Designation: A 943/A 943M – 01 (Reapproved 2005)

Standard Specification for Spray-Formed Seamless Austenitic Stainless Steel Pipes[1]

This standard is issued under the fixed designation A 943/A 943M; 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 spray-formed seamless austenitic stainless steel pipe intended for high-temperature and general corrosive service.

1.2 Grades TP304H, TP309H, TP309HCb, TP310H, TP310HCb, TP316H, TP321H, TP347H, and TP348H are modifications of Grades TP304, TP309Cb, TP309S, TP310Cb, TP310S, TP316, TP321, TP347, and TP348, and are intended for high-temperature service.

1.3 Optional supplementary requirements are provided for pipe where a greater degree of testing is desired. These supplementary requirements call for additional tests to be made and, when desired, one or more of these may be specified in the order.

1.4 Appendix X1 lists the dimensions of seamless stainless steel pipe as shown in ANSI B36.19. Pipe having other dimensions may be furnished provided such pipe complies with all other requirements of this specification.

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 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. The inch-pound units shall apply unless the "M" designation of this specification is specified in the order.

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."

2. Referenced Documents

2.1 *ASTM Standards:* [2]

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

A 450/A 450M Specification for General Requirements for Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubes

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 112 Test Methods for Determining Average Grain Size

E 381 Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings

E 527 Practice for Numbering Metals and Alloys (UNS)

2.2 *ANSI/ASME Standards:*[3]

B1.20.1 Pipe Threads, General Purpose

B36.10 Welded and Seamless Wrought Steel Pipe

B36.19 Stainless Steel Pipe

2.3 *Other Standard:*[4]

SAE J1086 Practice for Numbering Metals and Alloys (UNS)

3. Terminology

3.1 For definitions of terms used in this specification, refer to Terminology A 941.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *spray–formed*—denotes the fabrication of different shapes of a metallic material by deposition of a spray, consisting of droplets, solid particles, and particles that are partially solid, onto a moving substrate.

3.2.1.1 *Discussion*—The spray is produced by gas atomization of the liquid metal or alloy. On impingement with the substrate, the species of the spray consolidate and solidify completely to produce a product that is essentially free of porosity. The metallurgical characteristics of the spray-formed product are controlled primarily by the thermal condition of the spray, and that of the surface of the metallic deposit formed on the substrate.

4. Ordering Information

4.1 Orders for material to this specification should include the following, as required, to describe the desired material adequately:

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

[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 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.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

[4] Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001.

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4.1.2 Name of material (austenitic steel pipe),
4.1.3 Grade (Table 1),
4.1.4 Size (NPS or outside diameter and schedule number or average wall thickness or other),
4.1.5 Length (specific or random) (Section 11),
4.1.6 End finish (Section on Ends of Specification A 999/A 999M),
4.1.7 Optional requirements (Section 8),
4.1.8 Test report required (Certification Section of Specification A 999/A 999M),

