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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes[1]

This standard is issued under the fixed designation A 312/A 312M; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification[2] covers seamless and straight-seam welded austenitic steel pipe intended for high-temperature and general corrosive service.

NOTE 1—When the impact test criterion for a low-temperature service would be 15 ft·lbf [20 J] energy absorption or 15 mils [0.38 mm] lateral expansion, some of the austenitic stainless steel grades covered by this specification are accepted by certain pressure vessel or piping codes without the necessity of making the actual test. For example, Grades TP304, TP304L, and TP347 are accepted by the ASME Pressure Vessel Code, Section VIII Division 1, and by the Chemical Plant and Refinery Piping Code, ANSI B31.3, for service at temperatures as low as −425°F [−250°C] without qualification by impact tests. Other AISI stainless steel grades are usually accepted for service temperatures as low as −325°F [−200°C] without impact testing. Impact testing may, under certain circumstances, be required. For example, materials with chromium or nickel content outside the AISI ranges, and for material with carbon content exceeding 0.10 %, are required to be impact tested under the rules of ASME Section VIII Division 1 when service temperatures are lower than −50°F [−45°C].

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 Table X1.1 lists the dimensions of welded and 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 Grades TP321 and TP321H have lower strength requirements for pipe manufactured by the seamless process in nominal wall thicknesses greater than ⅜ in. [9.5 mm].

1.6 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 2—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:*

A 262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels[3]

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products[3]

A 450/A 450M Specification for General Requirements for Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubes[4]

A 530/A 530M Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe[4]

E 112 Test Methods for Determining the Average Grain Size[5]

E 213 Practice for Ultrasonic Examination of Metal Pipe and Tubing[6]

E 381 Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings[5]

E 426 Practice for Electromagnetic (Eddy-Current) Examination of Seamless and Welded Tubular Products, Austenitic Stainless Steel, and Similar Alloys[6]

E 527 Practice for Numbering Metals and Alloys (UNS)[4]

2.2 *ANSI Standards:*[7]

B1.20.1 Pipe Threads, General Purpose

B36.10 Welded and Seamless Wrought Steel Pipe

B36.19 Stainless Steel Pipe

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[1] This specification is under the jurisdiction of ASTM Committee A-1 on Steel, Stainless Steel, and Related Alloys and is the direct responsibility of Subcommittee A01.10 on Steel Tubing.

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[2] For ASME Boiler and Pressure Vessel Code applications see related Specification SA-312 in Section II of that Code.

[3] *Annual Book of ASTM Standards*, Vol 01.03.

[4] *Annual Book of ASTM Standards*, Vol 01.01.

[5] *Annual Book of ASTM Standards*, Vol 03.01.

[6] *Annual Book of ASTM Standards*, Vol 03.03.

[7] Available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.

2.3 *AWS Standard:*

A5.9 Corrosion-Resisting Chromium and Chromium-Nickel Steel Welding Rods and Electrodes[8]

2.4 *Other Standard:*

SAE J1086 Practice for Numbering Metals and Alloys (UNS)[9]

2.5 *Other Standard:*

SNT-TC-1A Personnel Qualification and Certification in Nondestructive Testing[10]

3. Ordering Information

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

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

3.1.2 Name of material (austenitic steel pipe),

3.1.3 Process (seamless or welded),

3.1.4 Grade (Table 1),

3.1.5 Size (NPS or outside diameter and schedule number or average wall thickness),

3.1.6 Length (specific or random) (Section 10),

3.1.7 End finish (Section on Ends of Specification A 530/A 530M),

3.1.8 Optional requirements (Section 7),

3.1.9 Test report required (Certification Section of Specification A 530/A 530M),

3.1.10 Specification number, and

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

4. General Requirements

4.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification A 530/A 530M unless otherwise provided herein.

5. Materials and Manufacture

5.1 *Manufacture*:

5.1.1 The pipe shall be made by the seamless or an automatic welding process, with no addition of filler metal in the welding operation.

5.1.2 "Welded pipe NPS 14 and smaller shall have a single longitudinal weld. Welded pipe of a size larger than NPS 14 may be produced by forming and welding two longitudinal sections of flat stock when approved by the purchaser. All weld tests, examinations, inspections, or treatments are to be performed on each weld seam.''

