



Designation: A1106/A1106M – 17

## Standard Specification for Pressure Vessel Plate, Alloy Steel, Austenitic High Manganese for Cryogenic Application<sup>1</sup>

This standard is issued under the fixed designation A1106/A1106M; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

### 1. Scope

1.1 This specification<sup>2</sup> covers austenitic high-manganese alloy steel plates produced by hot rolling and controlled cooling. The plates are intended primarily for use in welded pressure vessels.

1.2 Due to the inherent characteristics of the rolling and cooling processes, or both, the plates shall not be formed at temperatures exceeding 932°F [500°C].

1.3 The maximum thickness of plates is limited only by the capacity of the material to meet the specified mechanical property requirements; however, current mill practice normally limits this material to 2.5 in. [63.5 mm] max.

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.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>3</sup>

<sup>1</sup> 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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<sup>2</sup> POSCO has the patented materials that meet this specification. Interested parties are invited to submit information regarding the identification of acceptable alternatives to these patented items to the Committee on Standards, ASTM Headquarters, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. Comments will receive careful consideration at the meeting of the responsible technical committee, which any interested party may attend.

<sup>3</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto: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. Manufacture

4.1 *Steelmaking Practice*—The steel shall be killed.

4.2 Plates shall be produced by hot rolling and shall be controlled cooled after rolling within the temperature range from 1472 to 932°F [800 to 500°C] at a rate that is on average faster than 18°F/s [10°C/s].

4.3 Heat treatment following the final rolling process shall not be permitted.

### 5. Chemical Requirements

5.1 The steel shall conform to the chemical requirements shown in [Table 1](#).

**TABLE 1 Chemical Requirements**

Element <sup>A</sup>	Composition, %
Carbon	0.35–0.55
Manganese	22.50–25.50
Phosphorus, max	0.030
Sulfur, max	0.010
Silicon <sup>B</sup>	0.10–0.50
Chromium	3.00–4.00
Copper	0.30–0.70
Boron, max	0.0050
Nitrogen, max	0.050

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

<sup>B</sup> Silicon may be less than 0.10 %, provided total aluminum is 0.03 % or over, or provided acid soluble aluminum is 0.025 % or over.

**TABLE 2 Tensile Requirements**

Tensile strength, ksi [MPa]	116–141 [800–970]
Yield strength (0.2 % offset), min, ksi [MPa]	58 [400]
Elongation in 2 in. [50 mm], min, % <sup>A</sup>	22.0

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

## 6. Mechanical Properties

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

6.1.1 Upon agreement between the purchaser and the manufacturer, yield strength may be determined by the extension under load method, using 0.005 in./in. [mm/mm] total extension.

6.1.2 For nominal plate thicknesses of  $\frac{3}{4}$  in. [20 mm] and under, the  $1\frac{1}{2}$  [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 shows the greatest elongation.

### 6.2 Impact Test Requirements:

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

6.2.2 The longitudinal axis of the test specimens shall be transverse to the final rolling direction of the plate.

6.2.3 Unless otherwise agreed, tests shall be conducted at –320°F [–195°C] and average absorbed energy for each set of three full size specimens shall be 20 ft·lbf [27 J] or more.

6.2.4 Each impact test value shall constitute the average value of three specimens, with not more than one value below the specified minimum value of 20 ft·lbf [27 J] but in no case below 15 ft·lbf [20 J] for full size specimens.

6.2.5 Each test specimen shall have a lateral expansion opposite the notch of not less than 0.015 in. [0.381 mm].

## 7. Finish

7.1 Because retained scale may mask surface imperfections, as well as mar the plate surface, plates shall be descaled by the producer.

## 8. Keywords

8.1 alloy steel; alloy steel plate; cryogenic; high manganese; high manganese austenitic; 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 standard supplementary requirements for use at the option of the purchaser are included in Specification **A20/A20M**. Several of those 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,

S6. Drop Weight Test (for Material 0.625 in. [16 mm] and over in Thickness),

S8. Ultrasonic Examination in accordance with Specification **A435/A435M**,

S11. Ultrasonic Examination in accordance with Specification **A577/A577M**, and

S12. Ultrasonic Examination in accordance with Specification **A578/A578M**.



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