Designation: A 995/A 995M – 98 (Reapproved 2007)

Standard Specification for Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts[1]

This standard is issued under the fixed designation A 995/A 995M; 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 austenitic-ferritic (duplex) stainless steel castings for valves, flanges, fittings, and other pressure-containing parts.

1.2 The duplex stainless steels offer a combination of enhanced mechanical properties and corrosion resistance when properly balanced in composition and properly heat treated. Ferrite levels are not specified, but these grades will develop a range of approximately 30 to 60 % ferrite with the balance austenite. It is the responsibility of the purchaser to determine which grade shall be furnished depending on design and service conditions, mechanical properties, and corrosion-resistant characteristics.

NOTE 1—Because of the possibility of precipitation of embrittling phases, the grades included in this specification are not recommended for service at temperatures above 600°F [315°C].

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:* [2]

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

E 125 Reference Photographs for Magnetic Particle Indications on Ferrous Castings

E 165 Test Method for Liquid Penetrant Examination

E 562 Test Method for Determining Volume Fraction by Systematic Manual Point Count

TABLE 1 Heat Treatment Requirements

Grade	Heat Treatment
1B	Heat to 1900°F [1040°C] minimum, hold for sufficient time to heat casting uniformly to temperature, quench in water or rapid cool by other means.
2A	Heat to 2050°F [1120°C] minimum, hold for sufficient time to heat casting uniformly to temperature, quench in water or rapid cool by other means.
3A	Heat to 1950°F [1070°C] minimum, hold for sufficient time to heat casting uniformly to temperature, quench in water or rapid cool by other means.
4A	Heat to 2050°F [1120°C] minimum for sufficient time to heat casting uniformly to temperature and water quench, or the casting may be furnace cooled to 1850°F [1010°C] minimum, hold for 15 min minimum and then water quench. A rapid cool by other means may be employed in lieu of water quench.
5A	Heat to 2050°F [1120°C] minimum, hold for sufficient time to heat casting to temperature, furnace cool to 1910°F [1045°C] minimum, quench in water or rapid cool by other means.
6A	Heat to 2010°F [1100°C] minimum, hold for sufficient time to heat casting uniformly to temperature, quench in water or cool rapidly by other means.

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *duplex stainless steel*—an iron-chromium-nickel-molybdenum alloy which when properly heat treated consists of approximately 30 to 60 % ferrite with the balance austenite.

4. General Conditions for Delivery

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

5. Ordering Information

5.1 It is the responsibility of the purchaser to specify all requirements that are necessary for material ordered under this specification. Such requirements may included, but are not limited to, 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.

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TABLE 2 Chemical Requirements

Grade	1B	2A	3A	4A	5A[A]	6A[A]
Type	25Cr-5Ni-M0-Cu-N	24Cr-10Ni-Mo-N	25Cr-5Ni-Mo-N	22Cr-5Ni-Mo-N	25Cr-7Ni-Mo-N	25Cr-7Ni-Mo-N
UNS	J93372	J93345	J93371	J92205	J93404	J93380
ACI	CD4MCuN	CE8MN	CD6MN	CD3MN	CE3MN	CD3MWCuN
Composition:						
Carbon, max	0.040	0.080	0.060	0.030	0.030	0.030
Manganese, max	1.00	1.00	1.00	1.50	1.50	1.00
Silicon, max	1.00	1.50	1.00	1.00	1.00	1.00
Phosphorus, max	0.040	0.040	0.040	0.040	0.040	0.030
Sulfur, max	0.040	0.040	0.040	0.020	0.040	0.025
Chromium	24.5-26.5	22.5-25.5	24.0-27.0	21.0-23.5	24.0-26.0	24.0-26.0
Nickel	4.7-6.0	8.0-11.0	4.0-6.0	4.5-6.5	6.0-8.0	6.5-8.5
Molybdenum	1.70-2.30	3.0-4.5	1.75-2.50	2.5-3.5	4.0-5.0	3.0-4.0
Copper	2.7-3.3	. . .	. . .	1.00, max	. . .	0.50-1.00
Tungsten	. . .	. . .	. . .	. . .	. . .	0.50-1.00
Nitrogen	0.10-0.25	0.10-0.30	0.15-0.25	0.10-0.30	0.10-0.30	0.20-0.30

[A] % Cr + 3.3 % Mo + 16 % N ≥ 40.