5.1.3 At the manufacturer's option, pipe may be either hot finished or cold finished.

5.1.4 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 may request that a passivating treatment be applied.

5.2 *Heat Treatment*—All pipe shall be furnished in the heat-treated condition in accordance with the requirements of Table 2. Alternatively, for seamless pipe, immediately following hot forming while the temperature of the pipes is not less than the specified minimum solution treatment temperature, pipes may be individually quenched in water or rapidly cooled by other means.

5.3 *Grain Size:*

5.3.1 The grain size of Grade UNS S32615, as determined in accordance with Test Methods E 112, shall be No. 3 or finer.

5.3.2 The grain size of TP309H, TP309HCb, TP310H and TP310HCb, as determined in accordance with Test Methods E 112, shall be No. 6 or coarser.

5.3.3 The grain size of grades 304H, 316H, 321H, 347H, and 348H, as determined in accordance with Test Methods E 112, shall be No. 7 or coarser.

6. Chemical Composition

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

7. Product Analysis

7.1 At the request of the purchaser, an analysis of one billet or one length of flat-rolled stock from each heat, or 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 steel:

NPS Designator	Lengths of Pipe in Lot
Under 2	400 or fraction thereof
2 to 5	200 or fraction thereof
6 and over	100 or fraction thereof

7.2 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 6.

7.3 If the analysis of one of the tests specified in 7.1 does not conform to the requirements specified in Section 6, an analysis of each billet or pipe from the same heat or lot may be made, and all billets or pipe conforming to the requirements shall be accepted.

8. Tensile Requirements

8.1 The tensile properties of the material shall conform to the requirements prescribed in Table 3.

9. Mechanical Tests and Grain Size Determinations Required

9.1 *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 3—The term "lot," for mechanical tests, applies to all pipe of the same diameter and wall thickness (or schedule) which are produced from the same heat of steel and subjected to the same finishing treatment: (*1*) in a continuous heat-treatment furnace, (*2*) in a batch-type heat-treatment furnace, equipped with recording pyrometers and automatically controlled within a 50°F [30°C] range, or (*3*) by direct quenching after hot forming, the larger of: (*a*) Each 200 ft [60 m] or fraction thereof or, (*b*) That pipe heat treated in the same batch furnace charge.

9.2 *Flattening Test*—For material heat treated in a batch-type furnace, flattening tests shall be made on 5 % of the pipe

[8] Available from the American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33135.

[9] Available from Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.

[10] Society for Nondestructive Testing, 1711 Arlingate Plaza, PO Box 28518, Columbus, OH, 43228-0518.

