



Designation: A270/A270M – 23

Standard Specification for Seamless and Welded Austenitic and Ferritic/Austenitic Stainless Steel Sanitary Tubing¹

This standard is issued under the fixed designation A270/A270M; 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 U.S. Department of Defense.

1. Scope*

1.1 This specification covers grades of seamless, welded, and heavily cold worked welded austenitic and ferritic/austenitic stainless steel sanitary tubing intended for use in the dairy and food industry and having special surface finishes. Pharmaceutical quality may be requested, as a supplementary requirement.

1.2 This specification covers tubes in sizes up to and including 12 in. [300 mm] in outside diameter.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. 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.

1.4 Optional supplementary requirements are provided, and when one or more of these are desired, each shall be so stated in the order.

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.*

2. Referenced Documents

2.1 *ASTM Standards:*²

- A262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
- A480/A480M Specification for General Requirements for

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.

Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

A923 Test Methods for Detecting Detrimental Intermetallic Phase in Duplex Austenitic/Ferritic Stainless Steels

A967/A967M Specification for Chemical Passivation Treatments for Stainless Steel Parts

A1016/A1016M Specification for General Requirements for Ferritic Alloy Steel, Austenitic Alloy Steel, and Stainless Steel Tubes

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

2.2 *ASME Standard:*

B46.1 Surface Texture (Surface Roughness, Waviness, and Lay)³

2.3 *ASME Boiler and Pressure Vessel Code: Section VIII Pressure Vessels*³

2.4 *Other Standard:*

SAE J1086 Practice for Numbering Metals and Alloys (UNS)⁴

3. Terminology

3.1 *Definitions:*

3.1.1 *roughness average, Ra, n*—arithmetic average surface roughness normally reported in microinches or microns; a measurement of surface roughness usually performed by moving a stylus in a straight line along the surface, although other methods may be used.

4. Ordering Information

4.1 It is the responsibility of the purchaser to specify all requirements that are necessary for material ordered under this specification. Such requirements may include, but are not limited to, the following:

- 4.1.1 Quantity (feet, metres, or number of lengths),
- 4.1.2 Grade or UNS Designation,

³ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

⁴ Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.

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

- 4.1.3 Process seamless (SML), welded (WLD), or heavily cold worked (HCW),
- 4.1.4 Size (outside diameter and average wall thickness),
- 4.1.5 Length (specific or random),
- 4.1.6 Surface finish (Section 13),
- 4.1.7 Optional requirements (product analysis, see Section 9; hydrostatic or nondestructive electric test, see Section 11).
- 4.1.8 Test report required (Certification Section of Specification A1016/A1016M),
- 4.1.9 Specification designation,
- 4.1.10 Special requirements, and
- 4.2 Any supplementary requirements.

5. General Requirements

5.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification A1016/A1016M, unless otherwise provided herein.

6. Manufacture

6.1 The tubes shall be manufactured by one of the following processes:

6.1.1 Seamless (SML) tubes shall be made by a process that does not involve welding at any stage.

6.1.2 Welded (WLD) tubes shall be made using an automated welding process with no addition of filler metal during the welding process.

6.1.3 Heavily cold worked (HCW) tubes shall be made by applying cold working of not less than 35 % reduction of thickness of both wall and weld to a welded tube prior to the final anneal. No filler shall be used in making the weld. Prior to cold working, the weld shall be 100 % radiographically inspected in accordance with the requirements of ASME Boiler and Pressure Vessel Code Section VIII, Division 1, latest revision, Paragraph UW 51.

6.2 At the manufacturer's option, tubing may be furnished either hot finished or cold finished.

7. Heat Treatment

7.1 All material shall be furnished in the heat-treated condition. The heat treatment procedure, except for S31803, S32003, S32205, S32750, N08926 and N08367, shall consist of heating the material to a minimum temperature of 1900 °F [1040 °C] and quenching in water or rapid cooling by other means.

7.2 N08926 shall be heat-treated to a minimum temperature of 2010 °F [1100 °C] followed by quenching in water or rapidly cooling by other means. UNS N08367 should be solution annealed from 2025 °F [1110 °C] minimum followed by rapid quenching.

7.3 S31803 and S32205 shall be heat-treated in a temperature range of 1870 °F [1020 °C] to 2010 °F [1100 °C] followed by quenching in water or rapidly cooling by other means.

7.4 S32750 shall be heat-treated in a temperature range of 1880 °F [1025 °C] to 2060 °F [1125 °C] followed by quenching in water or rapidly cooling by other means.

