



Designation: **A376/A376M – 22**

Used in USDOE-NE standards

Standard Specification for Seamless Austenitic Steel Pipe for High-Temperature Service¹

This standard is issued under the fixed designation A376/A376M; 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 specification² covers seamless austenitic steel pipe intended for high-temperature service. Among the grades covered are H grades and nitrogen grades that are specifically intended for high-temperature service.

NOTE 1—This specification was originally developed for use for piping in the central stations of electric-power generating thermal plants. However, its use is not restricted to such applications and it may be used in other applications for which the attributes of the materials, as defined by this specification, are appropriate.

1.2 Optional supplementary requirements (S1 through S10) are provided. These supplementary requirements specify additional tests that will be made only when stated in the order, together with the number of such tests required.

1.3 Grades TP321 and TP321H have lower strength requirements for nominal wall thicknesses greater than $\frac{3}{8}$ in. [9.5 mm].

1.4 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard. The inch-pound units shall apply unless the “M” designation of this specification is specified in the order.

NOTE 2—The dimensionless designators NPS (nominal pipe size) and DN (Diametre Nominel) have been substituted in this standard for such traditional terms as “nominal diameter,” “size,” and “nominal size.”

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

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.

Current edition approved Nov. 1, 2022. Published November 2022. Originally approved in 1954. Last previous edition approved in 2019 as A376/A376M – 19. DOI: 10.1520/A0376_A0376M-22.

² For ASME Boiler and Pressure Vessel Code applications see related Specification SA-376 in Section II of that Code.

2. Referenced Documents

2.1 *ASTM Standards:*³

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

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

E112 Test Methods for Determining Average Grain Size

E213 Practice for Ultrasonic Testing of Metal Pipe and Tubing

E381 Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings

E426 Practice for Electromagnetic (Eddy Current) Examination of Seamless and Welded Tubular Products, Titanium, Austenitic Stainless Steel and Similar Alloys

2.2 *Other Standards:*

SNT-TC-1A Personnel Qualification and Certification in Nondestructive Testing⁴

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 (seamless austenitic steel pipe),

3.1.3 Grade (Table 1),

3.1.4 Size (nominal size, or outside diameter and schedule number or average wall thickness),

3.1.5 Lengths (specific or random), (Permissible Variations in Length Section of Specification A999/A999M),

3.1.6 End finish (Ends Section of Specification A999/A999M),

3.1.7 Optional requirements (Section 8) (see Hydrostatic Test Requirements Section and the Permissible Variation in Weight for Seamless Pipe Section for weighing individual lengths, of Specification A999/A999M), (see 9.6, repairing by welding; 13.3, die stamping),

³ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

⁴ Available from American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlingate Ln., Columbus, OH 43228-0518.

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



TABLE 1 Chemical Requirements

Grade	UNS Designation	Composition, % ^A												
		Carbon	Man-ganese	Phos-phorus	Sul-fur	Sili-con	Nickel	Chromium	Molyb-denum	Tita-nium	Nio-bium ^B	Tan-talum	Nitro-gen ^C	Others
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	...	...	...	...	...	...
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	0.035	2.00	0.045	0.030	0.75	8.0–11.0	18.0–20.0	...	...	...	...	0.10–0.16	...
TP316	S31600	0.08	2.00	0.045	0.030	0.75	10.0–14.0	16.0–18.0	2.00–3.00	...	...	...	...	...
TP316H	S31609	0.04–0.10	2.00	0.045	0.030	0.75	10.0–14.0	16.0–18.0	2.00–3.00	...	...	...	...	...
TP316N	S31651	0.08	2.00	0.045	0.030	0.75	10.0–14.0	16.0–18.0	2.00–3.00	...	...	...	0.10–0.16	...
TP316LN	S31653	0.035	2.00	0.045	0.030	0.75	10.0–14.0	16.0–18.0	2.00–3.00	...	...	...	0.10–0.16	...
TP321	S32100	0.08	2.00	0.045	0.030	0.75	9.0–13.0	17.0–19.0	...	^D	...	...	...	...
TP321H	S32109	0.04–0.10	2.00	0.045	0.030	0.75	9.0–13.0	17.0–19.0	...	^E	...	...	...	...
TP347	S34700	0.08	2.00	0.045	0.030	0.75	9.0–13.0	17.0–19.0	...	...	^F	...	...	...
TP347H	S34709	0.04–0.10	2.00	0.045	0.030	0.75	9.0–13.0	17.0–19.0	...	...	^G	...	...	...
TP347LN	S34751	0.005–0.020	2.00	0.045	0.030	1.00	9.0–13.0	17.0–19.0	...	...	0.20–0.50 ^H	...	0.06–0.10	...
TP348 ^I	S34800	0.08	2.00	0.045	0.030	0.75	9.0–13.0	17.0–19.0	...	...	^F	0.10	...	Co 0.20
TP348H	S34809	0.04–0.10	2.00	0.045	0.030	1.00	9.0–13.0	17.0–19.0	...	...	^G	0.10	...	...
16-8-2H	S16800	0.05–0.10	2.00	0.045	0.030	0.75	7.5–9.5	14.5–16.5	1.50–2.00	...	...	...	...	...
...	S31725	0.030	2.00	0.045	0.030	0.75	13.5–17.5	18.0–20.0	4.0–5.0	...	...	...	0.20 max	Cu 0.75
...	S31726	0.030	2.00	0.045	0.030	0.75	14.5–17.5	17.0–20.0	4.0–5.0	...	...	...	0.10–0.20	Cu 0.75
...	S34565	0.030	5.0–7.0	0.030	0.010	1.0	16.0–18.0	23.0–25.0	4.0–5.0	...	...	...	0.040–0.060	Cb 0.10
...	S31266	0.030	2.00–4.00	0.035	0.020	1.00	21.0–24.0	23.0–25.0	5.2–6.2	...	...	...	0.035–0.060	Cu
														1.00–2.50 W 1.50–2.50