TABLE 1 Chemical Requirements

Grade	UNS Designation[A]	Composition, %																
		Carbon, max[B]	Manganese, max[B]	Phosphorus, max	Sulfur, max	Silicon	Nickel	Chromium	Molybdenum	Titanium	Columbium plus Tantalum	Tantalum, max	Nitrogen[C]	Vanadium	Copper	Cerium	Boron	Aluminum
TP304	S30400	0.08	2.00	0.040	0.030	0.75 max	8.00–11.0	18.0–20.0	...	...	...	...	...	...	...	...		
TP304H	S30409	0.04–0.10	2.00	0.040	0.030	0.75 max	8.00–11.0	18.0–20.0	...	...	...	...	...	...	...	...		
TP304L	S30403	0.035[E]	2.00	0.040	0.030	0.75 max	8.00–13.0	18.0–20.0	...	...	...	...	...	...	...	...		
TP304N	S30451	0.08	2.00	0.040	0.030	0.75 max	8.00–11.0	18.0–20.0	...	...	...	...	0.10–0.16	...	...	...		
TP304LN	S30453	0.035	2.00	0.040	0.030	0.75 max	8.00–11.0	18.0–20.0	...	...	...	...	0.10–0.16	...	...	...		
TP309Cb	S30940	0.08	2.00	0.045	0.030	0.75 max	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	0.040	0.030	0.75 max	12.0–15.0	22.0–24.0	...	...	...	...	...	...	...			
TP309HCb	S30941	0.04–0.10	2.00	0.045	0.030	0.75 max	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 max	12.0–15.0	22.0–24.0	0.75 max	...	...	...	...	...	...	...		
TP310Cb	S31040	0.08	2.00	0.045	0.030	0.75 max	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	0.040	0.030	0.75 max	19.0–22.0	24.0–26.0	...	...	...	...	...	...	...			
TP310HCb	S31041	0.04–0.10	2.00	0.045	0.030	0.75 max	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 max	19.0–22.0	24.0–26.0	0.75 max	...	...	...	...	...	...	...		
	S31272	0.08–012	1.5–2.00	0.030	0.015	0.3–0.7	14.0–16.0	14.0–16.0	1.0–1.4	0.3–0.6							0.004–0.008	
TP316	S31600	0.08	2.00	0.040	0.030	0.75 max	11.0–14.0[D]	16.0–18.0	2.00–3.00	...	...	...	...	...	...	...		
TP316H	S31609	0.04–0.10	2.00	0.040	0.030	0.75 max	11.0–14.0[D]	16.0–18.0	2.00–3.00	...	...	...	...	...	...	...		
TP316L	S31603	0.035[E]	2.00	0.040	0.030	0.75 max	10.0–15.0	16.0–18.0	2.00–3.00	...	...	...	...	...	...	...		
TP316N	S31651	0.08	2.00	0.040	0.030	0.75 max	11.0–14.0[D]	16.0–18.0	2.00–3.00				0.10–0.16	...	...	...		
TP316LN	S31653	0.035	2.00	0.040	0.030	0.75 max	11.0–14.0[D]	16.0–18.0	2.00–3.00	...	...	...	0.10–0.16	...	...	...		
TP317	S31700	0.08	2.00	0.040	0.030	0.75 max	11.0–14.0	18.0–20.0	3.00–4.00	...	...	...	...	...	...	...		
TP317L	S31703	0.035	2.00	0.040	0.030	0.75 max	11.0–15.0	18.0–20.0	3.00–4.00	...	...	...	...	...	...	...		
TP321	S32100	0.08	2.00	0.040	0.030	0.75 max	9.00–13.0	17.0–20.0	...	[F]	...	...	...	...	...	...		
TP321H	S32109	0.04–0.10	2.00	0.040	0.030	0.75 max	9.00–13.0	17.0–20.0	...	[G]	...	...	...	...	...	...		
TP347	S34700	0.08	2.00	0.040	0.030	0.75 max	9.00–13.0	17.0–20.0	...	...	[H]	...	...	...	...	...		
TP347H	S34709	0.04–0.10	2.00	0.040	0.030	0.75 max	9.00–13.0	17.0–20.0	...	...	[I]	...	...	...	...	...		
TP347LN	S34751	0.005–0.020	2.00	0.040	0.030	0.75 max	9.00–13.0	17.0–20.0	...	...	0.2–0.5[K]	...	0.06–0.10	...	...	...	...	...
TP348	S34800	0.08	2.00	0.040	0.030	0.75 max	9.00–13.0	17.0–20.0	...	...	[H]	0.10	...	...	...	...		
TP348H	S34809	0.04–0.10	2.00	0.040	0.030	0.75 max	9.00–13.0	17.0–20.0	...	...	[I]	0.10	...	...	...	...		
TPXM-10	S21900	0.08	8.00–10.00	0.040	0.030	1.00 max	5.50–7.50	19.0–21.5	...	...	...	...	0.15–0.40	...	...	...		
TPXM-11	S21904	0.04	8.00–10.00	0.040	0.030	1.00 max	5.50–7.50	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	0.060	4.00–6.00	0.040	0.030	1.00 max	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	0.080	11.5–14.5	0.060	0.030	1.00 max	2.25–3.75	17.0–19.0	...	...	...	...	0.20–0.40	...	...	...		
...	S31254	0.020	1.00	0.030	0.010	0.80 max	17.5–18.5	19.5–20.5	6.00–6.50	...	...	...	0.18–0.22	...	0.50–1.00	...		
...	S30615	0.16–0.24	2.00	0.03	0.03	3.2–4.0	13.5–16.0	17.0–19.5	...	...	...	...	...	...	...	...	...	0.8–1.5
...	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	0.025	2.00	0.020	0.015	0.4	20.5–23.5	24.0–26.0	1.6–2.6	...	...	...	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	0.03	2.00	0.040[J]	0.030	0.75	13.5–17.5	18.0–20.0	4.0–5.0	...	...	...	0.10 max	...	0.75 max	...		
...	S31726	0.03	2.00	0.040[J]	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	0.3–1.5	...	...	...	...	...	1.5–2.5	...		
...	S33228	0.04–0.08	1.0	0.020	0.015	0.30 max	31.0–33.0	26.0–28.0	...	...	0.6–1.0	...	...	...	...	0.05–0.10	...	0.025 max
...	S24565	0.03	5.0–7.0	0.030	0.010	1.00 max	16.0–18.0	23.0–25.0	4.0–5.0	...	0.1 max	...	0.4–0.6	...	...	...	...	
...	S30415	0.04–0.06	0.80	0.045	0.030	1.00–2.00	9.00–10.0	18.0–19.0	...	...	...	...	0.12–0.18	...	...	0.03–0.08		
...	S32654	0.020	2.00–4.00	0.030	0.005	0.50 max	21.0–23.0	24.0–25.0	7.00–8.00	...	...	...	0.45–0.55	...	0.30–0.60	...		
...	S35315	0.04–0.08	2.00	0.045	0.030	0.75	34.0–36.0	24.0–26.0	...	...	...	...	0.12–0.18	...	...	0.03–0.08	...	...
...	N08367	0.030	2.00	0.040	0.030	1.00 max	23.50–25.50	20.00–22.00	6.00–7.00	...	...	...	0.18–0.25	...	0.75 max	...	...	...
...	N08904	0.020	2.00	0.045	0.035	1.00	23.0–28.0	19.0–23.0	4.0–5.0	...	...	...	0.10 max	...	1.0–2.0	...	...	...

