Designation: A 389/A 389M – 03 (Reapproved 2007)

Standard Specification for Steel Castings, Alloy, Specially Heat-Treated, for Pressure-Containing Parts, Suitable for High-Temperature Service[1]

This standard is issued under the fixed designation A 389/A 389M; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification covers alloy steel castings, which have been subjected to special heat treatment, for valves, flanges, fittings, and other pressure-containing parts (Note 1) intended primarily for high-temperature service.

1.2 The high-temperature properties of the materials covered in this specification are dependent upon special heat treatment that is required. Although the high-temperature properties are not specified, they are implied by control of chemistry, heat treatment, and room-temperature properties.

1.3 Two grades of ferritic alloy steel are covered (Note 2). Selection will depend on the design and service conditions, mechanical properties, and high-temperature characteristics.

NOTE 1—Carbon steel castings for pressure-containing parts are covered by Specification A 216/A 216M. Alloy steel castings are covered by Specification A 217/A 217M.

NOTE 2—The grades covered by this specification represent materials that are generally suitable for assembly with other castings or wrought steel parts by fusion welding. It is not intended to imply that these grades possess equal degrees of weldability; therefore, it is the responsibility of the purchaser to establish for himself a suitable welding technique. Since these grades possess varying degrees of suitability for resistance to oxidation and for high-temperature service, it is also the responsibility of the purchaser to determine which grade shall be furnished, due consideration being given to the requirements of the applicable construction codes.

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:* [2]

A 216/A 216M Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service

A 217/A 217M Specification for Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service

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

A 703/A 703M Specification for Steel Castings, General Requirements, for Pressure-Containing Parts

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

SP-55 Quality Standard for Steel Castings for Valves, Flanges, and Fittings and other Components (Visual Method)[3]

3. General Conditions for Delivery

3.1 Material furnished to this specification shall conform to the requirements of Specification A 703/A 703M, including any supplementary requirements that are indicated in the purchase order. Failure to comply with the general requirements of A 703/A 703M constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and A 703/A 703M, this specification shall prevail.

4. Ordering Information

4.1 The inquiry and order should include or indicate the following:

[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.

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[2] 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.

[3] Available from Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), 127 Park St., NE, Vienna, VA 22180-4602, http://www.mss-hq.com.

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

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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. Heat Treatment

5.1 All castings shall receive a heat treatment proper to their design and chemical composition. Heat treatment shall be performed before machining except in instances when reheat treating is necessary. All castings shall have been allowed to cool, after pouring, to a temperature below the critical range before heat treatment.

5.2 At the option of the manufacturer the castings may be given any preliminary heat treatment that will aid in their processing.

5.3 All castings shall receive a final heat treatment consisting of normalizing and tempering at the temperature prescribed for each grade in Table 1.

5.4 Furnace temperatures for heat treating shall be effectively controlled by use of pyrometers.

6. Chemical Composition

6.1 The steel shall conform to the requirements as to chemical composition prescribed in Table 2.

7. *Tensile Requirements* Tensile Requirements

7.1 Steel used for the castings shall conform to the requirements as to tensile properties prescribed in Table 3.

8. Quality

8.1 The surface of the casting shall be examined visually and shall be free of adhering sand, scale, cracks, and hot tears. Other surface discontinuities shall meet the visual acceptance standards specified in the order. Visual Method SP-55 or other visual standards may be used to define acceptable surface discontinuities and finish. Unacceptable visual surface discontinuities shall be removed and their removal verified by visual examination of the resultant cavities. When methods involving high temperature are used in the removal of discontinuities, castings shall be preheated to at least the minimum temperatures in Table 4.

8.2 The castings shall not be peened, plugged, or impregnated to stop leaks.

9. Repair by Welding

9.1 Repair shall be made by using a welding procedure and operators qualified in accordance with Practice A 488/A 488M.

TABLE 1 Heat Treating Temperatures

Grade	Normalizing Temperature, °F[°C]	Tempering	
		Temperature, °F[°C]	Holding Time, h
C23	1850–1950 [1010–1065]	1250–1350 [675–730]	1[A]
C24	1850–1950 [1010–1065]	1250–1350 [675–730]	12

[A] Per inch or less of thickness.

TABLE 2 Chemical Requirements

Grade (UNS No.)	Composition, %	
	C23 (J12080)	C24 (J12092)
Carbon, max	0.20	0.20
Manganese	0.30–0.80	0.30–0.80
Phosphorus, max	0.04	0.04
Sulfur, max	0.045	0.045
Silicon, max	0.60	0.60
Chromium	1.00–1.50	0.80–1.25
Molybdenum	0.45–0.65	0.90–1.20
Vanadium	0.15–0.25	0.15–0.25

TABLE 3 Tensile Requirements

Grade	C23	C24
Tensile strength, min, ksi [MPa]	70 [483]	80 [552]
Yield strength,[A] min, ksi [MPa]	40 [276]	50 [345]
Elongation in 2 in. [50 mm], min, %[B]	18.0	15.0
Reduction of area, min, %	35.0	35.0

[A] Determine by either 0.2 % offset or 0.5 % extension-under-load method.
[B] When ICI test bars are used in tensile testing as provided for in Specification A 703/A 703M, the gage length to reduced section diameter ratio shall be 4 to 1.

TABLE 4 Minimum Preheat Temperature

Grade	Minimum Preheat Temperature, °F[°C]
C23	300 [150]
C24	300 [150]

The composition of the deposit weld material shall be similar to that of the casting, or of other composition as may be agreed upon between the manufacturer and the purchaser. The castings after complement of weld repairing shall be retempered except that local tempering of the weld repairs will be permitted if, in the manufacturer's opinion, complete furnace-heat treatment would be damaging to the finished surfaces of a machined casting. Heat treatments after weld repair other than tempering shall be performed only when agreed upon between the manufacturer and the purchaser.

9.2 Weld repairs shall be considered major in the case of a casting that had leaked on hydrostatic test, or when the depth of cavity prepared for welding exceeds 20 % of the actual wall thickness or 1 in. [25.4 mm], whichever is smaller, or when the extent of the cavity exceeds approximately 10 in.^{2} [64.5 cm^2]. When requested by the purchaser's inspector, such weld repairs shall be subject to his approval. He shall also have the right to require complete reheat treatment of the repaired casting in accordance with 5.3. When mutually agreed upon between the purchaser and the manufacturer, major repair weld may be examined at the manufacturer's expense by magnetic particle examination or radiographing, or both, to check the adequacy of the repair.

10. Keywords

10.1 steel castings; alloy steel; pressure containing parts; high temperature applications

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SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall not apply unless specified in the purchase order. A list of standardized supplementary requirements for use at the option of the purchaser is included in Specification A 703/A 703M. Those which are ordinarily considered suitable for use with this specification are given below. Others enumerated in Specification A 703/A 703M may be used with this specification upon agreement between the manufacturer and purchaser.

S1. Residual Elements Chemical Analysis
S2. Destruction Tests
S3. Bend Tests
S4. Magnetic Particle Inspection
S5. Radiographic Inspection
S10. Examination of Weld Preparation

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes made to this standard since the last issue (A 389/A 389M–93 (1998)) that may impact the use of this standard.

(1) Added the UNS Numbers to the grades in Table 2.

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