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Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products[1]

This standard is issued under the fixed designation A778/A778M; 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 straight seam and spiral butt seam welded unannealed austenitic stainless steel tubular products intended for low and moderate temperatures and corrosive service where heat treatment is not necessary for corrosion resistance. Table 1 lists the five grades covered by this specification. The user of this specification should be aware that a minimum amount of testing and examination is required of the basic product. The user requiring additional testing or examination is referred to the supplemental requirements or Ordering Information, or both. Users requiring a tubular product with post-weld heat treatment or with radiographic examination are referred to Specification A312/A312M, A358/A358M, or A409/A409M, as applicable.

1.2 This specification covers welded unannealed tubular products 3 in. [75 mm] through 48 in. [1200 mm] in outside diameter and in nominal wall thicknesses of 0.062 in. [1.57 mm] through 0.500 in. [12.70 mm] produced to this specification. Tubular products having other diameters or wall thickness, or both, may be furnished provided it complies with all other requirements of this specification.

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

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2. Referenced Documents

2.1 *ASTM Standards:*[2]

A240/A240M Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

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

A312/A312M Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

A358/A358M Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Stainless Steel Pipe for High-Temperature Service and General Applications

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A409/A409M Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service

A700 Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment

A941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys

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

E340 Practice for Macroetching Metals and Alloys

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

2.2 *AWS Standards:*

A5.4 Corrosion—Resisting Chromium and Chromium-Nickel Steel Covered Welding Electrodes[3]

A5.9 Corrosion–Resisting Chromium and Chromium-Nickel Steel Welding Rods and Bare Electrodes[3]

[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 American Welding Society (AWS), 550 NW LeJeune Rd., Miami, FL 33126, http://www.aws.org.

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

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TABLE 1 Chemical Requirements

Grade	UNS Designation[A]	Carbon max[B]	Manganese, max	Phosphorus, max	Composition, %					Titanium	Columbium Plus Tantalum	Nitrogen, max
					Sulfur, max	Silicon, max	Chromium	Nickel				
TP 304L	S30403	0.030	2.00	0.045	0.030	1.00	18.0–20.0	8.0–13.0	...	...	...	0.10
TP 316L	S31603	0.030	2.00	0.045	0.030	1.00	16.0–18.0	10.0–14.0	2.00 3.00	...	...	0.10
TP 317L	S31703	0.030	2.00	0.045	0.030	1.00	18.0–20.0	11.0–15.0	3.0 4.0	...	...	0.10
TP 321	S32100	0.08	2.00	0.045	0.030	1.00	17.0–19.0	9.0–12.0	...	[C]	...	...
TP 347	S34700	0.08	2.00	0.045	0.030	1.00	17.0–19.0	9.0–12.0	...	...	[D]	...

[A] New designation established in accordance with Practice E527 and SAE J1086.
[B] The carbon analysis shall be reported to the nearest 0.01 %, except for the low carbon (0.030) types, which shall be reported to the nearest 0.001 %.
[C] The titanium content shall be not less than five times the carbon content and not more than 0.70 %.
[D] The columbium plus tantalum content shall be not less than ten times the carbon content and not more than 1.10 %.

2.3 *SAE Standard:*
SAE J1086 Practice for Numbering Metals and Alloys (UNS)[4]

3. Terminology

3.1 *Definitions:*

3.2 The definitions in Specification A999/A999M and Terminology A941 are applicable to this specification.

4. Ordering Information

4.1 Orders for material to this specification should include the following:
4.1.1 Quantity (feet, metres, or number of pieces),
4.1.2 Name of material (welded unannealed austenitic stainless steel tubular products),
4.1.3 Straight seam or spiral butt seam,
4.1.4 Grade (see Table 1),
4.1.5 Size (outside diameter and specified wall thickness) (see 10.3 and 10.4),
4.1.6 Length (mill standard lengths, or specify cut lengths) (see 10.1),
4.1.7 Optional requirements (Supplementary Requirements S1 to S5),
4.1.8 Certification requirements,
4.1.9 Specification designation, and
4.1.10 Special requirements.

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5. Significance and Use

5.1 It is anticipated that the ASTM Subcommittees A01.06, A01.10, A01.17, A01.22, and A01.28 will use the standard composition limits listed in this specification for the grades identified by the corresponding UNS designation in the product specification unless there is a specific technical justification for doing otherwise. The compositions in this specification shall not be considered as chemical requirements for any particular product until adopted by the subcommittee overseeing that product.

