



Designation: A 736/A 736M – 88 (Reapproved 2000)

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

This standard is issued under the fixed designation A 736/A 736M; 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 two grades of low-carbon age-hardening alloy steel plates for welded pressure vessels and piping components. The two grades are nickel-copper-chromium-molybdenum-columbium and nickel-copper-manganese-molybdenum-columbium steels.

1.2 Plates under this specification are available in three Classes, as follows:

1.2.1 *Class 1*—As-rolled and precipitation heat treated. Available in thicknesses of $\frac{3}{4}$ in. [20 mm] and under. Grade A, Class 1 has a minimum specified tensile strength of 90 ksi. Grade C, Class 1 has a minimum specified tensile strength of 100 ksi.

1.2.2 *Class 2*—Normalized and precipitation heat treated.

1.2.2.1 Available in Grade A only. Grade A has minimum specified tensile strength of 72 ksi for thinner plates and 65 and 60 ksi for thicker plates, with the minimum tensile strength dependent upon the plate thickness. The maximum thickness of Grade A, Class 2 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].

1.2.3 *Class 3*—Quenched and precipitation heat treated.

1.2.3.1 Available as Grade A 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].

1.2.3.2 Available as Grade C with a specified minimum tensile strength of 95 ksi for plates $\frac{3}{4}$ in. [20 mm] and under in

thickness and 90 ksi for plates over $\frac{3}{4}$ in. in thickness. The maximum thickness of Grade C, Class 3, plates is 2 in. [50 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:

A 20/A20M Specification for General Requirements for Steel Plates for Pressure Vessels³

A 435/A435M Specification for Straight-Beam Ultrasonic Examination of Steel Plates³

A 577/A577M Specification for Ultrasonic Angle-Beam Examination of Steel Plates³

A 578/A578M 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 specification shall conform to the requirements of Specification A 20/A 20M. These requirements outline the testing and retesting methods and procedures, permissible variations in dimensions and weight, quality, repair of defects, marking, loading, etc.

3.2 Specification A 20/A 20M also establishes the rules for compliance to the basis of purchase when purchasing material to this specification.

3.3 Certain supplementary requirements considered suitable for use with this specification are listed at the end of this

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-736 in Section II of that Code.

³ *Annual Book of ASTM Standards*, Vol 01.04.

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specification. These include some of the standardized supplementary requirements listed in Specification A 20/A 20M as well as additional ones unique to this specification.

4. Manufacture

4.1 The steel shall be killed and shall conform to the fine austenitic grain size requirement of Specification A 20/A 20M.

5. Heat Treatment

5.1 *Class 1*—The material shall be 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 material manufacturer.

5.2 *Class 2*—The material shall be normalized at 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 material manufacturer.

5.3 *Class 3*—The material 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 material manufacturer.

5.4 If the purchaser elects to perform the thermal treatment, the material shall be accepted on the basis of mill tests from test coupons heat treated in accordance with the purchase order requirements. If the test coupon heat treatment requirements are not indicated on the purchase order, the manufacturer shall heat treat the test coupons under conditions he considers appropriate. The manufacturer shall inform the purchaser of the procedure followed in thermally treating the test coupons at the mill.

6. Chemical Requirements

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

TABLE 1 Chemical Requirements

Element	Composition, %	
	Grade A	Grade C
Carbon, max		
Heat analysis	0.07	0.07
Product analysis	0.09	0.090
Manganese		
Heat analysis	0.40–0.70	1.30–1.65
Product analysis	0.35–0.78	1.21–1.77
Phosphorus, max ^A	0.025	0.025
Sulfur, max ^A	0.025	0.025
Silicon, max		
Heat analysis	0.40	0.40
Product analysis	0.45	0.45
Chromium		
Heat analysis	0.60–0.90	...
Product analysis	0.56–0.94	...
Nickel		
Heat analysis	0.70–1.00	0.70–1.00
Product analysis	0.67–1.03	0.67–1.03
Molybdenum		
Heat analysis	0.15–0.25	0.15–0.25
Product analysis	0.12–0.28	0.12–0.28
Copper		
Heat analysis	1.00–1.30	1.00–1.30
Product analysis	0.95–1.35	0.95–1.35
Columbium, min		
Heat analysis	0.02	0.02
Product analysis	0.01	0.01

^AApplies to both heat analysis and product analysis.

7. Mechanical Requirements

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

7.1.1 For nominal plate thicknesses 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.

7.2 *Notch Toughness Test Requirements:*

7.2.1 Charpy V-notch impact tests shall be made in accordance with Specification A 20/A 20M.

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].

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 A 20/A 20M. Several of those considered suitable for use with this specification are listed in this section by title. Other tests may be performed by agreement between the supplier and the purchaser.

- 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,
- S8. Ultrasonic Examination in accordance with Specification A 435/A 435M,

- S9. Magnetic Particle Examination,
- S10. Charpy V-Notch Test Curve,
- S11. Ultrasonic Examination in accordance with Specification A 577/A 577M,
- S12. Ultrasonic Examination in accordance with Specification A 578/A 578M,
- S13. NDT Temperature Determination,
- S14. Bend Test,
- S15. Reduction of Area Measurement

