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Used in USDOE-NE Standards

Standard Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Stainless Steel Pipe for High-Temperature Service and General Applications[1]

This standard is issued under the fixed designation A358/A358M; 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[2] 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 may not be exact equivalents; therefore, each system 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]

A240/A240M Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

A262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels

A480/A480M Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

A941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys

A999/A999M Specification for General Requirements for Alloy and Stainless Steel Pipe

E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

2.2 *ASME Boiler and Pressure Vessel Code:*[4]

Section II

Section III

Section VIII

Section IX

[1] This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloysand 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, Two Park Ave., New York, NY 10016-5990, http://www.asme.org.

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

TABLE 1 Plate and Filler Metal Specifications

Grade	UNS Designation	Material, Type	ASTM Plate Specification No. and Grade	Filler Metal Classification and UNS Designation[A] for Applicable[B] AWS Specification											
				A5.4/A5.4M		A5.9/A5.9M		A5.11/A5.11M		A5.14/A5.14M		A5.22/A5.22M		A5.30/A5.30M	
				Class.	UNS	Class.	UNS	Class.	UNS	Class.	UNS	Class.	UNS	Class.	UNS
...	N08020	...	A240/A240M N08020	...	...	...	...	...	...	...	...	...	...	...	...
...	N08367	...	A240/A240M N08367	...	...	...	...	ENiCrMo-3	W86112	ERNiCrMo-3	N06625	...	...	...	...
...	N08700	...	A240/A240M N08700	...	...	...	...	ENiCrMo-3	W86112	ERNiCrMo-3	N06625	...	...	...	...
800[E]	N08800	...	A240/A240M N08800	...	...	...	...	ENiCrFe-3	W86182	ERNiCr-3	N06082	...	...	...	...
800H[E]	N08810	...	A240/A240M N08810	...	...	...	...	ENiCrFe-3[F]	W86182[F]	ERNiCr-3[F]	N06082[F]	...	...	...	...
...	N08811	...	A240/A240M N08811	...	...	...	...	ENiCrFe-3[F]	W86182[F]	ERNiCr-3[F]	N06082[F]				
...	N08904	...	A240/A240M N08904	...	...	...	...	...	...	...	...	...	...	...	...
...	N08926	...	A240/A240M N08926	...	...	...	...	ENiCrMo–3	W86112	ERNiCrMo–3	N06625	...	...	...	...
201	S20100	201	A240/A240M Type 201	...	...	...	...	...	...	...	...	...	...	...	...
201LN	S20153	201LN	A240/A240M Type 201LN	...	...	...	...	...	...	...	...	...	...	...	...
...	S20400	...	A240/A240M S20400	E 209	W32210	ER209	S20980	...	...	...	...	...	...	...	...
XM-19	S20910	XM-19	A240/A240M Type XM-19	E209	W32210	ER209	S20980	...	...	...	...	...	...	...	...
XM-29	S24000	XM-29	A240/A240M Type XM-29	E240	W32410	ER240	S24080	...	...	...	...	...	...	...	...
304	S30400	304	A240/A240M Type 304	E308	W30810	ER308	S30880	...	...	...	...	E308T	W30831	IN308	S30880
304L	S30403	304L	A240/A240M Type 304	E308L	W30813	ER308L	S30883	...	...	...	...	E308LT	W30835	IN308L	S30883
304H	S30409	304H	A240/A240M Type 304H	E308H	W30810	ER308	S30880	...	...	...	...	E308T	W30831	IN308	S30880
...	S30415	...	A240/A240M S30415	...	...	...	...	...	...	...	...	...	...	...	...
304N	S30451	304N	A240/A240M Type 304N	E308	W30810	ER308	S30880	...	...	...	...	E308T	W30831	IN308	S30880
304LN	S30453	304LN	A240/A240M Type 304LN	E308L	W30813	ER308L	S30883	...	...	...	...	E308LTT	W30835	IN308L	S30883
...	S30600[D]	...	A240/A240M S30600[D]	...	...	...	...	...	...	...	...	...	...	...	...
	S30815	...	A240/A240M S30815	...	...	...	...	...	...	...	...	...	...	...	...
309S	S30908	309S	A240/A240M Type 309S	...	...	...	...	...	...	...	...	...	...	...	...
309Cb	S30940	309Nb	A240/A240M Type 309Cb	E309Cb	W30917	...	...	...	...	...	...	...	...	...	...
310S	S31008	310S	A240/A240M Type 310S	...	...	...	...	...	...	...	...	...	...	...	...
310Cb	S31040	310Cb	A240/A240M Type 310Cb	E310NB	W31017	...	...	...	...	...	...	...	...	...	...
...	S31254	...	A240/A240M S31254	...	...	...	...	ENiCrMo-3	W86112	ERNiCrMo-3	N06625	...	...	...	...
...	S31266	...	A240/A240M S31266	...	...	...	...	ENiCrMo–13	W86059	ERNiCrMo–13	N06059	...	...	...	...