6. Manufacture

6.1 The tubular products shall be made from flat-rolled steel sheet, coil, or plate by a shielded arc-welding process. The material used for manufacture shall conform to the requirements of one of the grades of Specification A240/A240M listed in Table 1. At the manufacturer's option, filler metal may be used.

6.2 Tubular products 14 in. [350 mm] in diameter and smaller shall have a single longitudinal weld or a spiral butt weld seam. Tubular products of larger diameter may have a maximum of three longitudinal welds. All weld tests, examinations, inspections, or treatments are to be performed on each weld seam.

6.3 Circumferentially welded joints of the same quality as the longitudinal or spiral joints shall be permitted by agreement between the manufacturer and the purchaser.

6.4 All tubular products shall be furnished clean and free of scale.

6.5 *Welding:*
6.5.1 The welds shall be made by the manual or automatic electric-welding process.

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

6.5.2 The welded joints may show a reinforcing bead no greater than 1/16 in. [1.57 mm] on either surface of the tubular product. At no place shall the thickness of the weld section be less than the minimum wall thickness permitted by the tolerances of 10.4. The weld bead may be removed at the option of the manufacturer or upon agreement between the manufacturer and purchaser.

6.5.3 Injurious weld defects shall be repaired by removal to sound metal and rewelding.

6.5.4 The alloy content (chromium, nickel, molybdenum, columbium, and carbon) of the filler metal shall conform to that required for the plate or the welding electrodes as shown in Table II of Specification AWS A5.4 or in Table I of Specification AWS A5.9, except that when welding on Type 321 base metal, the deposited weld metal may correspond to Type 347.

7. Mechanical Test Requirements

7.1 Each lot shall be subjected to one transverse tension test and two transverse guided bend tests.

NOTE 1—The term *lot* applies to all pipe of the same grade, of the same thickness, produced from the same heat with the same weld procedure.

7.2 The maximum lot size shall be in accordance with the following table:

Diameter Range	Lot Size (lengths)
up to 3 in. [75 mm] exclusive	400
~~3–8 in. [75–200 mm] exclusive~~	~~300~~
3 in. [75 mm] to 8 in. [200 mm] exclusive	300
~~8–14 in. [200–350 mm]~~	~~200~~
~~exclusive~~	
8 in. [200 mm]	200
to 14 in. [350 mm] exclusive	
14 in. [350 mm] and over	100

7.3 *Specimen Preparation:*

7.3.1 Transverse tension and bend test specimens shall be taken from the end of a length and shall be flattened cold before final machining to size.

7.3.2 As an alternative to the requirements of 7.3.1, the test specimens may be taken from test plates of the same material as the tube, which are attached to the end of the cylinder and welded as a prolongation of the tube longitudinal weld.

7.3.3 Tension test specimens shall be made in accordance with Test Methods and Definitions A370.

7.4 *Transverse Tension Test:*

7.4.1 Transverse tension tests taken transversely across the welded joint shall meet the same minimum tensile strength as the base material (Table 2).

7.4.2 When diameters below 8-in. [200 mm] make it impractical to perform a transverse tension test, an alternative test may be permitted by agreement between the manufacturer and the purchaser.

7.5 *Transverse Guided—Bend Weld Test:*

7.5.1 Take two bend test specimens transversely from the weld. Subject one to a face guided-bend test and the second to a root guided-bend test. Bend one specimen with the inside surface of the tube against the plunger, and the other with the outside surface against the plunger.

7.5.2 The bend test shall be acceptable if no cracks or other defects exceeding 1/8 in. [3.17 mm] in any direction are present in the weld metal or between the weld and the parent metal after bending. Cracks that originate along the edges of the specimen during testing, and that are less than 1/4 in. [6.35 mm] measured in any direction shall not be considered.

7.5.3 Make and test transverse guided-bend weld test specimens in accordance with Test Methods and Definitions A370.

7.5.4 When diameters below 8 in. [200 mm] make it impractical to perform a transverse guided-bend test, a flattening test may be substituted (see Supplementary Requirement S5).

8. Heat Treatment

8.1 Heat treatment shall not be required.

9. Chemical Requirements

9.1 Mill certificates of heat analysis of each heat of steel shall be furnished upon request.

TABLE 2 Tensile Requirements

Grade	UNS Designation	Tensile Strength, min, ksi [MPa]
TP 304L	S30403	70 [485]
TP 316L	S31603	70 [485]
TP 317L	S31703	75 [515]
TP 321	S32100	75 [515]
TP 347	S34700	75 [515]