[A] New designation established in accordance with Practice E 527 and SAE J1086.
[B] Maximum, unless otherwise indicated.
[C] The method of analysis for nitrogen shall be a matter of agreement between the purchaser and manufacturer.
[D] For welded TP316, TP316N, TP316LN, and TP316H pipe, the nickel range shall be 10.0–14.0 %.
[E] For small diameter or thin walls or both, where many drawing passes are required, a carbon maximum of 0.040 % is necessary in grades TP304L and TP316L. Small outside diameter tubes are defined as those less than 0.500 in. [12.7 mm] in outside diameter and light wall tubes as those less than 0.049 in. [1.20 mm] in average wall thickness (0.044 in. [1.10 mm] in minimum wall thickness).
[F] The titanium content shall be not less than five times the carbon content and not more than 0.70 %.
[G] The titanium content shall be not less than four times the carbon content and not more than 0.60 %.
[H] The columbium plus tantalum content shall be not less than ten times the carbon content and not more than 1.00 %.
[I] The columbium plus tantalum content shall be not less than eight times the carbon content and not more than 1.0 %.
[J] For welded pipe, the phosphorus maximum shall be 0.045 %.
[K] Grade S34751 shall have a columbium (niobium) plus tantalum content of not less than 15 times the carbon content.

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]
TP321H, TP347H, TP348H		
Cold finished	2000°F [1100°C]	[D]
Hot finished	1925°F [1050°C]	[D]
TP304H, TP316H		
Cold finished	1900°F [1040°C]	[D]
Hot finished	1900°F [1040°C]	[D]
TP309H, TP309HCb, TP310H, TP310HCb	1900°F [1040°C]	[D]
S30600	2010–2140°F [1100–1170°C]	[D]
S30815, S31272	1920°F [1050°C]	[D]
S31254, S32654	2100°F [1150°C]	[D]
S33228	2050–2160°F [1120–1180°C]	[D]
S24565	2050–2140°F [1120–1170°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.

from each heat-treated lot. For material heat treated by the continuous process, or by direct quenching after hot forming 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.

9.2.1 For welded pipe a transverse-guided face bend test of the weld may be conducted instead of a flattening test in accordance with the method outlined in the steel tubular product supplement of Test Methods and Definitions A 370. The ductility of the weld shall be considered acceptable when there is no evidence of cracks in the weld or between the weld and the base metal after bending. Test specimens from 5 % of the lot shall be taken from the pipe or test plates of the same material as the pipe, the test plates being attached to the end of the cylinder and welded as a prolongation of the pipe longitudinal seam.

9.3 *Hydrostatic Test*—Each length of finished pipe shall be subjected to the hydrostatic test in accordance with Specification A 530/A 530M, unless specifically exempted under the provisions of 9.4 and 9.5.