7.5 S32003 shall be heat-treated in a temperature range of 1850 °F [1010 °C] to 2010 °F [1100 °C].

8. Chemical Composition

8.1 An analysis of either one length of flat-rolled stock or one tube shall be made for each heat. The chemical composition thus determined shall conform to the requirements given in Table 1.

9. Product Analysis

9.1 When requested by the purchaser, product analysis tolerance in Specification A480/A480M shall apply. The product analysis tolerance is not applicable to the carbon content for material with a specified maximum carbon of 0.04 % or less.

9.2 If the original test for product analysis fails, retests of two additional lengths of flat-rolled stock or tubes shall be made. Both retests for the elements in question shall meet the requirements of the specification; otherwise all remaining material in the heat or lot shall be rejected or, at the option of the producer, each length of flat-rolled stock or tube may be individually tested for acceptance. Lengths of flat rolled stock or tubes that do not meet the requirements of the specification shall be rejected.

10. Mechanical Tests Required

10.1 *Reverse Flattening Test*—For welded tubes, one reverse flattening test shall be made on a specimen from each 1500 ft [450 m] of finished tubing.

11. Hydrostatic or Nondestructive Electric Test

11.1 Each tube shall be subjected to the nondestructive electric test or the hydrostatic test. The type of test to be used shall be at the option of the manufacturer, unless otherwise specified in the purchase order.

12. Permissible Variations in Dimensions

12.1 The following variations in dimensions shall apply:

12.1.1 For tubes with a specified wall thickness of 0.049 in. [1.24 mm] and greater, variations in outside diameter from those specified shall not exceed the amount prescribed in Table 2. For tubes with a specified wall thickness less than 0.049 in. [1.24 mm], the diameter tolerances shall be a matter for agreement by the manufacturer and the purchaser.

12.1.2 When tubing >4 in. [100 mm] outside diameter is ordered, additional ovality may be required for thin wall tubing. Thin wall tubing applies when the specified wall is less than 0.150 in. [3.8 mm]. When thin wall tubing is ordered, the maximum and minimum outside diameter at any cross section shall deviate from the specified outside diameter by no more than twice the permissible variation in outside diameter given in Table 2; however, the mean diameter at that cross section must still be within the given permissible variation.

12.1.3 The wall thickness at any point shall not vary more than 12.5 %, from the specified wall thickness.

12.1.4 Variations in length shall meet the requirements in Table 2 except when the Pharmaceutical Quality Tubing (Supplementary Requirement S2) is specified.



TABLE 1 Chemical Requirements

Element	TP 304		TP 304L		TP 316		TP 316L		2205		S32003	
	UNS	S30400	S30403	S31254	S31600	S31603	N08926	N08367	S31803	S32205	S32750	S32003
Designation ^A	Composition, %											
Carbon, max	0.08	0.035 ^B	0.030	0.020	0.08	0.035 ^B	0.020	0.030	0.030	0.030	0.030	0.030 max
Manganese, max	2.00	2.00	1.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	1.20	2.00 max
Phosphorus, max	0.045	0.045	0.030	0.030	0.045	0.045	0.030	0.040	0.030	0.030	0.035	0.030
Sulfur, max	0.030	0.030	0.010	0.010	0.030	0.030	0.010	0.030	0.020	0.020	0.020	0.020 max
Silicon, max	1.00	1.00	0.80	0.80	1.00	1.00	0.50	1.00	1.00	1.00	0.80	1.00 max
Nickel	8.0–11.0	8.0–12.0	17.5–18.5	10.0–14.0	10.0–14.0	10.0–14.0	24.0–26.0	23.5–25.5	4.5–6.5	4.5–6.5	6.0–8.0	3.0–4.0
Chromium	18.0–20.0	18.0–20.0	19.5–20.5	16.0–18.0	16.0–18.0	16.0–18.0	19.0–21.0	20.0–22.0	21.0–23.0	22.0–23.0	24.0–26.0	19.5–22.5
Molybdenum	...	...	6.0–6.5	2.00–3.00	2.00–3.00	2.00–3.00	6.0–7.0	6.0–7.0	2.5–3.5	3.0–3.5	3.0–5.0	1.5–2.0
Nitrogen ^C	...	...	0.18–0.22	...	...	...	0.15–0.25	0.18–0.25	0.08–0.20	0.14–0.20	0.24–0.32	0.14–0.20
Copper	...	...	0.50–1.00	...	...	...	0.50–1.5	0.75 max	...	...	0.50 max	...

