columbium and niobium are interchangeable names for the same element and both names are acceptable for use in A01 specifications.
[B] The Ti/N ratio of Grade 23 shall be greater than or equal to 3.5.
[C] Acid Soluble Aluminum.

TABLE 2 Tensile Requirements

	Grade 23	Grade 911	Grade 122	Grade 92
Tensile Strength, ksi [MPa]	74 to 100 [510 to 690]	90 to 120 [620 to 840]	90 [620] min	90 to 120 [620 to 840]
Yield Strength ksi [MPa], min	58 [400]	64 [440]	58 [400]	64 [440]
Elongation in 2 in. or 50 mm, % min	20	18	20	20

5.2 If permitted by the purchaser, plates for Grades 23, 92, and 122 may be austenitized at 1900 to 1975°F [1040 to 1080°C], subjected to accelerated cooling from the austenitizing temperature by air blasting or liquid quenching, and then tempered at 1350 to 1470°F [730 to 800°C].

5.3 Plates ordered without the heat treatment required by either 5.1 or 5.2 shall be furnished in either the stress-relieved or annealed condition, and the purchaser shall be responsible for the heat treatment of such plates to conform to either 5.1 or 5.2.

6. Chemical Composition

6.1 The steel shall conform to the requirements for chemical composition given in Table 1.

7. Mechanical Properties

7.1 *Tension Test:*

7.1.1 The material as represented by the tension test specimens shall conform to the applicable requirements given in Table 2.

7.2 *Hardness Test:*

7.2.1 Grade 23 plates shall have a hardness not exceeding 220 HB [97HRB].

7.2.2 Grade 122 plates shall have a hardness not exceeding 250 HB [25HRC].

8. Marking

8.1 In addition to the marking required in Specification A20/A20M, each plate shall be legibly stamped or stenciled, dependent upon the ordered thickness, with the letter "N" for normalized and tempered, "Q" for accelerated cooled and tempered, "S" for stress relieved, or "A" for annealed, whichever is applicable.

9. Keywords

9.1 alloy steel; alloy steel plate; pressure containing parts; pressure vessel steels; steel plates; steel plates for pressure vessels

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 is included in Specification A20/A20M. Several of those considered suitable for use with this specification are listed below 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,

S4.1 Additional Tension Test,

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.