

**SPECIFICATION FOR PRESSURE VESSEL PLATES,
LOW-CARBON AGE-HARDENING NICKEL-COPPER-
CHROMIUM-MOLYBDENUM-COLUMBIUM (NIOBIUM)
ALLOY STEEL**



SA-736/SA-736M



(Identical with ASTM Specification A736/A736M-17.)

Standard Specification for Pressure Vessel Plates, Low-Carbon Age-Hardening Nickel- Copper-Chromium-Molybdenum-Columbium (Niobium) Alloy Steel

1. Scope

1.1 This specification covers low-carbon age-hardening alloy steel plates for welded pressure vessels and piping components. The specification covers nickel-copper-chromium-molybdenum-columbium (niobium) 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.

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.

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:*

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]

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 (Niobium), ^B min		
Heat analysis	0.02	
Product analysis	0.01	

^A Applies to both heat analysis and product analysis.

^B Columbium and niobium are interchangeable names for the same element and both names are acceptable in A01 specifications.

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 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.

TABLE 2 Tensile Requirements

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

^A See Specification A20/A20M for elongation adjustment.

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.

7.1.2 For nominal plate thicknesses of $\frac{3}{4}$ 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 (niobium)

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.

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| S1. Vacuum Treatment, | S10. Charpy V-Notch Test Curve, |
| S2. Product Analysis, | S11. Ultrasonic Examination in accordance with Specification A577/A577M, |
| S3. Simulated Post Weld Heat Treatment of Mechanical Test Coupons, | S12. Ultrasonic Examination in accordance with Specification A578/A578M, |
| S4. Additional Tension Test, | S13. NDT Temperature Determination, |
| S5. Charpy V-Notch Impact Test, | S15. Reduction of Area Measurement, |
| S6. Drop-Weight Test (for Material 0.625 in. [16 mm] and Over in Thickness), | S17. Vacuum Carbon-Deoxidized Steel, |
| S8. Ultrasonic Examination in accordance with Specification A435/A435M, | S19. Restricted Chemical Requirements, |
| S9. Magnetic Particle Examination, | S24. Strain Age Test, and |
| | S25. Weldability. |