TABLE 1 *Continued*

Grade	UNS Designation	Material, Type	ASTM Plate Specification No. and Grade	Filler Metal Classification and UNS Designation[A] for Applicable[B] AWS Specification											
				A5.4/A5.4M		A5.9/A5.9M		A5.11/A5.11M		A5.14/A5.14M		A5.22/A5.22M		A5.30/A5.30M	
				Class.	UNS	Class.	UNS	Class.	UNS	Class.	UNS	Class.	UNS	Class.	UNS
...	S31266	...	A240/A240M S31266	...	...	...	...	ENiCrMo–10	W86022	ERNiCrMo–10	N06022	...	...	...	...
316	S31600	316	A240/A240M Type 316	E316	W31610	ER316	S31680 W31640	...	...	...	...	E316T	W31631	IN316	S31680
316L	S31603	316L	A240/A240M Type 316L	E316L	W31613	ER316L	S31683	...	...	...	...	E316LT	W31635	IN316L	S31683
316H	S31609	316H	A240/A240M Type 316H	E316H	W31610	ER316H	S31680	...	...	...	...	E316T	W31631	IN316	S31680
316N	S31651	316N	A240/A240M Type 316N	E316	W31610	ER316	S31680	...	...	...	...	E316T	W31631	IN316	S31680
316LN	S31653	316LN	A240/A240M Type 316LN	E316L	W31613	ER316L	S31683	...	...	...	...	E316LT	W31635	IN316L	S31683
...	S31655	...	A240/A240M S31655	...	...	...	...	...	...	...	...	...	...	...	...
317	S31700	317	A240/A240M Type 317	E317	W31710	ER 317	S31780	...	...	...	...	E317LT	W31735	...	...
317L	S31703	317L	A240/A240M Type 317L	E317L	W34713	ER317L	S31783	...	...	...	...	E317LT	W31735	...	...
...	S31725	...	A240/A240M S31725	...	...	...	...	ENiCrMo-3	W86112	ERNiCrMo-3	N06625	...	...	...	...
...	S31726	...	A240/A240M S31726	...	...	...	...	ENiCrMo-3	W86112	ERNiCrMo-3	N06625	...	...	...	...
...	S31727	...	A240/A240M S31727	...	...	...	...	...	...	...	...	...	...	...	...
...	S32050	...	A240/A240M S32050	...	...	...	...	...	...	...	...	...	...	...	...
...	S32053	...	A240/A240M S32053	...	...	...	...	...	...	...	...	...	...	...	...
321	S32100	321	A240/A240M Type 321	E347	W34710	ER321 ER347	S32180 S34780	...	...	...	...	E347T	W34731	IN348	S34780
321H[C]	S32109[C]	321H[C]	A240/A240M Type 321H[C]		W34710	ER321 ER347	S32180 S34780					E347T	W34731	IN348	S34780
...	S32654	...	A240/A240M S32654	...	...	...	...	...	...	...	...	...	...	...	...
...	S34565	...	A240/A240M S34565	...	...	...	...	...	...	...	...	...	...	...	...
347	S34700	347	A240/A240M Type 347	E347	W34710	ER347	S34780	...	...	...	...	E347T	W34731	IN348	S34780
347H[C]	S34709[C]	347H[C]	A240/A240M Type 347H[C]			ER347	S34780					E347T	W34731	IN348	S34780
347LN	S34751		A240/A240M Type 347LN	...	...	...	...	...	...	...	...	...	...	...	...
348	S34800	348	A240/A240M Type 348	E347	W34710	ER347	S34780	...	...	...	...	E347T	W34731	IN348	S34780