9.4 For pipe whose dimensions equal or exceed NPS10, 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''.

9.5 *Nondestructive Examination*:

9.5.1 As an alternative to the hydrostatic test, and when specified by the purchaser, each pipe shall be examined with a nondestructive test in accordance with Practice E 213, or E 426. Unless specifically called out by the purchaser, the selection of the nondestructive electric test will be at the option of the manufacturer. The range of pipe sizes that may be examined by each method shall be subject to the limitations in the scope of the respective practices.

TABLE 3 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:		
Welded		75 [515]	30 [205]
Seamless:			
≤ |n# in.		75 [515]	30 [205]
> |n# in.		70 [485]	25 [170]
TP321H	S32109:		
Welded		75 [515]	30 [205]
Seamless:			
≤ 3⁄16 in.		75 [515]	30 [205]
> 3⁄16 in.[A]		70 [480]	25 [170]
TP347	S34700	75 [515]	30 [205]
TP347H	S34709	75 [515]	30 [205]
TP347LN	S34751	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	S21904	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]
. . .	S30615	90 [620]	40 [275]
. . .	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]
. . .	S33228	73 [500]	27 [185]
. . .	S24565	115 [795]	60 [415]
. . .	S30415	87 [600]	42 [290]
. . .	S32654	109 [750]	62 [430]
. . .	S35315	94 [650]	39 [270]
. . .	N08367:		
t ≤ 0.187		100 [690]	45 [310]
t > 0.187		95 [655]	45 [310]
. . .	N08904	71 [490]	31 [215]

Elongation in 2 in. or 50 mm (or 4*D*), min, %:	Longitudinal	Transverse
All Grades except S 31050 and S 32615	35	25
S32615, S31050	25	. . .
N08367	30	. . .

[A]Prior to the issuance of A 312/A 312M - 88a, the tensile and yield strength values were 76 [515] and 30 [205], respectively, for nominal wall greater than 3⁄8in. [9.5 mm].

9.5.2 The following information is for the benefit of the user of this specification:

9.5.2.1 The reference standards defined in 9.5.2.2 through 9.5.2.5 are convenient standards for calibration of nondestructive testing equipment. The dimensions of these standards should not be construed as the minimum size imperfection detectable by such equipment.

9.5.2.2 The ultrasonic testing (UT) can be performed to detect both longitudinally and circumferentially oriented defects. It should be recognized that different techniques should be employed to detect differently oriented imperfections. The examination may not detect short, deep, defects.

9.5.2.3 The eddy-current testing (ET) referenced in this specification, (Practice E 426), has the capability of detecting significant discontinuities, especially the short abrupt type.

9.5.2.4 A purchaser interested in ascertaining the nature (type, size, location, and orientation) of discontinuities that can be detected in the specific application of these examinations should discuss this with the manufacturer of the tubular product.

9.5.3 *Time of Examination*:

9.5.3.1 Nondestructive testing for specification acceptance shall be performed after all mechanical processing, heat treatments, and straightening operations. This requirement does not preclude additional testing at earlier stages in the processing.

9.5.4 *Surface Condition*:

9.5.4.1 All surfaces shall be free of scale, dirt, grease, paint, or other foreign material that could interfere with interpretation of test results. The methods used for cleaning and preparing the surfaces for examination shall not be detrimental to the base metal or the surface finish.

9.5.4.2 Excessive surface roughness or deep scratches can produce signals that interfere with the test.

9.5.5 *Extent of Examination*:

9.5.5.1 The relative motion of the pipe and the transducer(s), coil(s), or sensor(s) shall be such that the entire pipe surface is scanned, except as in 9.5.5.2.

9.5.5.2 The existence of end effects is recognized, and the extent of such effects shall be determined by the manufacturer, and, if requested, shall be reported to the purchaser. Other nondestructive tests may be applied to the end areas, subject to agreement between the purchaser and the manufacturer.

9.5.6 *Operator Qualifications*:

9.5.6.1 The test unit operator shall be certified in accordance with SNT-TC-1A, or an equivalent recognized and documented standard.

9.5.7 *Test Conditions*:

9.5.7.1 For eddy-current testing, the excitation coil frequency shall be chosen to ensure adequate penetration yet provide good signal-to-noise ratio.

