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Standard Specification for Castings, Austenitic, for Pressure-Containing Parts[1]

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 (ε) indicates an editorial change since the last revision or reapproval.

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

1. Scope*

1.1 This specification[2] 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].

1.3 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:*[3]

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:*[4]

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

[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 ASME Boiler and Pressure Vessel Code applications, see related Specification SA-351/SA-351M in Section II of that code.

[3] 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.

[4] 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**

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 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

TABLE 1 Heat-Treatment Requirements

Grade	Temperature, min	
	°F	°C
HK30, HK40, HT30, CT15C, HG10MnN	as-cast	as-cast
CF3, CF3A, CF8, CF8A, CF3M, CF3MA, CF8M, CF3MN, CG3M, CF10, CF10M, CG8M	1900	1040
CF10SMnN, CF8C, CF10MC	1950	1065
CN7M, CG6MMnN	2050	1120
CH8, CH10, CH20, CK20	2100	1150
CK3MCuN, CN3MN[B]	2200	1200
CE20N[A]	2225	1220

[A] 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.

[B] Castings of these grades shall be held at the specified temperature for a minimum of 4 hours.

TABLE 2 Chemical Requirements

NOTE 1—CE8MN and CD3MWCuN have been deleted from this specification and added to Specification A995/A995M as Grades 2A and 6A respectively. CD4MCu has also been removed. Specification A995/A995M Grade 1B, CD4MCuN, is an acceptable substitute.

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	HG10MNN J92604	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	0.07–0.11	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	3.0–5.0	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	0.70	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	0.030	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	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	18.5–20.5	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	11.5–13.5	19.0–22.0	19.0–22.0
Molybdenum	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	0.25–0.45	0.50	0.50
Columbium (niobium)	...	...	...	...	...	[A]	...	...	...	...	...	...	[C]	...	...
Vanadium	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Nitrogen	...	...	...	...	0.10–0.20	...	...	...	...	...	...	...	0.20–0.30	...	...
Copper	...	...	...	...	...	...	...	...	...	...	...	...	0.50	...	...

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	4.0–6.0	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	20.5–23.5	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	11.5–13.5	9.0–13.0	8.0–9.0	31.0–34.0	17.5–19.5	8.0–11.0	9.0–13.0
Molybdenum	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)	...	[B]	...	...	0.10–0.30	...	...	0.50–1.50	...	...	...
Vanadium	...	...	...	...	0.10–	...	...	...	...	...	...

~~TABLE 2 Continued~~

~~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~~
~~—~~	~~—~~	~~—~~	~~—~~	~~—~~	~~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~~	~~...~~	~~...~~
~~—~~											

TABLE 2 Chemical Requirements

NOTE 1—CE8MN and CD3MWCuN have been deleted from this specification and added to Specification A995/A995M as Grades 2A and 6A respectively. CD4MCu has also been removed. Specification A995/A995M Grade 1B, CD4MCuN, is an acceptable substitute

	Element, % (max, except where range is given)											
Material Grade	Carbon	Manganese	Silicon	Sulfur	Phosphorus	Chromium	Nickel	Molybdenum	Columbium (Niobium)[D]	Vanadium	Nitrogen	Copper
CE20N J92802	0.20	1.50	1.50	0.040	0.040	23.0–26.0	8.0–11.0	0.50	...	...	0.08–0.20	...
CF3, CF3A J92700	0.03	1.50	2.00	0.040	0.040	17.0–21.0	8.0–12.0	0.50	...	...	...	...
CF8, CF8A J92600	0.08	1.50	2.00	0.040	0.040	18.0–21.0	8.0–11.0	0.50	...	...	...	...
CF3M, CF3MA J92800	0.03	1.50	1.50	0.040	0.040	17.0–21.0	9.0–13.0	2.0–3.0	...	...	...	...
CF8M J92900	0.08	1.50	1.50	0.040	0.040	18.0–21.0	9.0–12.0	2.0–3.0	...	...	...	...
CF3MN J92804	0.03	1.50	1.50	0.040	0.040	17.0–21.0	9.0–13.0	2.0–3.0	...	...	0.10–0.20	...
CF8C J92710	0.08	1.50	2.00	0.040	0.040	18.0–21.0	9.0–12.0	0.50	[A]	...	...	...
CF10 J92950	0.04–0.10	1.50	2.00	0.040	0.040	18.0–21.0	8.0–11.0	0.50	...	...	...	...
CF10M J92901	0.04–0.10	1.50	1.50	0.040	0.040	18.0–21.0	9.0–12.0	2.0–3.0	...	...	...	...
CF10MC	0.10	1.50	1.50	0.040	0.040	15.0–18.0	13.0–16.0	1.75–2.25	[B]	...	...	...
CF10SMnN J92972	0.10	7.00–9.00	3.50–4.50	0.030	0.060	16.0–18.0	8.0–9.0	...	...	...	0.08–0.18	...
CG3M J92999	0.03	1.50	1.50	0.04	0.04	18.0–21.0	9.0–13.0	3.0–4.0	...	...	...	...