[A] New designation established in accordance with Practice E527 and SAE J1086.
[B] Choice of American Welding Society specification depends on the welding process used.
[C] Minimum carbon content of the filler metal shall be 0.040 mass %.
[D] In previous editions, S30600 was incorrectly shown as S01815.
[E] Common name, not a trademark, widely used, not associated with any one producer.
[F] These filler metals have a high nickel content and, therefore, lower creep strength than the parent metal at temperatures exceeding about 1470 °F [800 °C], and its resistance to sulphurous media is inferior in certain cases.

2.3 *AWS Specifications:*[5]

A5.4/A5.4M Stainless Steel Electrodes for Shielded Metal Arc Welding

A5.9/A5.9M Bare Stainless Steel Welding Electrodes and Rods

A5.11/A5.11M Nickel and Nickel-Alloy Welding Electrodes for Shielded Metal Arc Welding

A5.14/A5.14M Nickel and Nickel-Alloy Bare Welding Electrodes and Rods

A5.22/A5.22M Stainless Steel Flux Cored and Metal Cored Welding Electrodes and Rods

A5.30/A5.30M Consumable Inserts

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 A999/A999M and Terminology A941 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 A999/A999M),

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 S8),

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 A999/A999M).

5. General Requirements

5.1 Material furnished to this specification shall conform to the applicable requirements of the current edition of Specification A999/A999M 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 A240/A240M, 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 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 ⅛ 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

[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.

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]
N08700	2000 °F [1095 °C]	[D]
N08810	2050 °F [1120 °C]	[D]
N08811	2100 °F [1150 °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 E527 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 A262, 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 A262 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.

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 A240/A240M.

7.2 Except for Grade S34751, the chemical composition of the welding filler metal shall conform to the requirements of the applicable AWS specification for the corresponding grade shown in Table 1, or shall conform to the chemical composition specified for the plate in Specification A240/A240M, or shall, subject to purchaser approval, be a filler metal more highly alloyed than the base metal when needed for corrosion resistance or other properties. Use of a filler metal other than that listed in Table 1 or conforming to the chemical composition specified for the plate in Specification A240/A240M shall be reported and the filler metal identified on the certificate of tests. When nitrogen and cerium are specified elements for the ordered grade, the method of analysis for these elements shall be a matter of agreement between the purchaser and the manufacturer.

7.3 The chemical composition of the welding filler metal for Grade S34751 shall conform to the chemical composition specified for the plate in Specification A240/A240M. The method for analysis for nitrogen shall be a matter of agreement between the purchaser and the manufacturer.

8. Permissible Variations in Dimensions

8.1 *Permissible Variations*—The dimensions at any point in a length of pipe shall not exceed the following:

8.1.1 *Outside Diameter*—Based on circumferential measurement, ±0.5 % of the specified outside diameter.

8.1.2 *Out-of-Roundness*—Difference between major and minor outside diameters, 1 %.

8.1.3 *Alignment*—Using a 10-ft [3-m] straightedge placed so that both ends are in contact with the pipe, ⅛ in. [3 mm] deviation from contact with the pipe.

8.1.4 *Thickness*—The minimum wall thickness at any point in the pipe shall not be more than 0.01 in. [0.3 mm] under the nominal thickness.

9. Workmanship, Finish, and Appearance

9.1 The finished pipe shall have a workmanlike finish.

9.2 *Repair of Plate Defects by Machining or Grinding*—It is permitted to repair pipes showing slivers, or other surface defects, by machining or grounding inside or outside to a depth that ensures the removal of all included scale and slivers, provided that the wall thickness is not reduced below the specified minimum wall thickness. Machining or grinding shall

follow inspection of the pipe as rolled, and shall be followed by supplementary visual inspection.

