



Designation: A 813/A 813M – 01

Standard Specification for Single- or Double-Welded Austenitic Stainless Steel Pipe¹

This standard is issued under the fixed designation A 813/A 813M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This specification covers two classes of fit-up and alignment quality straight-seam single- or double-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 304, 304L, and 347 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, TP304N, TP316H, TP316N, TP321H, TP347H, and TP348H are modifications of Grades TP304, TP316, TP321, TP347, and TP348, and are intended for high-temperature service.

1.3 Two classes of pipe are covered as follows:

1.3.1 *Class SW*—Pipe, single-welded with no addition of filler metal and

1.3.2 *Class DW*—Pipe, double-welded with no addition of filler metal.

1.4 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.

1.5 Table 1 lists the dimensions of welded 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.

1.6 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.

2. Referenced Documents

2.1 ASTM Standards:

A 262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels²

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products²

A 480/A 480M Specification for the General Requirements of Flat-rolled Stainless and Heat Resisting Steel Plate, Sheet and Strip²

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products^{2,3}

A 999/A 999M Specification for General Requirements for Alloy and Stainless Steel Pipe³

E 213 Practice for Ultrasonic Examination of Metal Pipe and Tubing⁴

E 381 Method of Macroetch Testing, Inspection, and Rating Steel Products, Comprising Bars, Billets, Blooms, and Forgings⁴

E 426 Practice for Electromagnetic (Eddy-Current) Examination of Seamless and Welded Tubular Products, Austenitic Stainless Steel, and Similar Alloys⁴

E 527 Practice for Numbering Metals and Alloys (UNS)³

2.2 ANSI Standards:

B1.20.1 Pipe Threads, General Purpose⁵

B36.10 Welded and Seamless Wrought Steel Pipe⁵

B36.19 Stainless Steel Pipe⁵

2.3 ASME Boiler and Pressure Vessel Code:

Section VIII Division 1, Pressure Vessels⁶

2.4 Other Standard:

SNT-TC-1A Personnel Qualification and Certification in

² Annual Book of ASTM Standards, Vol 01.03.

³ Annual Book of ASTM Standards, Vol 01.01.

⁴ Annual Book of ASTM Standards, Vol 03.03.

⁵ Available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.

⁶ Available from American Society of Mechanical Engineers, 345 E. 47th St., New York, NY 10017.

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 Steel Tubing.

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TABLE 1 Dimensions of Welded and Seamless Stainless Steel Pipe^A

NOTE 1—Table 1 is based on Table number 1 of the American National Standard for Stainless Steel Pipe (ANSI B36.19-1965).
NOTE 2—The decimal thickness listed for the respective pipe sizes represents their nominal or average wall dimensions.

Table with 11 columns: NPS Designator, Outside Diameter (in., mm), and Nominal Wall Thickness (Schedule 5S, 10S, 40S, 80S in., mm). Rows list pipe sizes from 1/8 to 30 inches.

For pipe sizes not listed, the dimensions and tolerances shall be by agreement between the purchaser and producer.
Schedules 5S and 10S wall thicknesses do not permit threading in accordance with the American National Standard for Pipe Threads (ANSI B1.20.1).
These do not conform to the American National Standard for Welded and Seamless Wrought Steel Pipe (ANSI B36.10-1979).

Nondestructive Testing⁷

3. Ordering Information

3.1 Orders for material under 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 Class (1.3). If not specified by the purchaser, the producer shall have the option to furnish either single-welded (SW) or double-welded (DW) pipe,
3.1.4 Grade (Table 2),
3.1.5 Size (NPS or outside diameter and schedule number or average wall thickness),
3.1.6 Length (specific or random), (Section 9),
3.1.7 End finish (section on Ends of Specification A 999/A 999M),
3.1.8 Optional requirements (hydrostatic or nondestructive electric test, Section 13,) (Supplementary Requirements S1 to S6),
3.1.9 Test report required (Section on Certification of Specification A 999/A 999M),
3.1.10 Specification number, and
3.1.11 Special requirements or exceptions to the specification.

