



Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium- Molybdenum¹

This standard is issued under the fixed designation A 387/A 387M; 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 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 Molybde- num 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
911	9.00	1.00

1.3 Each grade except Grades 21L, 22L, 91 and 911 is available in two classes of tensile strength levels as defined in the Tensile Requirements tables, depending on heat treatment. In the annealed condition all grades are available only as Class 1. Grades 21L and 22L are available only as Class 1. Grade 91 and 911 are available only as Class 2.

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:

A 20/A 20M Specification for General Requirements for

¹ This specification is under the jurisdiction of ASTM Committee A-1 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.

Steel Plates for Pressure Vessels³

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products⁴

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 weight, quality and repair of defects, marking, loading, etc.

3.2 Specification A 20/A 20M also establishes the rules for the ordering information that 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,

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. 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.

5. Heat Treatment

5.1 Except for Grades 91 and 911, all plates shall be thermally treated either by annealing, normalizing- and

³ Annual Book of ASTM Standards, Vol 01.04.

⁴ Annual Book of ASTM Standards, Vol 01.01.

TABLE 1 Chemical Requirements

Element	Composition, %										
	Grade 2	Grade 12	Grade 11	Grade 22	Grade 22L	Grade 21	Grade 21L	Grade 5	Grade 9	Grade 91	Grade 91L
Carbon:											
Heat analysis	0.05–0.21	0.05–0.17	0.05–0.17	0.05–0.15 ^A	0.10 max	0.05–0.15 ^A	0.10 max	0.15 max	0.15 max	0.08–0.12	0.09–0.13
Product analysis	0.04–0.21	0.04–0.17	0.04–0.17	0.04–0.15 ^A	0.12 max	0.04–0.15 ^A	0.12 max	0.15 max	0.15 max	0.06–0.15	0.08–0.14
Manganese:											
Heat analysis	0.55–0.80	0.40–0.65	0.40–0.65	0.30–0.60	0.30–0.60	0.30–0.60	0.30–0.60	0.30–0.60	0.30–0.60	0.30–0.60	0.30–0.60
Product analysis	0.50–0.88	0.35–0.73	0.35–0.73	0.25–0.66	0.25–0.66	0.25–0.66	0.25–0.66	0.25–0.66	0.25–0.66	0.25–0.66	0.25–0.66
Phosphorus, max:											
Heat analysis	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.030	0.020	0.020
Product analysis	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.030	0.025	0.025
Sulfur, max:											
Heat analysis	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.030	0.030	0.010	0.010
Product analysis	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.030	0.030	0.012	0.012
Silicon:											
Heat analysis	0.15–0.40	0.15–0.40	0.50–0.80	0.50 max	0.50 max	0.50 max	0.50 max	0.50 max	1.00 max	0.20–0.50	0.10–0.50
Product analysis	0.13–0.45	0.13–0.45	0.44–0.86	0.50 max	0.50 max	0.50 max	0.50 max	0.55 max	1.05 max	0.18–0.56	0.08–0.56
Chromium:											
Heat analysis	0.50–0.80	0.80–1.15	1.00–1.50	2.00–2.50	2.00–2.50	2.75–3.25	2.75–3.25	4.00–6.00	8.00–10.00	8.00–9.50	8.50–10.50
Product analysis	0.46–0.85	0.74–1.21	0.94–1.56	1.88–2.62	1.88–2.62	2.63–3.37	2.63–3.37	3.90–6.10	7.90–10.10	7.90–9.60	8.40–10.70
Molybdenum:											
Heat analysis	0.45–0.60	0.45–0.60	0.45–0.65	0.90–1.10	0.90–1.10	0.90–1.10	0.90–1.10	0.45–0.65	0.90–1.10	0.85–1.05	0.90–1.10
Product analysis	0.40–0.65	0.40–0.65	0.40–0.70	0.85–1.15	0.85–1.15	0.85–1.15	0.85–1.15	0.40–0.70	0.85–1.15	0.80–1.10	0.85–1.15
Nickel, max:											
Heat analysis	...	...	...	...	...	...	...	...	...	0.40	0.40
Product analysis	...	...	...	...	...	...	...	...	...	0.43	0.43
Vanadium:											
Heat analysis	...	...	...	...	...	...	...	...	...	0.18–0.25	0.18–0.25
Product analysis	...	...	...	...	...	...	...	...	...	0.16–0.27	0.16–0.27
Columbium:											
Heat analysis	...	...	...	...	...	...	...	...	...	0.06–0.10	0.060–0.10
Product analysis	...	...	...	...	...	...	...	...	...	0.05–0.11	0.05–0.11
Boron:											
Heat analysis	...	...	...	...	...	...	...	...	...	...	0.0003–0.006
Product analysis	...	...	...	...	...	...	...	...	...	...	0.0002–0.007
Nitrogen:											
Heat analysis	...	...	...	...	...	...	...	...	...	0.030–0.070	0.04–0.09
Product analysis	...	...	...	...	...	...	...	...	...	0.025–0.080	0.035–0.095
Aluminum, max:											
Heat analysis	...	...	...	...	...	...	...	...	...	0.04	0.04
Product analysis	...	...	...	...	...	...	...	...	...	0.05	0.05
Tungsten:											
Heat analysis	...	...	...	...	...	...	...	...	...	...	0.90–1.10
Product analysis	...	...	...	...	...	...	...	...	...	...	0.85–1.15

^A The carbon content for plates over 5 in. [125 mm] in thickness is 0.17 max on product analysis.