



Designation: A537/A537M – 20

Standard Specification for Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel¹

This standard is issued under the fixed designation A537/A537M; 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 specification² covers heat-treated carbon-manganese-silicon steel plates intended for fusion welded pressure vessels and structures.

1.2 Plates furnished under this specification are available in the following three classes:

| Class | Heat Treatment | Thickness | Yield Strength, min, ksi [MPa] | Tensile Strength, min, ksi [MPa] |
|-------|-----------------------|--------------------------------------|--------------------------------|----------------------------------|
| 1 | Normalized | 2½ in. and under [65 mm and under] | 50 [345] | 70 [485] |
| | | Over 2½ in. [Over 65 mm] | 45 [310] | 65 [450] |
| 2 | Quenched and tempered | 2½ in. and under [65 mm and under] | 60 [415] | 80 [550] |
| | | Over 2½ to 4 in. [Over 65 to 100 mm] | 55 [380] | 75 [515] |
| | | Over 4 in. [Over 100 mm] | 46 [315] | 70 [485] |
| 3 | Quenched and tempered | 2½ in. and under [65 mm and under] | 55 [380] | 80 [550] |
| | | Over 2½ to 4 in. [Over 65 to 100 mm] | 50 [345] | 75 [515] |
| | | Over 4 in. [Over 100 mm] | 40 [275] | 70 [485] |

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

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

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² For ASME Boiler and Pressure Vessel Code applications, see related Specification SA-537/SA-537M in Section II of that Code.

system are not exact equivalents; therefore, each system is to be used independently of the other without combining values in any way.

1.5 *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: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 supplied to this material specification shall conform to Specification [A20/A20M](#). These requirements outline the testing and retesting methods and procedures; permissible 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 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

TABLE 1 Chemical Requirements

| Element | Composition, % |
|---|----------------|
| Carbon, max ^A | 0.24 |
| Manganese: | |
| 1½ in. [40 mm] and under in thickness: ^B | |
| Heat analysis | 0.70–1.35 |
| Product analysis | 0.64–1.46 |
| Over 1½ in. [40 mm] in thickness: | |
| Heat analysis | 1.00–1.60 |
| Product analysis | 0.92–1.72 |
| Phosphorus, max ^A | 0.025 |
| Sulfur, max ^A | 0.025 |
| Silicon: | |
| Heat analysis | 0.15–0.50 |
| Product analysis | 0.13–0.55 |
| Copper, max: | |
| Heat analysis | 0.35 |
| Product analysis | 0.38 |
| Nickel, max: ^B | |
| Heat analysis | 0.25 |
| Product analysis | 0.28 |
| Chromium, max: | |
| Heat analysis | 0.25 |
| Product analysis | 0.29 |
| Molybdenum, max: | |
| Heat analysis | 0.08 |
| Product analysis | 0.09 |

^A Applies to both heat and product analyses.

^B Manganese may exceed 1.35 % on heat analysis, up to a maximum of 1.60 %, and nickel may exceed 0.25 % on heat analysis, up to a maximum of 0.50 %, provided the heat analysis carbon equivalent does not exceed 0.57 % when based upon the following equation:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

When this option is exercised, the manganese and nickel contents on product analysis shall not exceed the heat analysis content by more than 0.12 % and 0.03 %, respectively.

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 conform to the fine austenitic grain size requirement of Specification **A20/A20M**.

5. Heat Treatment

5.1 All plates shall be thermally treated as follows:

5.1.1 Class 1 plates shall be normalized.

5.1.2 Class 2 and Class 3 plates shall be quenched and tempered. The tempering temperature for Class 2 plates shall

TABLE 2 Tensile Requirements

| | Class 1 | Class 2 | Class 3 |
|--------------------------------|-----------|--------------|--------------|
| | ksi [MPa] | ksi [MPa] | ksi [MPa] |
| Tensile strength: | | | |
| 2½ in. and under | 70–90 | 80–100 | 80–100 |
| [65 mm and under] | [485–620] | [550–690] | [550–690] |
| Over 2½ to 4 in., incl | 65–85 | 75–95 | 75–95 |
| [Over 65 to 100 mm, incl] | [450–585] | [515–655] | [515–655] |
| Over 4 in. | 65–85 | 70–90 | 70–90 |
| [Over 100 mm] | [450–585] | [485–620] | [485–620] |
| Yield strength, min: | | | |
| 2½ in. and under | 50 | 60 | 55 |
| [65 mm and under] | [345] | [415] | [380] |
| Over 2½ to 4 in., incl | 45 | 55 | 50 |
| [Over 65 to 100 mm, incl] | [310] | [380] | [345] |
| Over 4 in. | 45 | 46 | 40 |
| [Over 100 mm] | [310] | [315] | [275] |
| Elongation in 2 in. | | | |
| [50 mm], min, %: ^A | | | |
| 4 in. [100 mm] and under | 22 | 22 | 22 |
| Over 4 in. [100 mm] | 20 | 20 | 20 |
| Elongation in 8 in. | | | |
| [200 mm], min, %: ^A | 18 | ^B | ^B |

^A See Specification **A20/A20M** for elongation adjustments.

^B There is no requirement for elongation in 8 in.

not be less than 1100°F [595°C] and not less than 1150°F [620°C] for Class 3 plates.

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**.

7. Mechanical Requirements

7.1 Tension Tests:

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

7.1.2 For Class 2 and Class 3 plates with a nominal thickness of ¾ in. [20 mm] and under, the 1½-in. [40-mm] wide rectangular specimen may be used for the tension test, and the elongation may be determined in a 2-in. [50-mm] gage length that includes the fracture and that shows the greatest elongation.

8. Keywords

8.1 carbon steel plate; pressure containing parts; pressure vessel steels; steel plates for pressure vessel application