4. Materials and Manufacture

4.1 Manufacture:

4.1.1 The pipe shall be made by a machine-welding or an automatic-welding process, welding from one or both sides and producing full penetration welds with no addition of filler metal in the welding operation.

4.1.2 Weld repairs, with the addition of compatible filler metal, may be made to the weld joint in accordance with the requirements of the section on Repair by Welding of Specification A 999/A 999M.

4.1.3 The pipe shall be pickled free of scale. When bright annealing is used, pickling is not necessary.

4.2 Heat Treatment:

4.2.1 Except as provided in 4.2.5 and 4.2.6, all pipe shall be furnished in the heat-treated condition, except pipe sizes over NPS 6 may be furnished in the unheat-treated condition when specified in the order. When the pipe is furnished without final heat treatment, each pipe shall be marked HT-O and when a material test report for such pipe is furnished to the purchaser, the report shall indicate that the pipe has not been heat-treated. The heat-treatment procedure, except for H grades, N08367, 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.
4.2.2 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

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



TABLE 2 Chemical Requirements

| Grade | UNS Designation ^A | Composition, % | | | | | | | | | | | | | | | |
|---------|------------------------------|--------------------------|-----------------------------|-----------------|-------------|-----------|-----------|-----------|------------|----------|----------------------|---------------|-----------------------|----------|-----------|--------|-----------|
| | | Carbon, max ^B | Manganese, max ^B | Phosphorus, max | Sulfur, max | Silicon | Nickel | Chromium | Molybdenum | Titanium | Columbium | Tantalum, max | Nitrogen ^C | Vanadium | Copper | Cerium | Cobalt |
| TP304 | S30400 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 max | 8.0–11.0 | 18.0–20.0 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| TP304H | S30409 | 0.04–0.10 | 2.00 | 0.045 | 0.030 | 1.00 max | 8.0–11.0 | 18.0–20.0 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| TP304L | S30403 | 0.030 ^D | 2.00 | 0.045 | 0.030 | 1.00 max | 8.0–12.0 | 18.0–20.0 | ... | ... | ... | 0.10–0.16 | ... | ... | ... | ... | ... |
| TP304N | S30451 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 max | 8.0–11.0 | 18.0–20.0 | ... | ... | ... | 0.10–0.16 | ... | ... | ... | ... | ... |
| TP304LN | S30453 | 0.030 | 2.00 | 0.045 | 0.030 | 1.00 max | 8.0–11.0 | 18.0–20.0 | ... | ... | ... | 0.10–0.16 | ... | ... | ... | ... | ... |
| TP309Cb | S30940 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 max | 12.0–16.0 | 22.0–24.0 | ... | ... | 10 × C min, 1.10 max | ... | ... | ... | ... | ... | ... |
| TP309S | S30908 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 max | 12.0–15.0 | 22.0–24.0 | ... | ... | 10 × C min, 1.10 max | ... | ... | ... | ... | ... | ... |
| TP310Cb | S31040 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 max | 19.0–22.0 | 24.0–26.0 | ... | ... | 10 × C min, 1.10 max | ... | ... | ... | ... | ... | ... |
| TP310S | S31008 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 max | 19.0–22.0 | 24.0–26.0 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| TP316 | S31600 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 max | 10.0–14.0 | 16.0–18.0 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| TP316H | S31609 | 0.04–0.10 | 2.00 | 0.045 | 0.030 | 1.00 max | 10.0–14.0 | 16.0–18.0 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| TP316L | S31603 | 0.030 ^D | 2.00 | 0.045 | 0.030 | 1.00 max | 10.0–14.0 | 16.0–18.0 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| TP316N | S31651 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 max | 10.0–15.0 | 16.0–18.0 | ... | ... | ... | 0.10–0.16 | ... | ... | ... | ... | ... |