9.5.7.2 The maximum eddy-current coil frequency used shall be as follows:

On specified walls up to 0.050 in.—100 KHz max
On specified walls up to 0.150 in.—50 KHz max
On specified walls up to 0.150 in.—10 KHz max

9.5.7.3 *Ultrasonic*—For examination by the ultrasonic method, the minimum nominal transducer frequency shall be 2.00 MHz and the maximum nominal transducer size shall be 1.5 in.

(*1*) If the equipment contains a reject notice filter setting, this shall remain off during calibration and testing unless linearity can be demonstrated at that setting.

9.5.8 *Reference Standards*:

9.5.8.1 Reference standards of convenient length shall be prepared from a length of pipe of the same grade, size (NPS, or outside diameter and schedule or wall thickness), surface finish and heat treatment condition as the pipe to be examined.

9.5.8.2 *For Ultrasonic Testing*, the reference ID and OD notches shall be any one of the three common notch shapes shown in Practice E 213, at the option of the manufacturer. The depth of each notch shall not exceed 12½ % of the specified nominal wall thickness of the pipe or 0.004 in., whichever is greater. The width of the notch shall not exceed twice the depth. Notches shall be placed on both the OD and ID surfaces.

9.5.8.3 *For Eddy-Current Testing*, the reference standard shall contain, at the option of the manufacturer, any one of the following discontinuities:

(*1*) *Drilled Hole*—The reference standard shall contain three or more holes, equally spaced circumferentially around the pipe and longitudinally separated by a sufficient distance to allow distinct identification of the signal from each hole. The holes shall be drilled radially and completely through the pipe wall, with care being taken to avoid distortion of the pipe while drilling. One hole shall be drilled in the weld, if visible. Alternately, the producer of welded pipe may choose to drill one hole in the weld and run the calibration standard through the test coils three times with the weld turned at 120° on each pass. The hole diameter shall vary with NPS as follows:

NPS Designator	Hole Diameter
½	0.039 in. (1 mm)
above ½ to 1¼	0.055 in. (1.4 mm)
above 1¼ to 2	0.071 in. (1.8 mm)
above 2 to 5	0.087 in. (2.2 mm)
above 5	0.106 in. (2.7 mm)

(*2*) *Transverse Tangential Notch*—Using a round tool or file with a ¼ in. (6.4 mm) diameter, a notch shall be filed or milled tangential to the surface and transverse to the longitudinal axis of the pipe. Said notch shall have a depth not exceeding 12½ % of the specified nominal wall thickness of the pipe or 0.004 in. (0.102 mm), whichever is greater.

(*3*) *Longitudinal Notch*—A notch 0.031 in. or less in width shall be machined in a radial plane parallel to the tube axis on the outside surface of the pipe, to have a depth not exceeding 12½ % of the specified wall thickness of the pipe or 0.004 in., whichever is greater. The length of the notch shall be compatible with the testing method.

9.5.8.4 More or smaller reference discontinuities, or both, may be used by agreement between the purchaser and the manufacturer.

9.5.9 *Standardization Procedure*:

9.5.9.1 The test apparatus shall be standardized at the beginning and end of each series of pipes of the same size (NPS or diameter and schedule or wall thickness), Grade and heat treatment condition, and at intervals not exceeding 4 h. More frequent standardization may be performed at the manufacturer's option or may be required upon agreement between

the purchaser and the manufacturer.

9.5.9.2 The test apparatus shall also be standardized after any change in test system settings, change of operator, equipment repair, or interruption due to power loss, process shutdown or when a problem is suspected.

9.5.9.3 The reference standard shall be passed through the test apparatus at the same speed and test system settings as the pipe to be tested.

9.5.9.4 The signal-to-noise ratio for the reference standard shall be 2½ to 1 or greater. Extraneous signals caused by identifiable causes such as dings, scratches, dents, straightener marks, etc., shall not be considered noise. The rejection amplitude shall be adjusted to be at least 50 % of full scale of the readout display.

9.5.9.5 If upon any standardization, the rejection amplitude has decreased by 29 % (3 dB) of peak height from the last standardization, the pipe since the last calibration shall be rejected. The test system settings may be changed, or the transducer(s), coil(s) or sensor(s) adjusted, and the unit restandardized, but all pipe tested since the last acceptable standardization must be retested for acceptance.