TABLE 1 Chemical Requirements

Grade	UNS Designation[A]	Composition, %														
		Carbon, max[B]	Manganese, max[B]	Phosphorus, max	Sulfur, max	Silicon, max[B]	Nickel	Chromium	Molybdenum	Titanium	Columbium plus Tantalum	Tantalum, max	Nitrogen[C]	Vanadium	Copper	Cerium
TP304	S30400	0.08	2.00	0.045	0.030	0.75	8.0–11.0	18.0–20.0	...	...	...	...	...	...	...	...
TP304H	S30409	0.04–0.10	2.00	0.045	0.030	0.75	8.0–11.0	18.0–20.0	...	...	...	...	...	...	...	...
TP304L	S30403	0.030	2.00	0.045	0.030	0.75	8.0–13.0	18.0–20.0	...	...	...	...	...	...	...	...
TP304N	S30451	0.08	2.00	0.045	0.030	0.75	8.0–11.0	18.0–20.0	...	...	...	...	0.10–0.16	...	...	...
TP304LN	S30453	0.030	2.00	0.045	0.030	0.75	8.0–11.0	18.0–20.0	...	...	...	...	0.10–0.16	...	...	...
TP309Cb	S30940	0.08	2.00	0.045	0.030	0.75	12.0–16.0	22.0–24.0	0.75 max	...	10 × C min 1.10 max	...	...	...	...	...
TP309H	S30909	0.04–0.10	2.00	0.045	0.030	0.75	12.0–15.0	22.0–24.0	...	...	...	...	...	...	...	...
TP309HCb	S30941	0.04–0.10	2.00	0.045	0.030	0.75	12.0–16.0	22.0–24.0	0.75 max	...	10 × C min 1.10 max	...	...	...	...	...
TP309S	S30908	0.08	2.00	0.045	0.030	0.75	12.0–15.0	22.0–24.0	0.75 max	...	...	...	...	...	...	...
TP310Cb	S31040	0.08	2.00	0.045	0.030	0.75	19.0–22.0	24.0–26.0	0.75 max	...	10 × C min 1.10 max	...	...	...	...	...
TP310H	S31009	0.04–0.10	2.00	0.045	0.030	0.75	19.0–22.0	24.0–26.0	...	...	...	...	...	...	...	...
TP310HCb	S31041	0.04–0.10	2.00	0.045	0.030	0.75	19.0–22.0	24.0–26.0	0.75 max	...	10 × C min 1.10 max	...	...	...	...	...
TP310S	S31008	0.08	2.00	0.045	0.030	0.75	19.0–22.0	24.0–26.0	0.75 max	...	...	...	...	...	...	...
...	S31272[D]	0.08–0.12	1.50–2.00	0.030	0.015	0.3–0.7	14.0–16.0	14.0–16.0	1.00–1.0	0.3–0.6	...	...	...	...	...	...
TP316	S31600	0.08	2.00	0.045	0.030	0.75	11.0–14.0	16.0–18.0	2.00–3.00	...	...	...	...	...	...	...
TP316H	S31609	0.04–0.10	2.00	0.045	0.030	0.75	11.0–14.0	16.0–18.0	2.00–3.00	...	...	...	...	...	...	...
TP316L	S31603	0.030	2.00	0.045	0.030	0.75	10.0–15.0	16.0–18.0	2.00–3.00	...	...	...	...	...	...	...
TP316N	S31651	0.08	2.00	0.045	0.030	0.75	11.0–14.0	16.0–18.0	2.00–3.00	...	...	...	0.10–0.16	...	...	...
TP316LN	S31653	0.030	2.00	0.045	0.030	0.75	11.0–14.0	16.0–18.0	2.00–3.00	...	...	...	0.10–0.16	...	...	...
TP317	S31700	0.08	2.00	0.045	0.030	0.75	11.0–14.0	18.0–20.0	3.0–4.0	...	...	...	...	...	...	...
TP317L	S31703	0.030	2.00	0.045	0.030	0.75	11.0–15.0	18.0–20.0	3.0–4.0	...	...	...	...	...	...	...
TP321	S32100	0.08	2.00	0.045	0.030	0.75	9.0–13.0	17.0–19.0	...	[E]	...	...	...	...	...	...
TP321H	S32109	0.04–0.10	2.00	0.045	0.030	0.75	9.0–13.0	17.0–19.0	...	[F]	...	...	...	...	...	...
TP347	S34700	0.08	2.00	0.045	0.030	0.75	9.0–13.0	17.0–19.0	...	...	[G]	...	...	...	...	...
TP347H	S34709	0.04–0.10	2.00	0.045	0.030	0.75	9.0–13.0	17.0–19.0	...	...	[H]	...	...	...	...	...
TP348	S34800	0.08	2.00	0.045	0.030	0.75	9.0–13.0	17.0–19.0	...	...	[G]	0.10	...	...	...	...
TP348H	S34809	0.04–0.10	2.00	0.045	0.030	0.75	9.0–13.0	17.0–19.0	...	...	[H]	0.10	...	...	...	...
TPXM-10	S21900	0.08	8.0–10.0	0.045	0.030	1.00	5.5–7.5	19.0–21.5	...	...	...	...	0.15–0.40	...	...	...
TPXM-11	S21903	0.04	8.0–10.0	0.045	0.030	1.00	5.50–7.5	19.0–21.5	...	...	...	...	0.15–0.40	...	...	...
TPXM-15	S38100	0.08	2.00	0.030	0.030	1.50–2.50	17.5–18.5	17.0–19.0	...	...	...	...	...	...	...	...
TPXM-19	S20910	0.06	4.0–6.0	0.045	0.030	1.00	11.5–13.5	20.5–23.5	1.50–3.00	...	0.10–0.30	...	0.20–0.40	0.10–0.30	...	...
TPXM-29	S24000	0.08	11.5–14.5	0.060	0.030	1.00	2.2–3.7	17.0–19.0	...	...	...	...	0.20–0.40	...	...	...
...	S31254	0.020	1.00	0.030	0.010	0.80	17.5–18.5	19.5–20.5	6.0–6.5	...	...	...	0.18–0.22	...	0.50–1.00	...
...	S30815	0.05–0.10	0.80	0.040	0.030	1.40–2.00	10.0–12.0	20.0–22.0	...	...	...	...	0.14–0.20	...	...	0.03–0.08
...	S31050	0.030	2.00	0.020	0.015	0.4	20.5–23.5	24.0–26.0	1.0–2.0	...	...	...	0.09–0.15	...	...	...
...	S30600	0.018	2.00	0.02	0.02	3.7–4.3	14.0–15.5	17.0–18.5	0.20 max	...	...	...	...	...	0.50 max	...
...	S31725	0.030	2.00	0.045	0.030	0.75	13.5–17.5	18.0–20.0	4.0–5.0	...	...	...	0.10 max	...	0.75 max	...
...	S31726	0.030	2.00	0.045	0.030	0.75	13.5–17.5	17.0–20.0	4.0–5.0	...	...	...	0.10–0.20	...	0.75 max	...
...	S32615	0.07	2.00	0.045	0.030	4.8–6.0	19.0–22.0	16.5–19.5	0.30–1.50	...	...	...	...	...	1.50–2.50	...
...	S34565	0.030	5.0–7.0	0.030	0.010	1.00	16.0–18.0	23.0–25.0	4.0–5.0	...	0.1 max	...	0.40–0.60	...	...	...

