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# Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched-and- Tempered, Chromium-Molybdenum, and Chromium- Molybdenum-Vanadium<sup>1</sup>

This standard is issued under the fixed designation A542/A542M; 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.

<sup>ε1</sup>Note—Supplementary Requirement S14, Bend Test, was editorially removed in September 2004.

## 1. Scope\*

1.1 This specification<sup>2</sup> covers two types of 2¼ Cr-1 Mo and three types of Cr-Mo-V alloy steel plates for use in the quenched-and-tempered condition, intended for the fabrication of welded pressure vessels and components.

1.2 Material under this specification is available in five types, designated “A,” “B,” “C,” “D,” and “E.” Type B is identical to Type A except for restrictive limits for carbon, phosphorus, sulfur, and nickel. The material is also available in five classes having the following strength levels. Type E is available only as Class 4 and 4a.

Class	Minimum Tensile Strength, ksi [MPa]
1	105 [725]
2	115 [795]
3	95 [655]
4 and 4a	85 [585]

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

1.4 The minimum thickness of plates is limited to ⅜ in. [5 mm].

1.5 The material is intended to be suitable for fusion welding. Welding technique is of fundamental importance and it is presupposed that welding procedures will be in accordance with approved methods.

~~1.6 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.~~

1.6 These alloy steel plates in the as-rolled condition are sensitive to cracking during flame cutting, transit, and handling. They should be shipped in the as-rolled condition only with the mutual agreement of the manufacturer and the purchaser or fabricator.

1.7 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:<sup>3</sup>

A20/A20M Specification for General Requirements for Steel Plates for Pressure Vessels

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A387/A387M Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum

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

<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> For ASME Boiler and Pressure Vessel Code applications, see related Specification SA-542 in Section II of that Code.

<sup>3</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard’s Document Summary page on the ASTM website.

\*A Summary of Changes section appears at the end of this standard.



### 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, permissible variations in dimensions, and mass, quality and repair of defects, marking, loading, etc.~~

~~3.2 Specification~~. 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 ~~also establishes the rules for the~~

**TABLE 1 Chemical Requirements**

NOTE 1—Where “...” appears there is no requirement.

Element	Composition, %				
	Type A	Type B	Type C	Type D	Type E
Carbon:					
Heat analysis	0.15 max	0.11–0.15	0.10–0.15	0.11–0.15	0.10–0.15
<del>Product analysis</del>	<del>0.18 max<sup>A</sup></del>	<del>0.09–0.18</del>	<del>0.08–0.18</del>	<del>0.09–0.18</del>	<del>0.08–0.18</del>
Product analysis	0.18 max	0.09–0.18	0.08–0.18	0.09–0.18	0.08–0.18
Manganese:					
Heat analysis	0.30–0.60	0.30–0.60	0.30–0.60	0.30–0.60	0.30–0.60
Product analysis	0.25–0.66	0.25–0.66	0.25–0.66	0.25–0.66	0.25–0.66
Phosphorus, max	0.025 <sup>B</sup>	0.015 <sup>B</sup>	0.025 <sup>B</sup>	...	0.025
Phosphorus, max	0.025	0.015	0.025	...	0.025
<del>Heat analysis</del>	...	...	...	0.015	...
Heat analysis	0.025	0.015	0.025	0.015	0.025
<del>Product analysis</del>	...	...	...	0.020	...
Product analysis	0.025	0.015	0.025	0.020	0.025
Sulfur, max	0.025 <sup>B</sup>	0.015 <sup>B</sup>	0.025 <sup>B</sup>	...	0.010
Sulfur, max	0.025	0.015	0.025	...	0.010
<del>Heat analysis</del>	...	...	...	0.010	...
Heat analysis	0.025	0.015	0.025	0.010	0.010
<del>Product analysis</del>	...	...	...	0.015	...
Product analysis	0.025	0.015	0.025	0.015	0.010
Silicon, max	0.50 <sup>B</sup>	0.50 <sup>B</sup>	0.13 <sup>B</sup>	...	0.15
Silicon, max	0.50	0.50	0.13	...	0.15
<del>Heat analysis</del>	...	...	...	0.40	...
Heat analysis	0.50	0.50	0.13	0.10	0.15
<del>Product analysis</del>	...	...	...	0.13	...
Product analysis	0.50	0.50	0.13	0.13	0.15
Chromium:					
Heat analysis	2.00–2.50	2.00–2.50	2.75–3.25	2.00–2.50	2.75–3.25
Product analysis	1.88–2.62	1.88–2.62	2.63–3.37	1.88–2.62	2.63–3.37
Molybdenum:					
Heat analysis	0.90–1.10	0.90–1.10	0.90–1.10	0.90–1.10	0.90–1.10
Product analysis	0.85–1.15	0.85–1.15	0.85–1.15	0.85–1.15	0.85–1.15
Copper, max:					
Heat analysis	0.40	0.25	0.25	0.20	0.25
Product analysis	0.43	0.28	0.28	0.23	0.28
Nickel, max:					
Heat analysis	0.40	0.25	0.25	0.25	0.25
Product analysis	0.43	0.28	0.28	0.28	0.28
Vanadium:					
Heat analysis	0.03 max	0.02 max	0.20–0.30	0.25–0.35	0.20–0.30
Product analysis	0.04 max	0.03 max	0.18–0.33	0.23–0.37	0.18–0.33
Titanium:					
Heat analysis	...	...	0.015–0.035	0.030 max	...
Product analysis	...	...	0.005–0.045	0.035 max	...
Boron:					
Heat analysis	...	...	0.001–0.003	0.0020 max	...
<del>Product analysis</del>	...	...	NA <sup>C</sup>	NA <sup>C</sup>	...
Product analysis	...	...	...	...	...
Columbium:					
Heat analysis	...	...	...	0.07 max	0.015–0.070
Product analysis	...	...	...	0.08 max	0.010–0.075
Calcium: <sup>D</sup>					
<del>Heat analysis</del>	...	...	...	0.015 max	0.0005–0.0150
<del>Product analysis</del>	...	...	...	0.020 max	NA <sup>C</sup>

<sup>A</sup>In A542/A542M–82 and earlier editions, for plates 5 in. [125 mm] and under in thickness, the carbon was limited to 0.15% maximum.

<sup>B</sup>Applies to both heat analysis and product analysis.

<sup>C</sup>NA = Product analysis is *not applicable*.

<sup>D</sup>Rare earth metals (REM) may be added in place of calcium, subject to agreement between the producer and the purchaser. In that case, the total amount of REM shall be determined and reported.