9.5.10 *Evaluation of Imperfections*:

9.5.10.1 Pipes producing a signal equal to or greater than the lowest signal produced by the reference standard(s) shall be identified and separated from the acceptable pipes. The area producing the signal may be reexamined.

9.5.10.2 Such pipes shall be rejected if the test signal was produced by imperfections that cannot be identified or was produced by cracks or crack-like imperfections. These pipes may be repaired per Sections 11 and 12. To be accepted, a repaired pipe must pass the same non-destructive test by which it was rejected, and it must meet the minimum wall thickness requirements of this specification.

9.5.10.3 If the test signals were produced by visual imperfections such as:

(*1*) Scratches,
(*2*) Surface roughness,
(*3*) Dings,
(*4*) Straightener marks,
(*5*) Cutting chips,
(*6*) Steel die stamps,
(*7*) Stop marks, or
(*8*) Pipe reducer ripple.

The pipe may be accepted based on visual examination provided the imperfection is less than 0.004 in. (0.1 mm) or 12½% of the specified wall thickness (whichever is greater).

9.5.10.4 Rejected pipe may be reconditioned and retested providing the wall thickness is not decreased to less than that required by this or the product specification. The outside diameter at the point of grinding may be reduced by the amount so removed. To be accepted, retested pipe shall meet the test requirement.

9.5.10.5 If the imperfection is explored to the extent that it can be identified as non-rejectable, the pipe may be accepted without further test providing the imperfection does not encroach on the minimum wall thickness.

9.6 *Grain Size*—Grain size determinations on grades TP309H, TP309HCb, TP310H, TP310HCb, and UNS S 32615 shall be made on the same number of tubes as prescribed for the flattening test.

10. Lengths

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

10.1.1 Unless otherwise agreed upon, all sizes from NPS ⅛ to and including NPS 8 are available in a length up to 24 ft [Note 4] with the permissible range of 15 to 24 ft [Note 4]. Short lengths are acceptable and the number and minimum length shall be agreed upon between the manufacturer and the purchaser.

NOTE 4—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.

10.1.2 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 ¼in. [6 mm] over that specified.

10.1.3 No jointers are permitted unless otherwise specified.

11. Workmanship, Finish, and Appearance

11.1 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 530/A 530M.

12. Repair by Welding

12.1 For welded pipe whose diameter equals or exceeds NPS 6, and whose nominal wall thickness equals or exceeds 0.200, weld repairs made with the addition of compatible filler metal may be made to the weld seam with the same procedures specified for plate defects in the section on Repair by Welding of Specification A 530/A 530M.

12.2 Weld repairs of the weld seam shall not exceed 20 % of the seam length.

12.3 Weld repairs shall be made only with the gas tungsten-arc welding process using the same classification of bare filler rod qualified to the most current AWS Specification A 5.9 as the grade of stainless steel pipe being repaired and as shown in Table 4. Alternatively, subject to approval by the purchaser, weld repairs shall be made only with the gas tungsten-arc welding process using a filler metal more highly alloyed than the base metal when needed for corrosion resistance or other properties.

12.4 Pipes that have had weld seam repairs with filler metal shall be uniquely identified and shall be so stated and identified on the certificate of tests. When filler metal other than that listed in Table 4 is used, the filler metal shall be identified on the certificate of tests.

13. Certification

13. In addition to the information required by Specification A 530/A 530M, the certification shall state whether or not the material was hydrostatically tested. If the material was nondestructively tested, the certification shall so state and shall show

TABLE 4 Pipe and Filler Metal Specification

Pipe		Filler Metal	
Grade	UNS Designation	AWS A 5.9 Class	UNS Designation
TP304	S30400	ER308	S30800, W30840
TP304L	S30403	ER308L	S30883, W30843
TP304N	S30451	ER308	S30880, W30840
TP304LN	S30453	ER308L	S30883, W30843
TP304H	S30409	ER308	S30880, W30840
TP309Cb	S30940	. . .	. . . . .
TP309S	S30908	. . .	. . . . .
TP310Cb	S31040	. . .	. . . . .
TP310S	S31008	. . .	. . . . .
	S31272	. . .	. . . . .
TP316	S31600	ER316	S31680, W31640
TP316L	S31603	ER316L	S31683, W31643
TP316N	S31651	ER316	S31680, W31640
TP316LN	S31653	ER316L	S31683, W31643
TP316H	S31609	ER316H	S31680, W31640
		ER321	S32180, W32140
	S32100	ER347	S34780, W34740
TP321			
TP347	S34700	ER347	S34780, W34740
TP348	S34800	ER347	S34780, W34740
TPXM-19	S22100	ER209	S20980, W32240
TPXM-29	S28300	ER240	S23980, W32440
. . .	N08367	. . .	N06625

which standard practice was followed and what reference discontinuities were used.