9.3 *Repair of Plate Defects by Welding*—It is permitted to repair by welding defects that violate minimum wall thickness, but only with the approval of the purchaser. Areas shall be suitably prepared for welding with tightly closed defects removed by grinding. Open, clean defects, such as pits or impressions, may require no preparation. All welders, welding operators, and weld procedures shall be qualified to the ASME Boiler and Pressure Vessel Code, Section IX. Unless the purchaser specifies otherwise, pipe required to be heat treated under the provisions of 6.3, shall be heat treated or reheat treated following repair welding. Repaired lengths, where repair depth is greater than ¼ of the thickness, shall be pressure tested or repressure tested after repair and heat treatment (if any). Repair welds shall also be examined by suitable nondestructive examination techniques, including any techniques specifically required of the primary weld.

9.4 The pipe shall be free of scale and contaminating iron particles. Pickling, blasting, or surface finishing is not mandatory when pipe is bright annealed. The purchaser is permitted to request that a passivating treatment be applied.

10. Heat Analysis

10.1 An analysis of each heat of steel shall be made by the plate manufacturer to determine the percentages of the elements prescribed in Specification A240/A240M. The chemical composition thus determined shall conform to the requirements prescribed in Specification A240/A240M.

11. Product Analysis

11.1 For each lot of 500 ft [150 m] of pipe or fraction thereof, analysis shall be made by the manufacturer from the finished pipe of the plate and of the weld deposit. Drillings for analysis may be taken from the mechanical test specimens. The results of these analyses shall be reported to the purchaser or the purchaser's representative, and shall conform to the requirements of Section 7, subject to the product analysis tolerances of Table 1 in Specification A480/A480M.

11.2 If the analysis of one of the tests specified in 9.1 does not conform to the requirements specified in Section 7, analyses shall be made on additional pipe of double the original number from the same lot, each of which shall conform to the requirements specified.

12. Tensile Requirements

12.1 The plate used in making the pipe shall conform to the requirements as to tensile properties of the applicable specifications listed in Table 1. Tension tests made by the plate manufacturer shall qualify the plate material.

12.2 The transverse tension test taken across the welded joint specimen shall have a tensile strength not less than the specified minimum tensile strength of the plate.

13. Transverse Guided-Bend Weld Tests

13.1 Two bend test specimens shall be taken transversely from the pipe. Except as provided in 13.2, one shall be subject to a face guided-bend test and the second to a root guided-bend test. One specimen shall be bent with the inside surface of the pipe against the plunger, and the other with the outside surface against the plunger.

13.2 For wall thicknesses over ⅜ in. [9.5 mm] but less than ¾ in. [19 mm] side-bend tests may be made instead of the face and root-bend tests. For specified wall thicknesses ¾ in. [19 mm] and over, both specimens shall be subjected to the side-bend tests. Side-bend specimens shall be bent so that one of the side surfaces becomes the convex surface of the bend specimen.

13.3 The bend test shall be acceptable if no cracks or other defects exceeding ⅛ in. [3 mm] in any direction is present in the weld metal or between the weld and the pipe metal after bending. Cracks that originate along the edges of the specimen during testing, and that are less than ¼ in. [6.5 mm] measured in any direction shall not be considered.

14. Test Specimens and Methods of Testing

14.1 Transverse tension and bend test specimens shall be taken from the end of the finished pipe; the transverse tension and bend test specimens shall be flattened cold before final machining to size.

14.2 As an alternative to the requirements of 14.1, it is permitted to take the test specimens from a test plate of the same material as the pipe that is attached to the end of the cylinder and welded as a prolongation of the pipe longitudinal seam.

14.3 Tension test specimens shall be made in accordance with Section IX, Part QW, Paragraph QW-150 of the ASME Boiler and Pressure Vessel Code and shall be one of the types shown in QW-462.1 of that code.