[A] New designation established in accordance with Practice E 527 and SAE J1086, Practice for Numbering Metals and Alloys (UNS).
[B] Maximum, unless otherwise indicated.
[C] The method of analysis for nitrogen shall be a matter of agreement between the purchaser and manufacturer.
[D] The boron content shall be in the range 0.004–0.008.
[E] The titanium content shall be not less than five times the carbon content and not more than 0.70 %.
[F] The titanium content shall be not less than four times the carbon content and not more than 0.60 %.
[G] The columbium (niobium) plus tantalum content shall be not less than ten times the carbon content and not more than 1.00 %.
[H] The columbium (niobium) plus tantalum content shall be not less than eight times the carbon content and not more than 1.0 %.

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4.1.9 Specification number, and

4.1.10 Special requirements or any supplementary requirements selected, or both.

5. General Requirements

5.1 Material furnished under 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 *Melting*—The steel shall be made by the electric-furnace process or by other similar processes. The primary melting may incorporate separate degassing or refining and may be followed by secondary melting, using electroslag remelting or vacuum-arc remelting. If secondary melting is employed, the heat shall be defined as all of the ingots remelted from a single primary heat.

6.1.1 If a specified type of melting is required by the purchaser, it shall be stated on the purchase order.

6.1.2 When specified on the purchase order, or when a specific type of melting has been specified, the material manufacturer shall include with the report required by the Heat Analysis section of this specification or the Certification section of Specification A 999/A 999M the type of melting used to produce the material.

6.2 *Pipe Manufacture*:

6.2.1 The pipe shall be made by the spray forming process using the steel from the electric steel process or other similar processes as in 6.1.

6.2.2 The pipe shall be made by spraying the melt on to a thin-walled collector tube. The as-spray formed pipe shall be machined on both the inner and outer surfaces. The remaining metal shall be homogeneous, sound, and meet the requirements of Section 11.

