



Designation: A 356/A 356M – 98 (Reapproved 2003)

Standard Specification for Steel Castings, Carbon, Low Alloy, and Stainless Steel, Heavy-Walled for Steam Turbines¹

This standard is issued under the fixed designation A 356/A 356M; 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 specification covers one grade of martensitic stainless steel and several grades of ferritic steel castings for cylinders (shells), valve chests, throttle valves, and other heavy-walled castings for steam turbine applications.

1.2 Optional supplementary requirements (S1 through S5) shall apply as selected by and specified by the purchaser.

1.3 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 370 Test Methods and Definitions for Mechanical Testing of Steel Products²

A 488/A 488M Practice for Steel Castings, Welding, Qualifications of Procedures and Personnel³

E 94 Guide for Radiographic Examination⁴

E 125 Reference Photographs for Magnetic Particle Indications on Ferrous Castings⁴

E 142 Method for Controlling Quality of Radiographic Testing⁵

E 165 Test Method for Liquid Penetrant Examination⁴

E 186 Reference Radiographs for Heavy-Walled (2 to 4 1/2-in. [51 to 114-mm]) Steel Castings⁴

E 280 Reference Radiographs for Heavy-Walled (4 1/2 to 12-in. [114 to 305-mm]) Steel Castings⁴

E 446 Reference Radiographs for Steel Castings Up to 2 in. [51 mm] in Thickness⁴

¹ This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel, and Related Alloys and is the direct responsibility of Subcommittee A01.18 on Castings.

Current edition approved April 10, 2003. Published April 2003. Originally approved in 1952. Last previous edition approved in 1998 as A 356/A 356M – 98^{ε1}.

² Annual Book of ASTM Standards, Vol 01.03.

³ Annual Book of ASTM Standards, Vol 01.02.

⁴ Annual Book of ASTM Standards, Vol 03.03.

⁵ Discontinued. Replaced by E 94. See 1999 Annual Book of ASTM Standards, Vol 03.03.

E 709 Guide for Magnetic Particle Examination⁴

2.2 *Manufacturers' Standardization Society of the Valve and Fitting Industry Standard:*

SP-55 Quality Standard for Steel Castings for Valves, Flanges, and Fittings and Other Piping Components (Visual Method)⁶

3. Classification

3.1 The castings are furnished in the grades shown in Table 1.

4. Ordering Information

4.1 Orders for material to this specification should include the following information:

4.1.1 A description of the casting by pattern number or drawing (dimensional tolerances shall be included on the casting drawing),

4.1.2 Grade of steel,

4.1.3 Options in the specification, and

4.1.4 The supplementary requirements desired, including the standards of acceptance.

5. Melting Process

5.1 The steel shall be made by the open-hearth or electric-furnace process.

5.2 *Deoxidation Practice:*

5.2.1 Deoxidation of the carbon and low-alloy steel grades shall be by manganese and silicon. Furnace or ladle deoxidation with other agents is permissible with the approval of the purchaser.

5.2.2 The purchaser may specify that no aluminum be added.

5.2.3 Vacuum deoxidation is acceptable. The specific method shall be subject to approval by the purchaser.

6. Heat Treatment

6.1 *Preliminary Heat Treatment*—The castings may receive such preliminary heat treatment as the founder may elect to employ.

6.2 *Heat Treatment for Final Properties:*

⁶ Available from the Manufacturers' Standardization Society of the Valve and Fittings Industry, 127 Park St., NE, Vienna, VA 22180.



TABLE 1 Chemical Requirements

Grade	Material	Composition, %											
		Carbon	Manganese	Silicon	Phosphorus, max	Sulfur, max	Molybdenum	Chromium	Nickel	Vanadium	Columbium	Nitrogen	Aluminum
1	carbon steel	0.35 ^A max	0.70 ^A max	0.60 max	0.035	0.030	...	...	...	...	...	...	
2	½% molybdenum	0.25 ^A max	0.70 ^A max	0.60 max	0.035	0.030	0.45-0.65	...	...	...	...	...	
5	½% chromium, ½ % molybdenum	0.25 ^A max	0.70 ^A max	0.60 max	0.035	0.030	0.40-0.60	0.40-0.70	...	...	...	...	
6	1 ¼% chromium, ½ % molybdenum	0.20 max	0.50-0.80	0.60 max	0.035	0.030	0.45-0.65	1.00-1.50	...	...	...	...	
8	1 % chromium, 1 % molybdenum, vanadium	0.20 max	0.50-0.90	0.20-0.60	0.035	0.030	0.90-1.20	1.00-1.50	0.05-0.15	...	...	...	
9	1 % chromium, 1 % molybdenum, vanadium	0.20 max	0.50-0.90	0.20-0.60	0.035	0.030	0.90-1.20	1.00-1.50	0.20-0.35	...	...	...	
10	2 ¼% chromium, 1 % molybdenum	0.20 max	0.50-0.80	0.60 max	0.035	0.030	0.90-1.20	2.00-2.75	...	...	...	...	
12 (J80490)	9 % chromium, 1 % molybdenum, vanadium	0.08-0.12	0.30-0.60	0.20-0.50	0.02 max	0.010 max	0.85-1.05	8.0-9.5	0.40 max	0.18-0.25	0.06-0.10	0.03-0.07	
CA6NM	martensitic chromium nickel	0.06 max	1.00 max	1.00 max	0.040	0.030	0.4-1.0	11.5-14.0	3.5-4.5	...	...	...	
												0.04 max	

^A For each 0.01 % reduction in carbon below the maximum specified, an increase of 0.04 percentage points of manganese over the maximum specified for that element will be permitted up to 1.00.