| TP316LN | S31653 | 0.030 ^D | 2.00 | 0.045 | 0.030 | 1.00 max | 10.0–13.0 | 16.0–18.0 | ... | ... | ... | 0.10–0.16 | ... | ... | ... | ... | ... |
| TP317 | S31700 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 max | 11.0–15.0 | 18.0–20.0 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| TP317L | S31703 | 0.030 | 2.00 | 0.045 | 0.030 | 1.00 max | 11.0–15.0 | 18.0–20.0 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| TP321 | S32100 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 max | 9.00–12.0 | 17.0–19.0 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| TP321H | S32109 | 0.04–0.10 | 2.00 | 0.045 | 0.030 | 1.00 max | 9.00–12.0 | 17.0–19.0 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| TP347 | S34700 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 max | 9.00–12.0 | 17.0–19.0 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| TP347H | S34709 | 0.04–0.10 | 2.00 | 0.045 | 0.030 | 1.00 max | 9.00–12.0 | 17.0–19.0 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| TP348 | S34800 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 max | 9.00–12.0 | 17.0–19.0 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| TP348H | S34809 | 0.04–0.10 | 2.00 | 0.045 | 0.030 | 1.00 max | 9.00–12.0 | 17.0–19.0 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| TPXM-10 | S21900 | 0.08 | 8.0–10.0 | 0.045 | 0.030 | 1.00 max | 5.5–7.5 | 19.0–21.5 | ... | ... | ... | 0.15–0.40 | ... | ... | ... | ... | 0.20 max |
| TPXM-11 | S21903 | 0.04 | 8.0–10.0 | 0.045 | 0.030 | 1.00 max | 5.5–7.5 | 19.0–21.5 | ... | ... | ... | 0.15–0.40 | ... | ... | ... | ... | 0.20 max |
| TPXM-15 | S38100 | 0.08 | 2.00 | 0.030 | 0.030 | 1.50–2.50 | 17.5–18.5 | 17.0–19.0 | ... | ... | ... | 0.20–0.40 | 0.10–0.30 | ... | ... | ... | ... |
| TPXM-19 | S20910 | 0.06 | 4.0–6.0 | 0.045 | 0.030 | 1.00 max | 11.5–13.5 | 20.5–23.5 | ... | ... | 0.10–0.30 | 0.20–0.40 | ... | ... | ... | ... | ... |
| TPXM-29 | S24000 | 0.08 | 11.5–14.5 | 0.060 | 0.030 | 1.00 max | 2.3–3.7 | 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 | ... | ... | ... | 0.18–0.22 | ... | ... | ... | ... | ... |
| ... | 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 | ... | ... | 0.50–1.00 | ... | 0.03–0.08 |
| ... | N08367 | 0.030 | 2.00 | 0.040 | 0.030 | 1.00 max | 23.5–25.5 | 20.0–22.0 | ... | ... | ... | 0.18–0.25 | ... | ... | 0.75 max | ... | ... |

^ANew designation established in accordance with ASTM E 527 and SAE J1086 Practice for Numbering Metals and Alloys (UNS).

^BMaximum, unless otherwise indicated.

^CThe method of analysis for nitrogen shall be a matter of agreement between the purchaser and manufacturer.

^DFor 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. [1.2 mm] in average wall thickness (0.044 in. [1.1 mm] in minimum wall thickness).

^EThe titanium content shall be not less than five times the carbon content and not more than 0.70 %.

^FThe titanium content shall be not less than four times the carbon content and not more than 0.70 %.

^GThe columbium plus tantalum content shall be not less than ten times the carbon content and not more than 1.0 %.

^HThe columbium plus tantalum content shall be not less than eight times the carbon content and not more than 1.10 %.

Grades TP304H and TP316H, 1900°F [1040°C]. If the H Grade is hot rolled, 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].

4.2.3 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.