6.2.3 Unless specified by the purchaser, pipe may be furnished as-spray formed or as-spray formed and cold finished.

6.2.4 All pipe shall be furnished in the descaled condition and be free of contaminating iron particles. Pickling, blasting or surface finishing is not mandatory when pipe is bright annealed. The purchaser may request that a passivating treatment be applied.

6.3 *Heat Treatment*:

6.3.1 All pipe shall be furnished in the heat-treated condition. The heat-treatment procedure, except for "H" grades, S30815 and S31254, shall consist of heating the pipe to a minimum temperature of 1900°F [1040°C] and quenching in water or rapidly cooling by other means.

6.3.2 All H grades shall be furnished in the solution-treated condition. If cold working is involved in processing, the minimum solution treating temperature for Grades TP321H, TP347H, and TP348H shall be 2000°F [1100°C] and for Grades TP304H, and TP316H, 1900°F [1040°C]. If the H Grade is furnished in the spray-formed condition only, the minimum solution treating temperatures for Grades TP321H, TP347H, and TP348H shall be 1925°F [1050°C], and for Grades TP304H, and TP316H, 1900°F [1040°C]. The minimum solution treating temperature for S30815 shall be 1920°F [1050°C]. The minimum solution treating temperature for TP309H, TP309HCb, TP310H, and TP310HCb shall be 1900°F [1040°C].

6.3.3 The heat-treatment procedure for S31254 shall consist of heating the pipe to a minimum temperature of 2100°F [1150°C] and quenching in water or rapidly cooling by other means.

6.3.4 A solution annealing temperature above 1950°F [1065°C] may impair the resistance to intergranular corrosion after subsequent exposure to sensitizing conditions in TP309HCb, TP310HCb, TP321, TP321H, TP347, TP347H, TP348, and TP348H. 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 S6).

6.4 *Grain Size*:

6.4.1 The grain size of TP304H, TP316H, TP321H, TP347H and TP348H, as determined in accordance with Test Methods E 112, shall be ASTM No. 7 or coarser.

6.4.2 The grain size of TP309H, TP309HCb, TP310H and TP310HCb, shall be ASTM No. 6 or coarser.

7. Chemical Composition

7.1 The steel shall conform to the requirements as to chemical composition prescribed in Table 1.

8. Product Analysis

8.1 At the request of the purchaser, an analysis of two pipes from each lot shall be made by the manufacturer. A lot of pipe shall consist of the following number of lengths of the same size and wall thickness from any one heat of stainless steel:

NPS Designator	Lengths of Pipe in Lot
Under 2	
2 to 5	200 or fraction thereof
6 and over	100 or fraction thereof

8.2 The results of these analyses shall be reported to the purchaser or the purchaser's representative, and shall conform to the requirements specified in Section 7.

8.3 If the analysis of one of the tests specified in 8.1 does not conform to the requirements specified in Section 7, an analysis of each pipe from the same heat or lot may be made, and all pipes conforming to the requirements shall be accepted.

9. Tensile Requirements

9.1 The tensile properties of the material shall conform to the requirements prescribed in Table 2.

10. Mechanical Tests and Grain Size Determinations Required

10.1 *Transverse or Longitudinal Tension Test*—One tension test shall be made on a specimen for lots of not more than 100 pipes. Tension tests shall be made on specimens from two tubes for lots of more than 100 pipes.

NOTE 2—The term "lot," for mechanical tests, applies to all pipe of the same diameter and wall thickness (or schedule) that are produced from the same heat of steel and subjected to the same finishing treatment: (*1*) in a continuous heat treatment furnace, or (*2*) in a batch-type heat treatment furnace, equipped with recording pyrometers and automatically controlled

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TABLE 2 Tensile Requirements