14.3.1 Reduced-section specimens conforming to the requirements given in QW-462.1(b) may be used for tension tests on all thicknesses of pipe having outside diameter greater than 3 in. [76 mm].

14.3.2 Turned specimens conforming to the requirements of QW-462.1(d) may be used for tension tests.

14.3.2.1 If turned specimens are used as given in 14.3.2.2 and 14.3.2.3, one complete set shall be made for each required tension test.

14.3.2.2 For thicknesses to and including 1¼ in. [32 mm], it is permitted to use a single turned specimen.

14.3.2.3 For thicknesses over 1¼ in. [32 mm], multiple specimens shall be cut through the full thickness of the weld with their centers parallel to the material surface and not over 1 in. [25 mm] apart. The centers of the specimens adjacent to material surfaces shall not exceed ⅝ in. [16 mm] from the surface.

14.4 The test specimens shall not be cut from the pipe or test plate until after final heat treatment.

15. Mechanical Tests Required

15.1 For the purposes of the tension and bend test requirements, the term "lot" shall mean all pipe of the same grade, permitted to include more than one heat of steel, within a 3⁄16-in [4.7-mm] range of thickness and welded to the same

weld procedure, and when heat treated, done so to the same heat-treating procedure and in the same furnace. The maximum lot size shall be 200 linear ft [60 m] of pipe.

15.1.1 *Transverse Tension Test*—One test shall be made to represent each lot of finished pipe.

15.1.2 *Transverse Guided-Bend Weld Test*—One test (two specimens) shall be made to represent each lot of finished pipe.

15.2 *Hydrostatic Test*—Each length of pipe shall be subjected to a hydrostatic test in accordance with Specification A999/A999M, unless specifically exempted under the provision of 15.3. Pressure shall be held for a sufficient time to permit the inspector to examine the entire length of the welded seam.

15.3 The purchaser, with the agreement of the manufacturer, is permitted to complete the hydrostatic test requirement with the system pressure test, performed at a pressure either lower or higher than the specification test pressure, but in no case shall the test pressure be lower than the system design pressure. Each length of pipe furnished without the completed manufacturer's hydrostatic test shall include with the mandatory marking the letters "NH."

16. Radiographic Examination

16.1 For Classes 1, 3, and 4 pipe, all welded joints shall be completely examined by radiography.

16.2 For Class 5 pipe, the welded joints shall be spot radiographed to the extent of not less than 12 in. [300 mm] of radiograph per 50 ft [15 m] of weld.

16.3 For Classes 1, 3, and 4 pipe, radiographic examination shall be in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section VIII, latest edition, Paragraph UW-51.

16.4 For Class 5 pipe, radiographic examination shall be in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, latest edition, Paragraph UW-52.

16.5 Radiographic examination is permitted to be performed prior to heat treatment.

17. Lengths

17.1 Circumferentially welded joints of the same quality as the longitudinal joints shall be permitted by agreement between the manufacturer and the purchaser.

18. Product Marking

18.1 In addition to the marking prescribed in Specification A999/A999M, the markings on each length of pipe shall include the plate material designations as shown in Table 1, the marking requirements of 6.3 and 15.3, and Class 1, 2, 3, or 4, as appropriate (see 1.3).

18.2 *Bar Coding*—In addition to the requirements in 18.1, bar coding is acceptable as a supplementary identification method. Bar coding should be consistent with the Automotive Industry Action Group (AIAG) standard prepared by the Primary Metals Subcommittee of the AIAG Bar Code Project Team.

19. Keywords

19.1 arc welded steel pipe; austenitic stainless steel; chromium-nickel steel; fusion welded steel pipe; high temperature application; steel pipe; temperature service applications; high; welded steel pipe

SUPPLEMENTARY REQUIREMENTS

One or more of the following supplementary requirements shall apply only when specified in the purchase order. The purchaser is permitted to specify a different frequency of test or analysis than is provided in the supplementary requirement. Subject to agreement between the purchaser and manufacturer, it is permitted to modify the retest and retreatment provisions of these supplementary requirements.

