SPECIFICATION FOR PRESSURE VESSEL PLATES, ALLOY STEEL, MANGANESE-VANADIUM-NICKEL

SA-225/SA-225M

(Identical with ASTM Specification A 225/A 225M-93.)

1. Scope

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

1.2 Material under this specification is available in two grades having different strength levels as follows:

Grade	Tensile Strength, ksi [MPa]
C	105–135 [725–930]
D	
3 in. [75 mm] and under	80–105 [550–725]
Over 3 in. [75 mm]	75–100 [515–690]

1.3 The maximum thickness of plates is limited only by the capacity of the chemical composition to meet the specified mechanical property requirements; however, current mill practice normally limits Grade C to 0.58 in. [15 mm] maximum and Grade D to 6 in. [150 mm] maximum.

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 the specification.

2. Referenced Documents

2.1 *ASTM Standards:*

A 20/A 20M Specification for General Requirements for Steel Plates for Pressure Vessels

A 435/A 435M Specification for Straight-Beam Ultrasonic Examination of Steel Plates

A 577/A 577M Specification for Ultrasonic Angle-Beam Examination of Steel Plates

A 578/A 578M Specification for Straight-Beam Ultrasonic Examination of Plain and Clad Steel Plates for Special Applications

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

3.2 Specification A 20/A 20M also establishes the rules for the basis of purchase 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.

3.5 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.

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4. Manufacture

4.1 *Steelmaking Practice* — 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 Grade D plates of all thicknesses and Grade C plates of thicknesses over 2 in. [50 mm] shall be normalized.

5.2 Grade C plates 2 in. [50 mm] and under in thickness are usually supplied in the as-rolled condition. The plates may be ordered normalized or stress relieved, or both.

6. Chemical Requirements

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 A 20/A 20M.

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.

7.2 For plates with a nominal thickness of $^{3}/_{4}$ in. [20 mm] and under, the $1^{1}/_{2}$ in. [40 mm] wide rectangular specimen may be used and the elongation determined in a 2 in. [50 mm] gage length that includes the fracture and that shows the greatest elongation.

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TABLE 1
CHEMICAL REQUIREMENTS

Elements	Composition, %	
	Grade C	Grade D
Carbon, max[A]	0.25	0.20
Manganese, max:		
Heat analysis	1.60	1.70
Product analysis	1.72	1.84
Phosphorus, max[A]	0.035	0.035
Sulfur, max[A]	0.035	0.035
Silicon:		
Heat analysis	0.15–0.40	0.10–0.50
Product analysis	0.13–0.45	0.08–0.56
Vanadium:		
Heat analysis	0.13–0.18	0.10–0.18
Product analysis	0.11–0.20	0.08–0.20
Nickel:		
Heat analysis	0.40–0.70	0.40–0.70
Product analysis	0.37–0.73	0.37–0.73

[A] Applies to both heat and product analyses.

TABLE 2
TENSILE REQUIREMENTS

	Grade C		Grade D	
	ksi	[MPa]	ksi	[MPa]
Tensile strength				
All thicknesses	105–135	[725–930]		
3 in. [75 mm] and under			80–105	[550–725]
Over 3 in. [75 mm]			75–100	[515–690]
Yield strength, min[B]				
All thicknesses	70	[485]	60	[415]
3 in. [75 mm] and under			55	[380]
Over 3 in. [75 mm]				
Elongation in 8 in. [200 mm], min, %			. . .	
Elongation in 2 in. [50 mm], min, %		20[A]	19	
Elongation in 5D, min, %			17	

[A] See Specification A 20/A 20M.
[B] Determined by either the 0.2% offset method or the 0.5% extension-under-load method.

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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 A 20/A 20M. Several of those which are considered suitable for use with this specification are listed below 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,

S4.1 Additional Tension Test,

S5. Charpy V-Notch Impact Test,

S6. Drop Weight Test,

S7. High-Temperature Tension Test,

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

S9. Magnetic Particle Examination,

S11. Ultrasonic Examination in Accordance with Specification A 577/A 577M,

S12. Ultrasonic Examination in Accordance with Specification A 578/A 578M,

S14. Bend Test, and

S17. Vacuum Carbon-Deoxidized Steel.

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