



Standard Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Stainless Steel Pipe for High-Temperature Service and General Applications¹

This standard is issued under the fixed designation A 358/A 358M; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope*

1.1 This specification² covers electric-fusion-welded austenitic chromium-nickel stainless steel pipe suitable for corrosive or high-temperature service, or both, or for general applications.

NOTE 1—The dimensionless designator NPS (nominal pipe size) has been substituted in this standard for such traditional terms as “nominal diameter,” “size,” and “nominal size.”

1.2 This specification covers the grades of alloy and stainless steel listed in Table 1. The selection of the proper grade and requirements for heat treatment shall be at the discretion of the purchaser, dependent on the service conditions to be encountered.

1.3 Five classes of pipe are covered as follows:

1.3.1 *Class 1*—Pipe shall be double welded by processes employing filler metal in all passes and shall be completely radiographed.

1.3.2 *Class 2*—Pipe shall be double welded by processes employing filler metal in all passes. No radiography is required.

1.3.3 *Class 3*—Pipe shall be single welded by processes employing filler metal in all passes and shall be completely radiographed.

1.3.4 *Class 4*—Same as Class 3 except that the weld pass exposed to the inside pipe surface may be made without the addition of filler metal (see 6.2.2.1 and 6.2.2.2).

1.3.5 *Class 5*—Pipe shall be double welded by processes employing filler metal in all passes and shall be spot radiographed.

1.4 Supplementary requirements covering provisions ranging from additional testing to formalized procedures for manufacturing practice are provided. Supplementary Requirements S1 through S6 are included as options to be specified when desired.

1.5 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 be exact equivalents; therefore, each system must shall be used independently of the other. Combining values from the two systems may result in nonconformance with the specification. The inch-pound units shall apply unless the “M” designation of this specification is specified in the order.

2. Referenced Documents

2.1 ASTM Standards:³

A 240/A 240M Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

A 262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels

A 480/A 480M Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

A 941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys

A 999/A 999M Specification for General Requirements for Alloy and Stainless Steel Pipe

E 527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

2.2 ASME Boiler and Pressure Vessel Code:⁴

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 A01.10 on Stainless and Alloy Steel Tubular Products.

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² For ASME Boiler and Pressure Vessel Code applications see related Specifications SA-358 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 American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

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

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Section II, Materials

Section III, Rules for Construction of Nuclear Facility Components

Section VIII, Pressure Vessels

Section IX, Welding and Brazing Qualifications

2.3 *AWS Specifications:*⁵

A 5.22 Flux Cored Arc Welding

A 5.30 Consumable Weld Inserts for Gas Tungsten Arc Welding

A 5.4 Corrosion-Resisting Chromium and Chromium-Nickel Steel Covered Welding Electrodes

A 5.9 Corrosion-Resisting Chromium and Chromium-Nickel Steel Welding Rods and Bare Electrodes

A 5.11 Nickel and Nickel-Alloy Covered Welding Electrodes

A 5.14 Nickel and Nickel-Alloy Bare Welding Rods and Electrodes

2.4 *Other Standard:*⁶

SAE J1086 Practice for Numbering Metals and Alloys (UNS)

3. Terminology

3.1 *Definitions:*

3.1.1 The definitions in Specification A 999/A 999M and Terminology A 941 are applicable to this specification.

4. Ordering Information

4.1 It shall be the responsibility of the purchaser to specify all requirements that are necessary for product under this specification. Such requirements to be considered include, but are not limited to, the following:

4.1.1 Quantity (feet, metres, or number of lengths),

4.1.2 Name of material (electric-fusion-welded pipe),

4.1.3 Grade (Table 1),

4.1.4 Class (see 1.3),

4.1.5 Size (outside diameter and nominal wall thickness),

4.1.6 Length (specific or random),

4.1.7 End finish (Section on Ends of Specification A 999/A 999M),

4.1.8 Authorization for repair of plate defects by welding and subsequent heat treatment without prior approval if such is intended (see 9.3),

4.1.9 Specification designation,

4.1.10 Special requirements,

4.1.11 Statement invoking requirements of 16.4 if such is intended.

4.1.12 Circumferential weld permissibility (see Section 16),

4.1.13 Supplementary Requirements (S1 through S6),

4.1.14 Applicable ASME Code if known,

4.1.15 For ASME Code Section III applications, the service classification intended, and

4.1.16 Certification requirements (see Section on Certification of Specification A 999/A 999M).

5. General Requirements

5.1 Material furnished to this specification shall conform to the applicable requirements of the current edition of Specification A 999/A 999M unless otherwise provided herein.

6. Materials and Manufacture

6.1 *Materials:*

6.1.1 The steel plate material shall conform to the requirements of one of the grades of Specification A 240/A 240M, listed in Table 1, except as provided in 6.3.2.3.

