



Standard Specification for Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts¹

This standard is issued under the fixed designation A995/A995M; 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 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.

2. Referenced Documents

2.1 ASTM Standards:²

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

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

E125 Reference Photographs for Magnetic Particle Indications on Ferrous Castings

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 Dec. 1, 2013. Published December 2013. Originally approved in 1998. Last previous edition approved in 2012 as A995/A995M – 12a. DOI: 10.1520/A0995_A0995M-13.

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.

E165 Practice for Liquid Penetrant Examination for General Industry

E562 Test Method for Determining Volume Fraction by Systematic Manual Point Count

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 A703/A703M, including the supplementary requirements that are indicated on the purchaser order. Failure to comply with the general requirements of Specification A703/A703M constitutes non-conformance with this specification. In case of conflict between the requirements of the specification and Specification A703/A703M, 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:

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.

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

**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.
7A	Heat to 2065°F [1130°C] minimum, hold for sufficient time to heat casting to temperature, furnace cool to 1940°F [1060°C] minimum, quench in water or rapid cool by other means.

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 [A488/A488M](#).

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.

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 cm²]. 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 unless Supplementary Requirement S11 is included in the purchase order.

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



TABLE 2 Chemical Requirements

Grade	1B	2A	3A	4A	5A ^A	6A ^A	7A ^B
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	27Cr-7Ni-Mo-W-N
UNS	J93372	J93345	J93371	J92205	J93404	J93380	J93379
ACI	CD4MCuN	CE8MN	CD6MN	CD3MN	CE3MN	CD3MWCuN	CD3MWN
Composition:							
Carbon, max	0.040	0.080	0.060	0.030	0.030	0.030	0.030
Manganese, max	1.00	1.00	1.00	1.50	1.50	1.00	1.00-3.00
Silicon, max	1.00	1.50	1.00	1.00	1.00	1.00	1.00
Phosphorus, max	0.040	0.040	0.040	0.040	0.040	0.030	0.030
Sulfur, max	0.040	0.040	0.040	0.020	0.040	0.025	0.020
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	26.0-28.0
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	6.0-8.0
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	2.0-3.5
Copper	2.7-3.3	...	...	1.00, max	...	0.50-1.00	1.00 max
Tungsten	...	...	...	...	...	0.50-1.00	3.0-4.0
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	0.30-0.40
Boron	...	...	...	...	...	...	0.0010-0.0100
Barium	...	...	...	...	...	...	0.0002-0.0100
Ce + La	...	...	...	...	...	...	0.005-0.030

^A % Cr + 3.3 % Mo + 16 % N ≥ 40.^B % Cr + 3.3 (% Mo + 0.5 % W) + 16 % N ≥ 45.

TABLE 3 Tensile Requirements

Grade	1B	2A	3A	4A	5A	6A	7A
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	27Cr-7Ni-Mo-W-N
Tensile strength, ksi [MPa], min	100 [690]	95 [655]	95 [655]	90 [620]	100 [690]	100 [690]	100 [690]
Yield strength (0.2 % offset), ksi [MPa], min	70 [485]	65 [450]	65 [450]	60 [415]	75 [515]	65 [450]	75 [515]
Elongation in 2 in. [50 mm], %, min ^A	16	25	25	25	18	25	20

^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.

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 **A703/A703M**. Those which are ordinarily considered suitable for use with this specification are given below. Others enumerated in Specification **A703/A703M** 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 with Practice **E165**. Unless other degrees of shrinkage or types of discontinuities

found in the cavities are specified, Type II, Internal Shrinkage, of Reference Photographs **E125**, 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 E562), 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.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A995/A995M – 12a) that may impact the use of this standard. (Approved Dec. 1, 2013.)

(1) In Table 2 revised the Grade 7A barium range minimum from 0.0010 to 0.0002.

Committee A01 has identified the location of selected changes to this standard since the last issue (A995/A995M – 12) that may impact the use of this standard. (Approved Nov. 1, 2012.)

(1) Corrected	PREN	formula	to	(2) Corrected “Type” to 27Cr-7Ni-Mo-W-N.
%Cr+3.3(%Mo+0.5%W)+16%N≥45.				(3) Added ACI designation CD3MWN.

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org). Permission rights to photocopy the standard may also be secured from the ASTM website (www.astm.org/COPYRIGHT/).