

# SPECIFICATION FOR PRESSURE VESSEL PLATES, ALLOY STEEL, NICKEL



SA-203/SA-203M



(Identical with ASTM Specification A203/A203M-17.)

# Standard Specification for Pressure Vessel Plates, Alloy Steel, Nickel

## 1. Scope

1.1 This specification covers nickel-alloy steel plates intended primarily for welded pressure vessels.

1.2 Plates under this specification are available with four strength levels and two nickel compositions as follows:

Grade	Nominal Nickel Content %	Yield Strength, min,		Tensile Strength, min, ksi [MPa]	
		ksi [MPa]		ksi [MPa]	
A	2.25	37 [255]		65 [450]	
B	2.25	40 [275]		70 [485]	
D	3.50	37 [255]		65 [450]	
E	3.50	40 [275]		70 [485]	
F	3.50				
	2 in. [50 mm] and under	55 [380]		80 [550]	
	Over 2 in. [50 mm]	50 [345]		75 [515]	

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

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 *Steelmaking Practice*—The steel shall be killed and shall conform to the fine grain size requirement of Specification A20/A20M.

## 5. Heat Treatment

5.1 All plates shall be thermally treated as follows:

TABLE 1 Chemical Requirements

Elements	Composition, %			
	Grade A	Grade B	Grade D	Grades E and F
Carbon, max: <sup>A</sup>				
Up to 2 in. [50 mm] in thickness	0.17	0.21	0.17	0.20
Over 2 in. to 4 in. [100 mm] incl. in thickness	0.20	0.24	0.20	0.23
Over 4 in. [100 mm] in thickness	0.23	0.25	...	...
Manganese, max:				
Heat analysis:				
2 in. [50 mm] and under	0.70	0.70	0.70	0.70
Over 2 in. [50 mm]	0.80	0.80	0.80	0.80
Product analysis:				
2 in. [50 mm] and under	0.78	0.78	0.78	0.78
Over 2 in. [50 mm]	0.88	0.88	0.88	0.88
Phosphorus, max <sup>A</sup>	0.025	0.025	0.025	0.025
Sulfur, max <sup>A</sup>	0.025	0.025	0.025	0.025
Silicon:				
Heat analysis	0.15–0.40	0.15–0.40	0.15–0.40	0.15–0.40
Product analysis	0.13–0.45	0.13–0.45	0.13–0.45	0.13–0.45
Nickel:				
Heat analysis	2.10–2.50	2.10–2.50	3.25–3.75	3.25–3.75
Product analysis	2.03–2.57	2.03–2.57	3.18–3.82	3.18–3.82

<sup>A</sup> Applies to both heat and product analyses.

TABLE 2 Tensile Requirements

	Grades A and D		Grades B and E		Grade F	
	ksi	[MPa]	ksi	[MPa]	ksi	[MPa]
Tensile strength						
2 in. [50 mm] and under	65–85	[450–585]	70–90	[485–620]	80–100	[550–690]
Over 2 in. [50 mm]	65–85	[450–585]	70–90	[485–620]	75–95	[515–655]
Yield strength, min						
2 in. [50 mm] and under	37	[255]	40	[275]	55	[380]
Over 2 in. [50 mm]	37	[255]	40	[275]	50	[345]
Elongation in 8 in. [200 mm] min, % <sup>A</sup>		19		17		...
Elongation in 2 in. [50 mm] min, % <sup>A,B</sup>		23		21		20

<sup>A</sup> See Specification A20/A20M for elongation adjustments.

<sup>B</sup> See 7.1.1.

5.1.1 All plates of Grades A, B, D, and E shall be normalized except as permitted by 5.1.1.1.

5.1.1.1 If approved by the purchaser for Grades A, B, D, and E, cooling rates faster than air cooling are permissible for improvement of the toughness, provided the plates are subsequently tempered at not less than 1100°F [595°C] for not less than ½ h.

5.1.2 All plates of Grade F shall be heat treated by heating into the austenitic range, quenching in water, and tempering at not less than 1100°F [595°C] for not less than ½ h.

## 6. Chemical Composition

6.1 The steel shall conform to the chemical requirements shown in Table 1 unless otherwise modified in accordance with Supplementary Requirement S17, Vacuum Carbon-Deoxidized Steel, in Specification A20/A20M.

## 7. Mechanical Properties

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 plates that have been heat treated in accordance with 5.1.1.1 or 5.1.2 and have a nominal thickness of ¾ in. [20 mm] and under, the 1½-in. (40-mm) wide rectangular specimens 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. When this specimen is used, the elongation shall be not less than 23 %.

### 7.2 Impact Test Requirements:

7.2.1 Plates of Grades A, B, D, and E that have been heat treated in accordance with 5.1.1.1 shall be Charpy V-notch impact tested. The impact test shall meet 20 ft · lbf [27 J]. The test temperature and orientation shall be a matter of agreement between the purchaser and supplier.

7.2.2 Grade F plates shall be impact tested in accordance with Supplementary Requirement S5 in Specification A20/A20M.

## 8. Keywords

8.1 alloy steel plate; nickel alloy steel; pressure containing parts; pressure vessel steels; steel plates; steel plates for pressure vessel applications

**SUPPLEMENTARY REQUIREMENTS**

Supplementary requirements shall not apply unless specified in the order.

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

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| S1. Vacuum Treatment,  | S8. Ultrasonic Examination in accordance with Specification A435/A435M,      |
| S2. Product Analysis,  | S9. Magnetic Particle Examination,   |
| S3. Simulated Post-Weld Heat Treatment of Mechanical Test Coupons,           | S11. Ultrasonic Examination in accordance with Specification A577/A577M,     |
| S4.1 Additional Tension Test,  | S12. Ultrasonic Examination in accordance with Specification A578/A578M, and |
| S5. Charpy V-Notch Impact Test,  | S17. Vacuum Carbon-Deoxidized Steel.   |
| S6. Drop Weight Test (for Material 0.625 in. [16 mm] and over in Thickness), |  |
| S7. High-Temperature Tension Test,   |  |