Grade	UNS Designation	Tensile Strength, min ksi [MPa]	Yield Strength, min ksi [MPa]
TP304L	S30403	70 [485]	25 [170]
TP316L	S31603	70 [485]	25 [170]
TP304	S30400	75 [515]	30 [205]
TP304H	S30409	75 [515]	30 [205]
TP309Cb	S30940	75 [515]	30 [205]
TP309H	S30909	75 [515]	30 [205]
TP309HCb	S30941	75 [515]	30 [205]
TP309S	S30908	75 [515]	30 [205]
TP310Cb	S31040	75 [515]	30 [205]
TP310H	S31009	75 [515]	30 [205]
TP310HCb	S31041	75 [515]	30 [205]
TP310S	S31008	75 [515]	30 [205]
. . .	S31272	65 [450]	29 [200]
TP316	S31600	75 [515]	30 [205]
TP316H	S31609	75 [515]	30 [205]
TP317	S31700	75 [515]	30 [205]
TP317L	S31703	75 [515]	30 [205]
TP321	S32100:		
$t^A \leq$ ⅜ in.		75 [515]	30 [205]
t > ⅜ in.		70 [485]	25 [170]
TP321H	S32109:		
t ≤ ⅜ in.		75 [515]	30 [205]
t > ⅜ in.		70 [485]	25 [170]
TP347	S34700	75 [515]	30 [205]
TP347H	S34709	75 [515]	30 [205]
TP348	S34800	75 [515]	30 [205]
TP348H	S34809	75 [515]	30 [205]
TPXM-10	S21900	90 [620]	50 [345]
TPXM-11	S21903	90 [620]	50 [345]
TPXM-15	S38100	75 [515]	30 [205]
TPXM-29	S24000	100 [690]	55 [380]
TPXM-19	S20910	100 [690]	55 [380]
TP304N	S30451	80 [550]	35 [240]
TP316N	S31651	80 [550]	35 [240]
TP304LN	S30453	75 [515]	30 [205]
TP316LN	S31653	75 [515]	30 [205]
. . .	S31254	94 [650]	44 [300]
. . .	S30815	87 [600]	45 [310]
. . .	S30600	78 [540]	35 [240]
. . .	S31725	75 [515]	30 [205]
. . .	S31726	80 [550]	35 [240]
. . .	S31050		
t ≤ 0.25 in.		84 [580]	39 [270]
t > 0.25 in.		78 [540]	37 [255]
. . .	S32615	80 [550]	32 [220]
. . .	S34565	115 [795]	60 [415]

Elongation in 2 in. or 50 mm (or 4D), min, %:	Longitudinal	Transverse
All Grades except S31050 and S32615	35	25
S31050 and S32615	25	. . .

[A] t = Specified wall thickness.

within a 50°F [30°C] range, the larger of: (*a*) each 200 ft [60°C] or fraction thereof or (*b*) that pipe heat treated in the same batch furnace charge.

10.2 *Flattening Test*—For material heat treated in a batch-typed furnace, flattening tests shall be made on 5 % of the pipe from each heat-treated lot. For material heat treated by the continuous process, this test shall be made on a sufficient number of pipe to constitute 5 % of the lot, but in no case less than two lengths of pipe.

10.3 *Hydrostatic Test*:

10.3.1 Each length of finished pipe shall be subjected to the hydrostatic test in accordance with Specification A 999/A 999M, unless specifically exempted under the provisions of 10.3.2.

10.3.2 For pipe whose dimensions are equal to or exceed NPS 10, the purchaser with the agreement of the manufacturer may waive the hydrostatic test requirement when in lieu of such test the purchaser performs a system test. Each length of pipe furnished without the completed manufacturer's hydrostatic test shall include with the mandatory markings the letters "NH".

10.3.3 When specified by the purchaser, a non-destructive electric test in accordance with Specification A 450/A 450M may be used instead of, or in addition to, the hydrostatic test.

10.4 *Grain Size*—Grain size determination, when required, shall be made on the same number of tubes as prescribed in 10.2.

11. Lengths

11.1 Pipe lengths shall be in accordance with the following regular practice:

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11.1.1 Unless otherwise agreed upon, all sizes from NPS ⅛ to and including NPS 8 are available in a length up to 24 ft (Note 3) with the permissible range of 15 to 24 ft (Note 3). Short lengths are acceptable and the number and minimum length shall be agreed upon between the manufacturer and the purchaser.

