Designation: A632 – 19

Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service[1]

This standard is issued under the fixed designation A632; 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 grades of stainless steel tubing in sizes under ½ down to 0.050 in. (12.7 to 1.27 mm) in outside diameter and wall thicknesses less than 0.065 in. down to 0.005 in. (1.65 to 0.13 mm) for general corrosion-resisting and low- or high-temperature service, as designated in Table 1.

NOTE 1—The grades of austenitic stainless steel tubing furnished in accordance with this specification have been found suitable for low-temperature service down to −325°F (−200°C) in which Charpy notched-bar impact values of 15 ft·lbf (20 J), minimum, are required and these grades need not be impact tested.

1.2 Optional supplementary requirements are provided and, when desired, shall be so stated in the order.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *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

A380/A380M Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems

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

E165/E165M Practice for Liquid Penetrant Testing for General Industry

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

2.2 *SAE Standard:*

SAE J 1086 Practice for Numbering Metals and Alloys (UNS)[3]

3. Ordering Information

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

3.1.1 Quantity (feet or number of lengths),

3.1.2 Name of product (seamless or welded tubes),

3.1.3 Grade (see Table 1),

3.1.4 Size (only two of the following: outside diameter, inside diameter, and average wall),

3.1.5 Length (specific or random),

3.1.6 Optional requirements (check analysis, see Section 7; hydrostatic, air underwater pressure test, or nondestructive electric test, see Section 13),

3.1.7 Test report required,

3.1.8 Specification designation, and

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

4. General Requirements

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

5. Manufacture

5.1 *Manufacture*—The tubes shall be cold finished and shall be made by the seamless or welded process.

5.2 *Heat Treatment*—All material shall be furnished in the heat-treated condition. The heat-treatment procedure shall consist of heating the material to a minimum temperature of 1900°F (1040°C) and quenching in water or rapidly cooling by other means.

[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 SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, http://www.sae.org.

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

TABLE 1 Chemical Requirements[B]

Element	Composition, %								
Grade	TP 304	TP 304L	TP 310	TP 316	TP 316L	TP 317	TP 321	TP 347	TP 348
UNS Designation[A]	S30400	S30403	S31000	S31600	S31603	S31700	S32100	S34700	S34800
Carbon, max	0.08	0.030	0.25	0.08	0.030	0.08	0.08	0.08	0.08
Manganese max	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Phosphorus, max	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045
Sulfur, max	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030
Silicon, max	1.00	1.00	1.50	1.00	1.00	1.00	1.00	1.00	1.00
Nickel	8.0–11.0	8.0–12.0	19.0–22.0	10.0–14.0	10.0–14.0	11.0–15.0	9.0–12.0	9.0–13.0	9.0–13.0
Chromium	18.0–20.0	18.0–20.0	24.0–26.0	16.0–18.0	16.0–18.0	18.0–20.0	17.0–19.0	17.0–19.0	17.0–19.0
Molybdenum	...	...	...	2.00–3.00	2.00–3.00	3.0–4.0	...	...	...
Titanium	...	...	...	...	...	...	[C]	...	...
Niobium[F] + tantalum	...	...	...	...	...	...	...	[D]	[E]
Tantalum, max	...	...	...	...	...	...	...	...	0.10
Other Elements	...	...	...	...	...	...	...	...	Co 0.20

[A] New designation established in accordance with Practice E527 and SAE J 1086, Practice for Numbering Metals and Alloys (UNS).
[B] Maximum, unless otherwise indicated. Where ellipses (...) appear in this table, there are no requirements and analysis for the element need not be determined or reported.
[C] Grade TP 321 shall have a titanium content of not less than five times the carbon content plus nitrogen and not more than 0.70 %.
[D] Grade TP 347 shall have a niobium content of not less than ten times the carbon content and not more than 1.10 %.
[E] Grade TP 348 shall have a niobium plus tantalum content of not less than ten times the carbon content and not more than 1.10 %.
[F] The terms Columbium (Cb) and Niobium (Nb) both refer to the same element.

6. Chemical Composition

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

7. Product Analysis

7.1 When specified on the purchase order, an analysis of either one billet or one length of flat-rolled stock or one tube shall be made from each heat. The chemical composition thus determined shall conform to the specified requirements.

7.2 If the analysis made in accordance with 7.1 does not conform to the specified requirements, an analysis of each billet or length of flat-rolled stock or tube from the same heat may be made and all billets, stock, or tubes thus conforming to the requirements shall be accepted so far as chemical composition is concerned.

8. Mechanical Properties

8.1 *Tensile Requirements*—The material shall conform to the requirements as to tensile properties specified in Table 2. These mechanical properties apply to tubing ⅛ in. (3.2 mm) and larger in outside diameter by 0.015 in. (0.38 mm) in wall thickness and heavier. Smaller sizes are available meeting the minimum tensile strength specified in Table 2; however, yield strength is not generally determined on such sizes, and the minimum elongation shall be 25 %.

TABLE 2 Tensile Requirements

Tensile strength, min, ksi (MPa)	75[A] (515)[A]
Yield strength, min, ksi (MPa)	30[A,B] (205)[A,B]
Elongation in 2 in. or 50 mm, min, %	35[B]

[A] Grades TP 304L and TP 316L shall have a minimum tensile strength of 70 ksi (485 MPa) and a minimum yield strength of 25 ksi (170 MPa).
[B] Yield strength is not generally determined on tubing sizes smaller than ⅛ in. (3.2 mm) in outside diameter or thinner than 0.015 in. (0.38 mm) wall, so yield strength is not required on such sizes. Also, the minimum elongation required on these smaller or thinner sizes is 25 %.

9. Permissible Variations in Dimensions

9.1 Variations in diameter and wall thickness from those specified shall not exceed the amounts specified in Table 3.

10. Surface Condition

10.1 The tubes shall be pickled free of scale. When bright annealing is used, pickling is not required.

11. Number of Tests

11.1 For each lot of 100 finished tubes or fraction thereof, two tubes shall be selected at random for the flaring test (see Note 2).

11.2 One tension test shall be made on a specimen for lots of not more than 50 tubes. Tension tests shall be made on specimens from two tubes for lots of more than 50 tubes (see Note 3).

NOTE 2—For flaring requirements, the term *lot* applies to all tubes of the same nominal size and wall thickness that are produced from the same heat of steel and subjected to the same finishing treatment in a continuous furnace; when final heat treatment is in a batch-type furnace, the lot shall include only those tubes that are heat treated in the same furnace charge.

NOTE 3—For tensile requirements, the term *lot* applies to all tubes prior to cutting, of the same nominal diameter and wall thickness that are produced from the same heat of steel. When final heat treatment is in a

TABLE 3 Permissible Variations in Dimensions

Outside Diameter Range	Outside Diameter, in. (mm)	Inside Diameter, in. (mm)	Wall, plus and minus, %
Up to, but not including 3/32 (0.094) in. (2.38 mm)	+0.002 (0.05) −0.000	+0.000 −0.002 (0.05)	10
3/32 (0.094) in. (2.38 mm) but not including 3/16 (0.188) in. (4.76 mm)	+0.003 (0.08) −0.000	+0.000 −0.003 (0.08)	10
3/16 to, but not including, ½ (0.500) in. (12.70 mm)	+0.004 (0.10) −0.000	+0.000 −0.004 (0.10)	10