4.2.4 UNS N08367 should be solution annealed from 2025°F [1107°C] minimum followed by rapid quenching.

4.2.5 Except for H Grades and S31254, pipe sizes over NPS 6 may be furnished in the unheat-treated condition when specified in the order.

4.2.6 H Grades and S31254 in pipe sizes NPS 6 may be furnished in the unheat-treated condition when specified in the order, provided the heat treatment of 4.2.2 or 4.2.3, as applicable, is applied by the purchaser.

4.2.7 When the pipe is furnished without final heat treatment, each pipe shall be marked HT-O and when a material test report for such pipe is furnished to the purchaser, the report shall indicate that the pipe has not been heat-treated.

5. Chemical Composition

5.1 The steel shall conform to the chemical composition in Table 2.

5.2 When specified on the purchase order, a product analysis shall be supplied from one tube or coil of steel per heat. The product analysis tolerance of Specification A 480/A 480M shall apply.

6. Product Analysis

6.1 At the request of the purchaser, an analysis of one length of flat-rolled stock from each heat, or one pipe 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 Number | Lengths of Pipe in Lot |
|------------------|-------------------------|
| Under 2 | 400 or fraction thereof |
| 2 to 5 inclusive | 200 or fraction thereof |
| 6 and over | 100 or fraction thereof |

6.2 The results of these analyses shall be reported to the purchaser or his representative, and shall conform to the requirements specified in Section 5.

6.3 If the analysis of one of the tests specified in 6.1 does not conform to the requirements specified in Section 5, an analysis of each length of flat-rolled stock from each heat or pipe from the same heat or lot may be made, and all pipe conforming to the requirements shall be accepted.

6.4 For referee purposes, Test Methods, Practices, and Terminology A 751 shall be used.

7. Tensile Requirements

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

8. Permissible Variations in Dimensions

8.1 Permissible variations in dimensions shall not exceed the following at any point in each length of pipe.

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] |
| TP309S | S30908 | 75 [515] | 30 [205] |
| TP310Cb | S31040 | 75 [515] | 30 [205] |
| TP310S | S31008 | 75 [515] | 30 [205] |
| 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 | 75 [515] | 30 [205] |
| TP321H | S32109 | 75 [515] | 30 [205] |
| 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] |
| ... | N08367 | | |
| | t ≤ 0.187 | 100 [690] | 45 [310] |
| | t > 0.187 | 95 [655] | 45 [310] |

8.1.1 *Specified Diameter*—The outside diameter shall be based on circumferential measurement and shall not exceed the tolerances stated as follows:

8.1.1.1 For sizes up to and including NPS 1¼, ±0.010 in. [±0.25 mm],

8.1.1.2 For sizes NPS 1½ up to and including NPS 6, ±0.020 in. [±0.5 mm],

8.1.1.3 For sizes NPS 8 up to and including NPS 18, ±0.030 in. [±0.75 mm],

8.1.1.4 For sizes NPS 20 up to and including NPS 24, ±0.040 in. [±1 mm], and

8.1.1.5 For sizes NPS 30, ±0.050 in. [±1.25 mm].

8.1.1.6 Outside diameter tolerances closer than shown above may be obtained by agreement between the pipe manufacturer and purchaser.

8.1.2 *Out-of-Roundness*—The difference between the major and the minor outside diameter shall not be more than 1.5 % of the specified outside diameter.

8.1.3 *Alignment (Camber)*—Using a 10-ft [3.0-m] straight-edge placed so that both ends are in contact with the pipe, the camber shall not be more than 3/16 in. [4.8 mm].

8.1.4 *Thickness*—The wall thickness at any point in the pipe excluding the weld, shall not be more than 12 % under or over the nominal thickness for wall thickness less than 0.188 in. [4.8 mm] and not more than 0.030 in. [0.8 mm] under or over the nominal thickness for wall thickness 0.188 in. [4.8 mm] and