NOTE 3—This value(s) applies when the inch-pound designation of this specification is the basis of purchase. When the "M" designation of this specification is the basis of purchase, the corresponding metric value(s) shall be agreed upon between the manufacturer and the purchaser.

11.1.2 If definite cut lengths are desired, the lengths required shall be specified in the order. No pipe shall be under the specified length and not more than ¼ in. [6 mm] over that specified.

12. Workmanship, Finish, and Appearance

12.1 The finished pipes shall be reasonably straight and shall have a workmanlike finish. Imperfections may be removed by grinding, provided the wall thicknesses are not decreased to less than that permitted, in Section 8 of Specification A 999/A 999M.

13. Product Marking

13.1 In addition to the marking specified in Specification A 999/A 999M, the marking shall include the manufacturer's private identifying mark and the marking requirement of 10.3.2, if applicable. The marking shall also include a designator, CF, when cold finishing is performed. For Grades TP304H, TP316H, TP321H, TP347H, TP348H, and S30815, the marking shall also include the heat number and heat-treatment lot identification. If specified in the purchase order, the marking for pipe larger than NPS 4 shall include the weight.

14. Keywords

14.1 austenitic; pipe; spray-formed; stainless

SUPPLEMENTARY REQUIREMENTS

FOR PIPE REQUIRING SPECIAL CONSIDERATION

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

S1. Product Analysis

S1.1 For all pipe NPS 5 and larger in nominal size there shall be one product analysis made of a representative sample from one piece of each ten lengths or fraction hereof from each heat of steel.

S1.2 For pipe smaller than NPS 5 there shall be one product analysis made from ten lengths per heat of steel or from 10 % of the number of lengths per heat of steel, whichever number is smaller.

S1.3 Individual lengths failing to conform to the chemical requirements specified in Section 7 shall be rejected.

S2. Transverse Tension Tests

S2.1 There shall be one transverse tension test made from one end of 10 % of the lengths furnished per heat of steel. This applies only to pipe NPS 8 and larger.

S2.2 If a specimen from any length fails to conform to the tensile properties specified, that length shall be rejected.

S3. Flattening Test

S3.1 The flattening test of Specification A 999/A 999M shall be made on a specimen from one end or both ends of each pipe. Crop ends may be used. If this supplementary requirement is specified, the number of tests per pipe shall also be specified. If a specimen from any length fails because of lack of ductility prior to satisfactory completion of the first step of the flattening test requirement, that pipe shall be rejected subject to retreatment in accordance with Specification A 999/A 999M and satisfactory retest. If a specimen from any length of pipe fails because of a lack of soundness that length shall be rejected, unless subsequent retesting indicates that the remaining length is sound.

S4. Etching Tests

S4.1 The steel shall be homogeneous as shown by etching tests conducted in accordance with the appropriate portions of Method E 381. Etching tests shall be made on a cross section from one end or both ends of each pipe and shall show sound and reasonably uniform material free of injurious laminations, cracks, and similar objectionable defects. If this supplementary requirement is specified, the number of tests per pipe required shall also be specified. If a specimen from any length shows objectionable defects, the length shall be rejected, subject to removal of the defective end and subsequent retests indicating the remainder of the length to be sound and reasonably uniform material.

S5. Stabilizing Heat Treatment

S5.1 Subsequent to the solution anneal required in 6.3.4, Grades TP309HCb, TP310HCb, TP321, TP321H, TP347, TP347H, TP348H 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 vendor.

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S6. Intergranular Corrosion Test

S6.1 When specified, material shall pass intergranular corrosion tests conducted by the manufacturer in accordance with Practices A 262, Practice E.

NOTE S6.1—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, particularly in their H versions.

S7. Minimum Wall Pipe

S7.1 When specified by the purchaser, pipe shall be furnished on a minimum wall basis. The wall of such pipe shall not fall below the thickness specified. In addition to the marking required by Section 13, the pipe shall be marked S7.

APPENDIX

(Nonmandatory Information)

X1. Welded and Seamless Stainless Steel Pipe Dimensions

X1.1 Table X1.1 is based on Table 1 of the American National Standard for Stainless Steel Pipe (ANSI/ASME B36.19M–1985).