^A New designation established in accordance with Practice E527 and SAE J 1086.

^B 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 mm] in outside diameter and light wall tubes as those less than 0.049 in. [1.24 mm] in average wall thickness (0.044 in. [1.12 mm] in minimum wall thickness).

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

TABLE 2 Permissible Variations in Dimensions

Size, Outside Diameter, in. [mm]	Permissible Variations in Outside Diameter, in. [mm]		Permissible Variations in Cut Length, in. [mm] ⁴	
	Over	Under	Over	Under
1.000 [25] and under	0.005 [0.13]	0.005 [0.13]	1/8 [3]	0
Over 1 [25] to 2 [50]	0.008 [0.20]	0.008 [0.20]	1/8 [3]	0
Over 2 [50] to 3 [75]	0.010 [0.25]	0.010 [0.25]	1/8 [3]	0
Over 3 [75] to 4 [100]	0.015 [0.38]	0.015 [0.38]	1/8 [3]	0
Over 4 [100] to 5 1/2 [140], excl	0.015 [0.38]	0.015 [0.38]	3/16 [5]	0
5 1/2 [140] to 8 [200], excl	0.030 [0.75]	0.030 [0.75]	3/16 [5]	0
8 [200] to 12 [300]	0.050 [1.25]	0.050 [1.25]	3/16 [5]	0

⁴ The cut tolerances do not apply to Pharmaceutical Tubing in S2 (see paragraph S2.7).

13. Surface Finishes

13.1 The following surface finishes may be specified:

13.1.1 *Mill Finish*—A finish without additional polishing or operations intended to smooth the surface.

13.1.2 *Mechanically Polished Surface Finish*—The purchaser may specify one of the following finish numbers for a mechanically polished surface:

13.1.2.1 *Finish No. 80*—A ground finish produced by polishing a tube with an abrasive media impregnated with No. 80 grit.

13.1.2.2 *Finish No. 120*—A ground finish produced by polishing a tube with an abrasive media impregnated with No. 120 grit.

13.1.2.3 *Finish No. 180*—A ground finish produced by polishing a tube with an abrasive media impregnated with No. 180 grit.

13.1.2.4 *Finish No. 240*—A ground finish produced by polishing a tube with an abrasive media impregnated with No. 240 grit.

13.1.2.5 Other mechanically polished finishes may be agreed upon between the purchaser and manufacturer.

13.1.3 *Electropolished Finish*—A bright reflective finish produced by electropolishing. The manufacturer may use other polishing operations prior to electropolishing.

13.1.4 *Maximum Roughness Average (Ra) Surface Finish*—The customer may specify a maximum Ra on the inside surface, outside surface, or both. The measurement of surface roughness shall be in accordance with ASME B46.1.

13.1.4.1 When no agreement is made regarding Ra measurement of longitudinally polished tube, disputes shall be resolved using measurements made in accordance with ASME B46.1.

13.2 The manufacturer shall select a manufacturing method to produce the specified finish. The operations may or may not include polishing.

13.2.1 The purchaser may specify the polishing type for either the inside surface, outside surface or both for the final desired effect.

13.2.1.1 *Longitudinally Polished Finish*—It is usually performed on the inside surface only.

13.2.1.2 *Circumferential (Rotary) Polished Finish*—This can be performed on either the inside surface, outside surface, or both.

13.2.1.3 When the surface is finished by circumferential mechanical polishing, the Ra measurement shall be measured in the longitudinal direction. Roughness measurement of a longitudinal mechanical polished surface shall be a matter of agreement between the manufacturer and the purchaser.

13.3 Acceptance criteria for minor surface imperfections shall be a matter of agreement by the manufacturer and the purchaser.

13.4 Combinations of the above finishes for internal and external surfaces may be specified. When tubes are polished only on one surface, the other surface may be the regular mill finish.

14. Product Marking

14.1 In addition to the marking prescribed in Specification **A1016/A1016M** and specified in the order, the marking shall include whether the tubing is seamless (SML), welded (WLD), or heavily cold worked (HCW), and the surface finish.

15. Packaging

15.1 Unless otherwise specified in the order, all tubing shall be protected for shipment by bundling, paper or burlap wrapping, or boxing at the discretion of the manufacturer.

16. Keywords

16.1 austenitic stainless steel; duplex stainless steel; ferritic/austenitic stainless steel; heavily cold worked tube; seamless steel tube; stainless steel tube; steel tube; welded steel tube