



Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched and Tempered, Manganese-Molybdenum and Manganese-Molybdenum-Nickel¹

This standard is issued under the fixed designation A 533/A 533M; 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 specification² covers manganese-molybdenum and manganese-molybdenum-nickel alloy steel plates for use in the quenched and tempered condition for the construction of welded pressure vessels.

1.2 This specification includes four types of chemical analysis and three classes of strength levels as follows:

Type	Nominal Molybdenum Content, %	Nominal Nickel Content, %
A	0.50	...
B	0.50	0.55
C	0.50	0.85
D	0.50	0.30

Class	Tensile Strength, ksi [MPa]
1	80–100 [550 to 690]
2	90–115 [620 to 795]
3	100–125 [690 to 860]

1.3 The maximum thickness of Class 1 and Class 2 plates is limited only by the capacity of the composition to meet the specified mechanical property requirements; however, current practice normally limits the maximum thickness to 12 in. [300 mm].

1.4 The maximum thickness of Class 3 plates is 2½ in. [65 mm].

1.5 The minimum nominal thickness of plates of all classes is 0.25 in. [6.5 mm].

1.6 These alloy steel plates in the as-rolled condition are sensitive to cracking during transit and handling, particularly in thicknesses over about 1 or 2 in. [25 or 50 mm]. They should be shipped in the as-rolled conditions only with the mutual agreement of manufacturer and fabricator.

1.7 Plates covered by this specification are often used in the beltline region of nuclear reactor vessels where the material properties may be affected by high levels of radiation. Appendix X1 provides some information pertinent to this usage.

1.8 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 must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

2. Referenced Documents

2.1 ASTM Standards:

A 20/A 20M Specification for General Requirements for Steel Plates for Pressure Vessels³

A 435/A 435M Specification for Straight-Beam Ultrasonic Examination of Steel Plates³

A 577/A 577M Specification for Ultrasonic Angle-Beam Examination of Steel Plates³

A 578/A 578M Specification for Straight-Beam Ultrasonic Examination of Plain and Clad Steel Plates for Special Applications³

3. General Requirements and Ordering Information

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

3.2 Specification A 20/A 20M also establishes the rules for the ordering information which should be complied with 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 end use requirements. These include:

3.3.1 Vacuum treatment,

3.3.2 Additional or special tension testing,

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² For ASME Boiler and Pressure Vessel Code applications, see related Specification SA-533/SA-533M in Section II of that Code.

³ Annual Book of ASTM Standards, Vol 01.04.

3.3.3 Impact testing, and

3.3.4 Nondestructive examination.

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

3.5 If the requirements of this specification are in conflict with the requirements of Specification A 20/A 20M, 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 requirement of Specification A 20/A 20M.

5. Heat Treatment

5.1 All plates shall be heat treated by heating to a suitable temperature within the range from 1550 to 1800°F [845 to 980°C], holding for a sufficient time to obtain uniform temperature throughout the plate thickness and then quenching, in water. Subsequently the plates shall be tempered at a suitable temperature to produce the specified properties, but not less

than 1100°F [595°C] with a minimum holding time of ½ h/in. [1.2 min/mm] of thickness, but not less than ½ h.

5.2 When the plates are heat treated by the fabricator, it shall be his responsibility to apply the proper heat treatment and to conduct tests he deems necessary to assure that the specified properties are attained.

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 A 20/A 20M.

7. Mechanical Requirements

7.1 Tension Test Requirements:

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

7.1.2 For nominal plate thicknesses of ¾ in. [20 mm] and under, the 1½ -in. [40 mm] wide rectangular specimen may be used, and the elongation may be determined in a 2-in. [50-mm] gage length that include the fracture and that shows the greatest elongation.

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