TABLE X1.1 Dimensions of Welded and Seamless Stainless Steel Pipe

NOTE 1—The decimal thickness listed for the respective pipe sizes represents their nominal or average wall dimensions.

NPS Designator	Outside Diameter		Nominal Wall Thickness							
			Schedule 5S[A]		Schedule 10S[A]		Schedule 40S		Schedule 80S	
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
⅛	0.405	[10.29]	. . .	. . .	0.049	[1.24]	0.068	[1.73]	0.095	[2.41]
¼	0.540	[13.72]	. . .	. . .	0.065	[1.65]	0.088	[2.24]	0.119	[3.02]
⅜	0.675	[17.15]	. . .	. . .	0.065	[1.65]	0.091	[2.31]	0.126	[3.20]
½	0.840	[21.34]	0.065	[1.65]	0.083	[2.11]	0.109	[2.77]	0.147	[3.73]
¾	1.050	[26.67]	0.065	[1.65]	0.083	[2.11]	0.113	[2.87]	0.154	[3.91]
1.0	1.315	[33.40]	0.065	[1.65]	0.109	[2.77]	0.133	[3.38]	0.179	[4.55]
1¼	1.660	[42.16]	0.065	[1.65]	0.109	[2.77]	0.140	[3.56]	0.191	[4.85]
1½	1.900	[48.26]	0.065	[1.65]	0.109	[2.77]	0.145	[3.68]	0.200	[5.08]
2	2.375	[60.33]	0.065	[1.65]	0.109	[2.77]	0.154	[3.91]	0.218	[5.54]
2½	2.875	[73.03]	0.083	[2.11]	0.120	[3.05]	0.203	[5.16]	0.276	[7.01]
3	3.500	[88.90]	0.083	[2.11]	0.120	[3.05]	0.216	[5.49]	0.300	[7.62]
3½	4.000	[101.60]	0.083	[2.11]	0.120	[3.05]	0.226	[5.74]	0.318	[8.08]
4	4.500	[114.30]	0.083	[2.11]	0.120	[3.05]	0.237	[6.02]	0.337	[8.56]
5	5.563	[141.30]	0.109	[2.77]	0.134	[3.40]	0.258	[6.55]	0.375	[9.52]
6	6.625	[168.28]	0.109	[2.77]	0.134	[3.40]	0.280	[7.11]	0.432	[10.97]
8	8.625	[219.08]	0.109	[2.77]	0.148	[3.76]	0.322	[8.18]	0.500	[12.70]
10	10.750	[273.05]	0.134	[3.40]	0.165	[4.19]	0.365	[9.27]	0.500[B]	[12.70][B]
12	12.750	[323.85]	0.156	[3.96]	0.180	[4.57]	0.375[B]	[9.52][B]	0.500[B]	[12.70][B]
14	14.000	[355.60]	0.156	[3.96]	0.188[B]	[4.78][B]	. . .	. . .	. . .	. . .
16	16.000	[406.40]	0.165	[4.19]	0.188[B]	[4.78][B]	. . .	. . .	. . .	. . .
18	18.000	[457.20]	0.165	[4.19]	0.188[B]	[4.78][B]	. . .	. . .	. . .	. . .
20	20.000	[508.00]	0.188	[4.78]	0.218[B]	[5.54][B]	. . .	. . .	. . .	. . .
22	22.000	[558.80]	0.188	[4.78]	0.218[B]	[5.54][B]	. . .	. . .	. . .	. . .
24	24.000	[609.60]	0.218	[5.54]	0.250	[6.35]	. . .	. . .	. . .	. . .
30	30.000	[762.00]	0.250	[6.35]	0.312	[7.92]	. . .	. . .	. . .	. . .

[A] Schedules 5S and 10S wall thicknesses do not permit threading in accordance with the American National Standard for Pipe Threads (ANSI/ASME B1.20.1).
[B] These do not conform to the American National Standard for Welded and Seamless Wrought Steel Pipe (ANSI/ASME B36.10M-1985).

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