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Used in USDOE-NE Standards

Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum[1]

This standard is issued under the fixed designation A387/A387M; 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 Department of Defense.

1. Scope*

1.1 This specification[2] covers chromium-molybdenum 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 several grades having different alloy contents as follows:

Grade	Nominal Chromium Content, %	Nominal Molybdenum Content, %
2	0.50	0.50
12	1.00	0.50
11	1.25	0.50
22, 22L	2.25	1.00
21, 21L	3.00	1.00
5	5.00	0.50
9	9.00	1.00
91	9.00	1.00

1.3 Each grade except Grades 21L, 22L, and 91 is available in two classes of tensile strength levels as defined in the Tensile Requirements tables. Grades 21L and 22L are available only as Class 1. Grade 91 is available only as Class 2.

NOTE 1—Grade 911, previously covered by this specification, is now covered by Specification A1017/A1017M.

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

1.5 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 this specification.

2. Referenced Documents

2.1 *ASTM Standards:*[3]

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

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

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

A1017/A1017M Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum-Tungsten

3. General Requirements and Ordering Information

3.1 Material 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 weight, 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. Manufacture

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

[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-387/SA-387M 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.**

TABLE 1 Tensile Requirements for Class 1 Plates

	Grades 2 and 12	Grade 11	Grades 22, 21, 5, 9, 21L, 22L
Tensile strength, ksi [MPa]	55 to 80 [380 to 550]	60 to 85 [415 to 585]	60 to 85 [415 to 585]
Yield strength, min, ksi [MPa]	33 [230]	35 [240]	30 [205]
Elongation in 8 in. [200 mm], min, %[A]	18	19	...
Elongation in 2 in. [50 mm], min, %[A]	22	22	18
Reduction of area, min, %	...	...	45[B] 40[C]

[A] See Specification A20/A20M, elongation adjustments.
[B] Measured on round test specimens.
[C] Measured on flat specimen.

TABLE 2 Tensile Requirements for Class 2 Plates[A]

	Grade 2	Grade 11	Grade 12	Grades 22, 21, 5, 9	Grade 91
Tensile strength, ksi [MPa]	70 to 90 [485 to 620]	75 to 100 [515 to 690]	65 to 85 [450 to 585]	75 to 100 [515 to 690]	85 to 110 [585 to 760]
Yield strength, min, ksi [MPa]/(0.2 % offset)	45 [310]	45 [310]	40 [275]	45 [310]	60 [415]
Elongation in 8 in. [200 mm], min, %[B]	18	18	19	...	...
Elongation in 2 in. [50 mm], min, %[B]	22	22	22	18	18
Reduction of area, min, %	...	...	...	45[C] 40[D]	...

[A] Not applicable to annealed material.
[B] See Specification A20/A20M, elongation adjustments.
[C] Measured on round test specimens.
[D] Measured on flat specimen.

5. Heat Treatment

5.1 Except for Grade 91, all plates shall be thermally treated either by annealing, normalizing- and -tempering, or, when permitted by the purchaser, accelerated cooling from the austenitizing temperature by air blasting or liquid quenching, followed by tempering. Minimum tempering temperatures shall be as follows:

Grade	Temperature, °F [°C]
2, 12, and 11	1150 [620]
22, 22L, 21, 21L, and 9	1250 [675]
5	1300 [705]

5.1.1 Grade 91 plates shall be normalized at 1900 to 1975°F [1040 to 1080°C] and shall be tempered at 1350 to 1470°F [730 to 800°C].

5.2 Grade 5, 9, 21, 21L, 22, 22L, and 91 plates ordered without the heat treatment required by 5.1 shall be furnished in either the stress-relieved or the annealed condition.

5.3 For plates ordered without the heat treatment required by 5.1, heat treatment of the plates to conform to 5.1 and to Table 1 or Table 2, as applicable, shall be the responsibility of the purchaser.

6. Chemical Requirements

6.1 The steel shall conform to the requirements as to chemical composition shown in Table 3 unless otherwise modified in accordance with Supplementary Requirement S17, Vacuum Carbon-Deoxidized Steel, in Specification A20/A20M for grades other than Grade 11.

7. Metallurgical Structure

7.1 *Austenitic Grain Size*—Grade 2 material shall have a coarse austenitic grain size.

8. Mechanical Requirements

8.1 *Tension Test Requirements*:

8.1.1 The material as represented by the tension test specimens shall conform to the applicable requirements of Table 1 or Table 2, as specified on the order.

8.1.2 Adjustment of the percentage elongation requirements is permitted in accordance with Specification A20/A20M for plates up to ¾ in. [20 mm] inclusive, in thickness when an 8-in. [200-mm] gage length is used.

9. Marking

9.1 In addition to the marking required in Specification A20/A20M, each plate shall be legibly stamped or stenciled, depending upon the ordered thickness, with the letter *A* for annealed, *N* for normalized and tempered, and *Q* for accelerated cooled and tempered, as applicable.

10. Keywords

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