^A Maximum, unless otherwise indicated. Where ellipses (. . .) appear in this table, there is no requirement and analysis for the element need not be determined or reported.

^B The terms Niobium (Nb) and Columbium (Cb) are alternative names for the same element.

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

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

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

^F The niobium content shall be not less than ten times the carbon content and not more than 1.10 %.

^G The niobium content shall be not less than eight times the carbon content and not more than 1.10 %.

^H The niobium content shall not be less than 15 times the carbon content.

^I This grade is intended for special purpose applications.

3.1.8 Test report required (Certification Section of Specification **A999/A999M**),

3.1.9 Specification designation, and

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

4. General Requirements

4.1 Material furnished to this specification shall conform to the applicable requirements of the current edition of Specification **A999/A999M** unless otherwise provided herein.

5. Materials and Manufacture

5.1 *Manufacture*—At the manufacturer's option, pipe may be either hot finished or cold finished, with a suitable finishing treatment, where necessary.

5.2 Heat Treatment:

5.2.1 All pipe shall be furnished in the heat-treated condition unless the order specifically states that no final heat treatment shall be applied. When the order is furnished without final heat treatment, each pipe shall be stenciled "HT-O."

5.2.2 As an alternate to final heat treatment in a continuous furnace or batch-type furnace, 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.

5.2.3 *Grades TP304, TP304N, TP304LN, TP316, TP316N, TP316LN, TP321, TP347, TP347LN, TP348, 16-8-2H, S 31725, and S 31726*—Unless otherwise stated in the order, heat treatment shall consist of heating to a minimum temperature of 1900 °F [1040 °C] and quenching in water or rapidly cooling by other means.

5.2.3.1 The purchaser may specify controlled structural or special service characteristics which shall be used as a guide for the most suitable heat treatment. If the final heat treatment is at a temperature under 1900 °F [1040 °C], each pipe shall be stenciled with the final heat treatment temperature in degrees Fahrenheit or Celsius after the suffix "HT."

5.2.4 *Grades TP304H, TP316H, TP321H, TP347H, TP348H, and 16-8-2H*—If cold working is involved in processing, the minimum solution-treating temperature for Grades TP321H, TP347H, and TP348H shall be 2000 °F [1100 °C], for Grades TP304H and TP316H, 1900 °F [1040 °C], and for Grade 16-8-2H, 1800 °F [980 °C]. If the material is hot-rolled, the minimum solution-treating temperatures for Grades TP321H, TP347H, and TP348H shall be 1925 °F [1050 °C], for Grades TP304H and TP316H, 1900 °F [1040 °C], and for Grade 16-8-2H, 1800 °F [980 °C].

5.2.5 *Grade S34565*—Heat treatment shall consist of heating to a temperature in the range of 2050 °F [1120 °C] minimum and 2140 °F [1170 °C] maximum, and quenching in water or rapidly cooling by other means.