6.2 *Welding:*

6.2.1 The joints shall be full penetration double-welded or single-welded butt joints employing fusion welding processes as defined under "Definitions," ASME Boiler and Pressure Vessel Code, Section IX. This specification makes no provision for any difference in weld quality requirements regardless of the weld joint type employed (single or double) in making the weld. Where backing rings or strips are employed, the ring or strip material shall be of the same P-Number (Table QW-422 of Section IX) as the plate being joined. Backing rings or strips shall be completely removed after welding, prior to any required radiography, and the exposed weld surface shall be examined visually for conformance to the requirements of 6.2.3. Welds made by procedures

⁵ Available from American Welding Society (AWS), 550 NW LeJeune Rd., Miami, FL 33126, <http://www.aws.org>.

⁶ Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.

employing backing strips or rings that remain in place are prohibited. Welding procedures, and welding operators shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX.

6.2.2 Except as provided in 6.2.2.1 and 6.2.2.2, welds shall be made in their entirety by processes involving the deposition of filler metal.

6.2.2.1 For Class 4 pipe employing multiple passes, the root-pass may be without the addition of filler metal.

6.2.2.2 For Class 4 pipe, the weld surface exposed inside the pipe may result from a single pass made from the inside of the pipe without the addition of filler metal.

6.2.2.3 All single-welded pipe shall be completely radiographed.

6.2.3 The weld surface on either side of the weld is permitted to be flush with the base plate or to have a reasonably uniform crown, not to exceed 1/8 in. [3 mm]. It is permitted at the option of the manufacturer or by agreement between the manufacturer and purchaser to remove any weld reinforcement. The contour of the reinforcement should be reasonably smooth and free from irregularities. The deposited metal shall be fused uniformly into the plate surface. No concavity of contour is permitted unless the resulting thickness of weld metal is equal to or greater than the minimum thickness of the adjacent base metal.

6.2.4 Weld defects shall be repaired by removal to sound metal and rewelding. Subsequent heat treatment and examination (that is, visual, radiographic, and dye penetrant) shall be as required on the original welds.

6.3 Heat Treatment:

6.3.1 Unless otherwise stated in the order, all pipe shall be furnished in the heat-treated condition in accordance with the requirements of Table 2.

6.3.2 The purchase order shall specify one of the following conditions if the heat-treated condition specified in 6.3.1 is not desired by the purchaser:

6.3.2.1 *A final heat-treatment temperature under 1900 °F [1040 °C]*—Each pipe supplied under this requirement shall be stenciled with the final heat-treatment temperature in degrees Fahrenheit or degrees Celsius after the suffix “HT”. Controlled structural or special service characteristics may be specified as a guide for the most suitable heat treatment.

6.3.2.2 *No final heat treatment of pipe fabricated of plate that has been solution heat treated at temperatures required by this specification*—Each pipe supplied under this requirement shall be stenciled with the suffix “HT-O”.

6.3.2.3 *No final heat treatment of pipe fabricated of plate that has not been solution heat treated*—Each pipe supplied under this requirement shall be stenciled with the suffix “HT-SO”.

6.4 A solution annealing temperature above 1950 °F [1065 °C] may impair the resistance to intergranular corrosion after subsequent exposure to sensitizing conditions in Grades 321, 321H, 347, 347H, and 348. When specified by the purchaser, a lower temperature stabilization or re-solution anneal shall be used subsequent to the initial high temperature solution anneal (see Supplementary Requirement S5).

7. Chemical Composition

7.1 The chemical composition of the plate shall conform to the requirements of the applicable specification and grade listed in Specification A 240/A 240M.

TABLE 2 Annealing Requirements

Grade or UNS Designation ^A	Heat Treating Temperature ^B	Cooling/Testing Requirements
All grades not individually listed below:	1900 °F [1040 °C]	C
304H, 309S, 309Cb, 310S, 310Cb, 321H, 347H, S22100, S28300,	1900 °F [1040 °C]	D
N08020	1800-1850 °F [980-1010 °C]	D
N08367	2025 °F [1110 °C]	D
N08810	2050 °F [1120 °C]	D
N08904	2000 °F [1095 °C]	D
N08926	2010 °F [1100 °C]	D
S30600	2100 °F [1150 °C]	D
S30815	1920 °F [1050 °C]	D
S31254	2100 °F [1150 °C]	D
S31266	2100 °F [1150 °C]	D
S31727	1975-2175 °F [1080 to 1180 °C]	D
S32050	2100 °F [1150 °C]	D
S32053	1975-2175 °F [1080 to 1180 °C]	D
S32654	2100 °F [1150 °C]	D
S34565	2050 °F [1120 °C]	D

^A New designation established in accordance with Practice E 527 and SAE J1086.

^B Minimum, unless otherwise stated.

^C Quenched in water or rapidly cooled by other means, at a rate sufficient to prevent reprecipitation of carbides, as demonstrable by the capability of passing Practices A 262, Practice E. The manufacturer is not required to run the test unless it is specified on the purchase order (see Supplementary Requirement S7). Note that Practices A 262 requires the test to be performed on sensitized specimens in the low-carbon and stabilized types and on specimens representative of the as-shipped condition for other types. In the case of low-carbon types containing 3 % or more molybdenum, the applicability of the sensitizing treatment prior to testing shall be a matter for negotiation between the seller and the purchaser.

^D Quenched in water or rapidly cooled by other means.