



Designation: **A351/A351M—12a** A351/A351M – 12b

# Standard Specification for Castings, Austenitic, for Pressure-Containing Parts<sup>1</sup>

This standard is issued under the fixed designation A351/A351M; 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 ( $\epsilon$ ) 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<sup>2</sup> covers austenitic steel castings for valves, flanges, fittings, and other pressure-containing parts (**Note 1**).

NOTE 1—Carbon steel castings for pressure-containing parts are covered by Specification **A216/A216M**, low-alloy steel castings by Specification **A217/A217M**, and duplex stainless steel castings by Specification **A995/A995M**.

1.2 A number of grades of austenitic steel castings are included in this specification. Since these grades possess varying degrees of suitability for service at high temperatures or in corrosive environments, it is the responsibility of the purchaser to determine which grade shall be furnished. Selection will depend on design and service conditions, mechanical properties, and high-temperature or corrosion-resistant characteristics, or both.

1.2.1 Because of thermal instability, Grades CE20N, CF3A, CF3MA, and CF8A are not recommended for service at temperatures above 800°F [425°C].

~~1.2.2 Because of embrittlement phases, Grade CD4MCu is not recommended for service at temperatures above 600°F [316°C].~~

1.3 Supplementary requirements of an optional nature are provided for use at the option of the purchaser. The Supplementary requirements shall apply only when specified individually by the purchaser in the purchase order or contract.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.4.1 This specification is expressed in both inch-pound units and in SI units; however, unless the purchase order or contract specifies the applicable M specification designation (SI units), the inch-pound units shall apply. Within the text, the SI units are shown in brackets or parentheses.

## 2. Referenced Documents

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

**A216/A216M** Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service

**A217/A217M** Specification for Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service

**A488/A488M** Practice for Steel Castings, Welding, Qualifications of Procedures and Personnel

**A703/A703M** Specification for Steel Castings, General Requirements, for Pressure-Containing Parts

**A985/A985M** Specification for Steel Investment Castings General Requirements, for Pressure-Containing Parts

**A995/A995M** Specification for Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts

**E165** Practice for Liquid Penetrant Examination for General Industry

**E709** Guide for Magnetic Particle Testing

2.2 *Manufacturers Standardization Society of the Valve and Fittings Industry Standard*:<sup>4</sup>

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

## 3. General Conditions for Delivery

3.1 Other than investment castings – Material furnished to this specification shall conform to the requirements of Specification **A703/A703M**, including any supplementary requirements that are indicated in the purchase order. Failure to comply with the general requirements of Specification **A703/A703M** constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and Specification **A703/A703M**, this specification shall prevail.

3.2 Investment Castings – Material furnished to this specification shall conform to the requirements of Specification **A985/A985M**, including any supplementary requirements that are indicated in the purchase order. Failure to comply with the

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

general requirements of Specification **A985/A985M** constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and Specification **A985/A985M**, Specification **A985/A985M** shall prevail.

3.3 The post weld heat treatment requirements of Supplementary Requirement S11 may be specified when austenitic castings other than HK, HT, or CT15C are to be subjected to severe corrosive service.

#### 4. Ordering Information

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

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 Supplementary requirements desired, including the standards of acceptance.

#### 5. Process

5.1 The steel shall be made by the electric furnace process with or without separate refining such as argon-oxygen decarburization (AOD).

#### 6. Heat Treatment

6.1 All castings shall receive a heat treatment at the temperature specified in **Table 1**, followed by a quench in water or rapid cool by other means except as noted.

NOTE 2—Proper heat treatment of these alloys is usually necessary to enhance corrosion resistance and in some cases to meet mechanical properties. Minimum heat-treat temperatures are specified; however, it is sometimes necessary to heat-treat at higher temperatures, hold for some minimum time at temperature, and then rapidly cool the castings in order to enhance the corrosion resistance and meet mechanical properties.

#### 7. Chemical Composition

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

#### 8. Tensile Properties

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

#### 9. Quality

9.1 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.

<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 **A01.18** on Castings.

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<sup>2</sup> For ASME Boiler and Pressure Vessel Code applications, see related Specification SA-351/SA-351M in Section II of that code.

<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.

<sup>4</sup> 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>.

**TABLE 1 Heat-Treatment Requirements**

Grade	Temperature, min	
	°F	°C
HK30, HK40, HT30, CT15C	as-cast	as-cast
CF3, CF3A, CF8, CF8A, CF3M, CF3MA, CF8M, CF3MN, CG3M, CF10, CF10M, CG8M	1900	1040
CF10SMnN, CF8C, CF10MC	1950	1065
CN7M, CG6MMN	2050	1120
CK3MCuN, CN3MN, CH8, CH10, CH20, CK20	2100	1150
CE20N <sup>4</sup>	2225	1220

<sup>4</sup> Grade shall be quenched in water or the castings may be furnace cooled to 2050°F [1120°C] minimum, held for 15 min minimum and then quenched in water or rapidly cooled by other means.