14. Marking

14.1 In addition to the marking specified in Specification A 530/A 530M, the marking shall include the NPS (nominal pipe size) and schedule, heat numbering and NH when hydrotesting is not performed and ET when eddy-current testing is performed or UT when ultrasonic testing is performed. The marking shall also include the manufacturer's private identifying mark, the marking requirement of 9.4, if applicable, and whether seamless or welded. 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.

15. Government Procurement

15.1 *Scale Free Pipe for Government Procurement*:

15.1.1 When specified in the contract or order, the following requirements shall be considered in the inquiry, contract or order, for agencies of the U.S. Government where scale free pipe or tube is required. These requirements shall take precedence if there is a conflict between these requirements and the product specifications.

15.1.2 The requirements of Specification A 530/A 530M for pipe and Specification A 450/A 450M for tubes shall be applicable when pipe or tube is ordered to this specification.

15.1.3 Pipe and tube shall be one of the following grades as specified herein:

Grade	UNS Designation
TP304	S30400
TP304L	S30403
TP304N	S30451
TP316	S31600
TP316L	S31603
TP316N	S31651
TP317	S31700
TP317L	S31703
TP321	S32100
TP347	S34700

15.1.4 *Part Number*:

Example: ASTM A 312/A 312M Pipe 304 NPS 12 SCH 40S SMLS

Specification Number	ASTM A 312
Pipe	P
Grade	304
NPS	12
Wall	0.375
SMLS OR WELDED	SML

15.1.4.1

Specification Number	ASTM A 312
Tube	T
Grade	304
Outside Diameter	0.250
Wall	0.035
SMLS OR WELDED	WLD

15.1.5 *Ordering Information*—Orders for material under this specification shall include the following in addition to the requirements of Section 3:

15.1.5.1 Pipe or tube,

15.1.5.2 Part number,

15.1.5.3 Ultrasonic inspection, if required,

15.1.5.4 If shear wave test is to be conducted in two opposite circumferential directions,

15.1.5.5 Intergranular corrosion test, and

15.1.5.6 Level of preservation and packing required.

16. Keywords

16.1 austenitic stainless steel; seamless steel pipe; stainless steel pipe; steel pipe; welded steel pipe

SUPPLEMENTARY REQUIREMENTS

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 for each ten lengths or fraction thereof 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 6 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 530/A 530M 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 530/A 530M 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. Radiographic Examination

S5.1 The entire length of weld in each double welded pipe shall be radiographically examined, using X-radiation, in accordance with Paragraph UW-51 of Section VIII Division 1 of the ASME Boiler and Pressure Vessel Code. In addition to the marking required by Section 13 each pipe shall be marked "RT" after the specification and grade. Requirements of S5 shall be required in the certification.

S6. Stabilizing Heat Treatment

S6.1 Subsequent to the solution anneal required in 5.3, Grades TP309HCb, TP310HCb, TP321, TP321H, TP347, TP347H, TP348, and 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.

S7. Intergranular Corrosion Test

S7.1 When specified, material shall pass intergranular corrosion tests conducted by the manufacturer in accordance with Practices A 262, 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.

S7.2 A stabilization heat treatment in accordance with Supplementary Requirement S6 may be necessary and is permitted in order to meet this requirement for the grades containing titanium or columbium, particularly in their H versions.

S8. Minimum Wall Pipe

S8.1 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 S8.

APPENDIX

(Nonmandatory Information)

X1. DIMENSIONS OF WELDED AND SEAMLESS STAINLESS STEEL PIPE

X1.1 Table X1.1 is based on Table 1 of the American National Standard for stainless steel pipe (ANSI B36.19–1965).

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							
	in.	mm	Schedule 5S[A]		Schedule 10S[A]		Schedule 40S		Schedule 80S	
			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 B1.20.1).
[B] These do not conform to the American National Standard for Welded and Seamless Wrought Steel Pipe (ANSI B36.10–1979).