TABLE 3 Tensile Requirements

Grade	1B	2A	3A	4A	5A	6A
Type	25Cr-5Ni-Mo-Cu-N	24Cr-10Ni-Mo-N	25Cr-5Ni-Mo-N	22Cr-5Ni-Mo-N	25Cr-7Ni-Mo-N	25Cr-7Ni-Mo-N
Tensile strength, ksi [MPa], min	100 [690]	95 [655]	95 [655]	90 [620]	100 [690]	100 [690]
Yield strength (0.2 % offset), ksi [MPa], min	70 [485]	65 [450]	65 [450]	60 [415]	75 [515]	65 [450]
Elongation in 2 in. [50 mm], %, min[A]	16	25	25	25	18	25

[A] When ICI test bars are used in tensile testing as provided for in this specification, the gage length to reduced section diameter ratio shall be 4:1.

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

5.1.2 Quantity (weight and number of castings),

5.1.3 Specification designation and date of issue,

5.1.4 Grade of steel,

5.1.5 Supplementary requirements including acceptance criteria, and

5.1.6 Additional requirements.

6. Process

6.1 The steel shall be made by the electric furnace process with or without separate refining.

7. Heat Treatment

7.1 All castings shall be heat treated in accordance with Table 1.

8. Chemical Composition

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

9. Tensile Properties

9.1 One tension test shall be made from each heat and shall conform to the requirements as to tensile properties prescribed in Table 3.

10. Quality

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

11. Repair by Welding

11.1 Repairs shall be made using procedures and welders qualified under Practice A 488/A 488M.

11.2 The composition of the deposited weld metal may be similar to that of the casting or may be suitably alloyed to achieve the desired corrosion resistance and mechanical properties.

11.3 Weld repairs shall be subject to the same quality standards as used to inspect the castings.

11.4 When postweld heat treatment is believed necessary for adequate corrosion resistance or impact toughness, Supplementary Requirement S11, Post Weld Heat Treatment, shall be included in the purchase order.

12. Post Weld Heat Treatment After Major Weld Repair

12.1 Weld repairs shall be considered major in the case of a casting that has leaked on hydrostatic testing or when the depth of the cavity after preparation for repair exceeds 20 % of the actual wall thickness, or 1 in. [25 mm], whichever is smaller, or when the extent of the cavity exceeds approximately 10 in.^{2} [65 cm^2]. All other weld repairs shall be considered minor.

12.2 Castings shall be heat-treated after major weld repairs. Heat treatment after minor weld repairs is not required except upon agreement between the manufacturer and the purchaser.

12.3 Post weld heat treatment shall be in accordance with Table 1.

13. Keywords

13.1 austenitic-ferritic; duplex stainless steel; pressure-containing; steel castings

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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. Unspecified Elements

S2. Destruction Tests

S5. Radiographic Inspection

S6. Liquid Penetrant Inspection

S8. Charpy Impact Test

S10. Examination of Weld Preparation

S10.1 Liquid penetrant examination of cavities prepared for welding shall be performed to verify removal of those discontinuities found unacceptable by the inspection method specified for the casting. The method of performing liquid penetrant examination shall be in accordance the with Practice E 165. Unless other degrees of shrinkage or types of discontinuities found in the cavities are specified, Type II, Internal Shrinkage, of Reference Photographs E 125, of Degree 2 in sections up to 2 in. [50 mm] thick and of Degree 3 in sections over 2 in. [50 mm] thick shall be acceptable.

S11. Post Weld Heat Treatment

S11.1 Castings shall be given a post weld solution heat treatment in accordance with Table 1.

S12. Prior Approval of Major Weld Repairs

Other supplementary requirements considered suitable for use with this specification are:

S50. Estimating Ferrite Content

S50.1 Ferrite contents shall be determined by point count (Practice E 562), by other quantitative metallographic methods such as image analysis, by measurement of magnetic response, or by other methods upon agreement between the manufacturer and the purchaser. Frequency of testing and location of tests shall be by agreement between the manufacturer and the purchaser.

S51. Prior Approval of Weld Material

S51.1 The purchaser must give approval of all weld filler materials to be used prior to any weld repairs.

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