TABLE 2 Chemical Requirements

NOTE 1—CE8MN, CD4MCu and CD3MWCuN have been deleted from this specification and added to Specification A995/A995M. They may now be supplied and purchased in compliance with Specification A995/A995M as grades 2A, 1B and 6A respectively.

Element, % (max, except where range is given)	CF3, CF3A J92700	CF8, CF8A J92600	CF3M, CF3MA J92800	CF8M J92900	CF3MN J92804	CF8C J92710	CF10 J92950	CF10M J92901	CH8 J93400	CH10 J93401	CH20 J93402	CK20 J94202	HK30 J94203	HK40 J94204
Carbon	0.03	0.08	0.03	0.08	0.03	0.08	0.04– 0.10	0.04– 0.10	0.08	0.04– 0.10	0.04– 0.20	0.04– 0.20	0.25– 0.35	0.35– 0.45
Manganese	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Silicon	2.00	2.00	1.50	1.50	1.50	2.00	2.00	1.50	1.50	2.00	2.00	1.75	1.75	1.75
Sulfur	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
Phosphorus	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
Chromium	17.0– 21.0	18.0– 21.0	17.0– 21.0	18.0– 21.0	17.0– 21.0	18.0– 21.0	18.0– 21.0	18.0– 21.0	22.0– 26.0	22.0– 26.0	22.0– 26.0	23.0– 27.0	23.0– 27.0	23.0– 27.0
Nickel	8.0– 12.0	8.0– 11.0	9.0– 13.0	9.0– 12.0	9.0– 13.0	9.0– 12.0	8.0– 11.0	9.0– 12.0	12.0– 15.0	12.0– 15.0	12.0– 15.0	19.0– 22.0	19.0– 22.0	19.0– 22.0
Molybde- num	0.50	0.50	2.0– 3.0	2.0– 3.0	2.0– 3.0	0.50	0.50	2.0– 3.0	0.50	0.50	0.50	0.50	0.50	0.50
Columbium (niobium)	...	...	...	...	...	<sup>A</sup>	...	...	...	...	...	...	...	...
Vanadium	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Nitrogen	...	...	...	...	0.10– 0.20	...	...	...	...	...	...	...	...	...
Copper	...	...	...	...	...	...	...	...	...	...	...	...	...	...

  

Element, % (max, except where range is given)	HT30 N08030	CF10MC	CN7M N08007	CN3MN J94651	CG- 6MMN J93790	CG8M J93000	CF10S- MnN J92972	CT15C N08151	CK- 3MCuN J93254	CE20N J92802	CG3M J92999
Carbon	0.25– 0.35	0.10	0.07	0.03 max	0.06	0.08	0.10	0.05– 0.15	0.025	0.20	0.03
Manganese	2.00	1.50	1.50	2.00 max	4.00– 6.00	1.50	7.00– 9.00	0.15– 1.50	1.20	1.50	1.50
Silicon	2.50	1.50	1.50	1.00 max	1.00	1.50	3.50– 4.50	0.50– 1.50	1.00	1.50	1.50
Sulfur	0.040	0.040	0.040	0.010 max	0.030	0.04	0.030	0.03	0.010	0.040	0.04
Phosphorus	0.040	0.040	0.040	0.040 max	0.040	0.04	0.060	0.03	0.045	0.040	0.04
Chromium	13.0– 17.0	15.0– 18.0	19.0– 22.0	20.0– 22.0	20.50– 23.50	18.0– 21.0	16.0– 18.0	19.0– 21.0	19.5– 20.5	23.0– 26.0	18.0– 21.0
Nickel	33.0– 37.0	13.0– 16.0	27.5– 30.5	23.5– 25.5	11.50– 13.50	9.0– 13.0	8.0– 9.0	31.0– 34.0	17.5– 19.5	8.0– 11.0	9.0– 13.0
Molybde- num	0.50	1.75– 2.25	2.0– 3.0	6.0– 7.0	1.50– 3.00	3.0– 4.0	...	...	6.0– 7.0	0.50	3.0– 4.0
Columbium (niobium)	...	<sup>B</sup>	...	...	0.10– 0.30	...	...	0.50– 1.50	...	...	...
Vanadium	...	...	...	...	0.10– 0.30	...	...	...	...	...	...
Nitrogen	...	...	...	0.18– 0.26	0.20– 0.40	...	0.08– 0.18	...	0.18– 0.24	0.08– 0.20	...
Copper	...	...	3.0– 4.0	0.75 max	...	...	...	...	0.50– 1.00	...	...

<sup>A</sup> Grade CF8C shall have a columbium content of not less than 8 times the carbon content but not over 1.00 %.

<sup>B</sup> Grade CF10MC shall have a columbium content of not less than 10 times the carbon content but not over 1.20 %.

9.2 When additional inspection is desired, Supplementary Requirements S5, S6, and S10 may be ordered.

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

**10. Repair by Welding**

10.1 Repairs shall be made using procedures and welders qualified under Practice A488/A488M.