S1. Product Analysis

S1.1 Product analysis shall be made on each length of pipe. Individual lengths failing to conform to the chemical composition requirements shall be rejected.

S2. Tension and Bend Tests

S2.1 Tension tests (Section 12) and bend tests (Section 13) shall be made on specimens to represent each length of pipe. Failure of any test specimen to meet the requirements shall be cause for the rejection of the pipe length represented.

S3. Penetrant Oil and Powder Examination

S3.1 All welded joints shall be subjected to examination by a penetrant oil and powder method. The details of the method and the disposition of flaws detected shall be a matter for agreement between the purchaser and the manufacturer.

S4. Ferrite Control in Weld Deposits

S4.1 The ferrite content of the deposited weld metal in any length of pipe shall be determined. The procedural details pertaining to this subject (that is, welding; plate and weld

deposit chemistry; testing equipment and method; number and location of test sites; and ferrite control limits) shall be a matter for agreement between the purchaser and the manufacturer.

S5. Stabilizing Heat Treatment

S5.1 Subsequent to the heat treatment required in 6.3, Grades 321, 321H, 347, 347H, and 348 shall be given a stabilization heat treatment at a temperature lower than that used for the initial solution annealing heat treatment. The temperature of stabilization heat treatment shall be at a temperature as agreed upon between the purchaser and manufacturer.

S6. Intergranular Corrosion Test

S6.1 When specified, material shall pass intergranular corrosion tests conducted by the manufacturer in accordance with Practices A262, Practice E.

NOTE S1—Practice E requires testing on the sensitized condition for low carbon or stabilized grades, and on the as-shipped condition for other grades.

S6.2 A stabilization heat treatment in accordance with Supplementary Requirement S5 may be necessary and is permitted in order to meet this requirement for the grades containing titanium or columbium.

S7. In-Process Heat Treatments

S7.1 For H grades, separate solution treatments are required for solution annealing. In-process heat treatments are not permitted as a substitute for separate solution annealing.

S8. ASME Section III or Section VIII, Division 1, Construction

S8.1 Products furnished under this specification that are intended for application under the rules of Section III or Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code shall be manufactured by holders of the appropriate ASME Certificate of Authorization and Certification Mark. The product is subject to all applicable requirements of Section III or Section VIII, Division 1, including welding, heat treatment, nondestructive examination, authorized inspection at the point of manufacture, and application of the Certification Mark.

S8.2 The applicable ASME Partial Data Report form, signed by an Authorized Inspector or Authorized Nuclear Inspector and a material test report shall be furnished for each lot of pipe.

S8.3 The welded joints shall be full penetration butt welds as obtained by double welding or by other means that will obtain the same quality of deposited weld metal on the inside and outside. Welds using metal backing strips that remain in place are prohibited.

S8.4 In addition to the requirements of 15.1, for pipe that is not heat treated, or that is heat treated in a continuous furnace, a lot shall consist of each 200 ft [60 m] or fraction thereof, of all pipe of the same heat of plate starting material of the same thickness, subjected to the same heat treatment. For pipe that is heat treated in a batch-type furnace that is automatically controlled within a 50 °F [25 °C] range and is equipped with recording pyrometers so that the heating records are available, a lot shall be defined as for continuous furnace heat treatment. Each length of pipe shall be so marked as to identify each such piece of pipe with the lot and the material test report.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue, A358/A358M – 14a, that may impact the use of this standard. (Approved September 1, 2015.)

(1) Added UNS S31655 to Table 1. Did not need to add to Table 2 as the heat treatment will governed by the "All grades not individually listed below."

Committee A01 has identified the location of selected changes to this standard since the last issue, A358/A358M – 14, that may impact the use of this standard. (Approved May 1, 2014.)

(1) Added Common Names for UNS N08800 and N08810 to Table 1.
(2) Added UNS N08700 and N08811 to Table 1.
(3) Added filler metals for UNS N08800 and N08810 to Table 1.
(4) Added UNS N08700 and N08811 to Table 2,