



Standard Specification for Pressure Vessel Plates, Low-Carbon Age-Hardening Nickel- Copper-Chromium-Molybdenum-Columbium Alloy Steel¹

This standard is issued under the fixed designation A736/A736M; 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 low-carbon age-hardening alloy steel plates for welded pressure vessels and piping components. The specification covers nickel-copper-chromium-molybdenum-columbium steel.

1.2 Plates under this specification are available as follows:

1.2.1 Available in Grade A, Class 3 only.

1.2.1.1 Quenched and precipitation heat treated with a minimum specified tensile strength of 85 ksi for thinner plates and 75 and 70 ksi for thicker plates, with the minimum tensile strength dependent upon the plate thickness. The maximum thickness of Grade A, Class 3 plates is limited only by the capacity of the chemical composition and heat treatment to meet the specified mechanical property requirements; however, current practice usually limits the maximum thickness to 8 in. [200 mm].

1.3 This 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 in inch-pound units.

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 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

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-736 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.

[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 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 The steel shall be killed and shall conform to the fine austenitic grain size requirement of Specification [A20/A20M](#).

5. Heat Treatment

5.1 The plates shall be quenched in a liquid medium from a temperature in the range from 1600 to 1700°F [870 to 930°C] and then precipitation heat treated at a temperature in the range from 1000 to 1300°F [540 to 705°C] for a time to be determined by the manufacturer or processor.

5.2 If the purchaser elects to perform the thermal treatment, the plates shall be accepted on the basis of mill tests made from test coupons heat treated as specified in the purchase order. If the test coupon heat treatment requirements are not specified in the purchase order, the manufacturer or processor shall heat

*A Summary of Changes section appears at the end of this standard

treat the test coupons under conditions it considers appropriate. The manufacturer or processor shall inform the purchaser of the procedure followed in thermally treating the test coupons at the mill.

6. Chemical Composition

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

7. Mechanical Properties

7.1 Tension Test:

7.1.1 The plates, as represented by the test specimens, shall conform to the requirements given in **Table 2**.

TABLE 1 Chemical Requirements

Element	Composition, %
	Grade A
Carbon, max	
Heat analysis	0.07
Product analysis	0.09
Manganese	
Heat analysis	0.40–0.70
Product analysis	0.35–0.78
Phosphorus, max ^A	0.025
Sulfur, max ^A	0.025
Silicon, max	
Heat analysis	0.40
Product analysis	0.45
Chromium	
Heat analysis	0.60–0.90
Product analysis	0.56–0.94
Nickel	
Heat analysis	0.70–1.00
Product analysis	0.67–1.03
Molybdenum	
Heat analysis	0.15–0.25
Product analysis	0.12–0.28
Copper	
Heat analysis	1.00–1.30
Product analysis	0.95–1.35
Columbium, min	
Heat analysis	0.02
Product analysis	0.01

^A Applies to both heat analysis and product analysis.

TABLE 2 Tensile Requirements

	Grade A Class 3, ksi [MPa]
Yield strength, min	
¾ in. and under	75
[20 mm and under]	[515]
Over ¾ to 1 in., incl	75
[Over 20 to 25 mm, incl]	[515]
Over 1 to 2 in., incl	75
[Over 25 to 50 mm, incl]	[515]
Over 2 to 4 in., incl	65
[Over 50 to 100 mm, incl]	[450]
Over 4 in.	60
[Over 100 mm]	[415]
Tensile strength	
¾ in. and under	85–105
[20 mm and under]	[585–725]
Over ¾ to 1 in., incl	85–105
[Over 20 to 25 mm, incl]	[585–725]
Over 1 to 2 in., incl	85–105
[Over 25 to 50 mm, incl]	[585–725]
Over 2 to 4 in., incl	75–95
[Over 50 to 100 mm, incl]	[515–655]
Over 4 in.	70–90
[Over 100 mm]	[485–620]
Elongation	
2 in. [50 mm], min, % ^A	20

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

7.1.2 For nominal plate thicknesses of ¾ in. [20 mm] and under, the 1½-in. [40-mm] wide rectangular test 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 shows the greatest elongation.

7.2 Notch-Toughness Test:

7.2.1 Charpy V-notch impact tests shall be made in accordance with Specification **A20/A20M**.

7.2.2 The test results of 10 by 10-mm specimens shall meet an average minimum value of 20 ft-lbf [27 J] at –50°F [–45°C].

8. Keywords

8.1 alloy steel; alloy steel plate; pressure vessel plate; low carbon; age hardening; pressure vessels; piping components; precipitation heat treated; nickel-copper-chromium-molybdenum-columbium

SUPPLEMENTARY REQUIREMENTS

Supplementary requirements shall not apply unless specified in the purchase order.

A list of standardized supplementary requirements for use at the option of the purchaser is included in Specification **A20/A20M**. Those that are considered suitable for use with this specification are listed below by title.

- S1. Vacuum Treatment,
- S2. Product Analysis,
- S3. Simulated Post Weld Heat Treatment of Mechanical Test Coupons,
- S4. Additional Tension Test,
- S5. Charpy V-Notch Impact Test,
- S6. Drop-Weight Test (for Material 0.625 in. [16 mm] and Over in Thickness),

- S8. Ultrasonic Examination in accordance with Specification **A435/A435M**,
- S9. Magnetic Particle Examination,
- S10. Charpy V-Notch Test Curve,
- S11. Ultrasonic Examination in accordance with Specification **A577/A577M**,
- S12. Ultrasonic Examination in accordance with Specification **A578/A578M**,



S13. NDT Temperature Determination,
S15. Reduction of Area Measurement,
S17. Vacuum Carbon-Deoxidized Steel,

S19. Restricted Chemical Requirements,
S24. Strain Age Test, and
S25. Weldability.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A736/A736M – 03 (2007)) that may impact the use of this standard. (Approved Nov. 1, 2012.)

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| (1) Revised title for accuracy. | (5) Added Section 8. |
| (2) Revised Section 1 to update grade and class information. | (6) Revised Table 1 and Table 2 to refer solely to Grade A and |
| (3) Revised Section 3 to remove redundancy. | Grade A, Class 3. |
| (4) Revised Section 5 to update class requirements. | |

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