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An American National Standard

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

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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 A 312/A 312M, A 358/A 358M, or A 409/A 409M, 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. (1.5 mm) through 0.500 in. (12.5 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 inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

A 240 Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels[2]

A 262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels[2]

A 312/A 312M Specification for Seamless and Welded Austenitic Stainless Steel Pipes[3]

A 358/A 358M Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High-Temperature Service[3]

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products[2]

A 409/A 409M Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service[3]

A 700 Practices for Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment[4]

A 941 Terminology Relating to Steel, Related Alloys, and Ferroalloys[3]

A 999/A 999M Specification for General Requirements for Alloy and Stainless Steel Pipe[3]

E 340 Test Method for Macroetching Metals and Alloys[5]

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

2.2 *AWS Standards:*

A 5.4 Corrosion—Resisting Chromium and Chromium-Nickel Steel Covered Welding Electrodes[6]

A 5.9 Corrosion–Resisting Chromium and Chromium-Nickel Steel Welding Rods and Bare Electrodes[6]

2.3 *SAE Standard:*

SAE J1086 Practice for Numbering Metals and Alloys (UNS)[7]

3. Terminology

3.1 *Definitions:*

3.2 The definitions in Specification A 999/A 999M and Terminology A 941 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),

[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] *Annual Book of ASTM Standards,* Vol 01.03.

[3] *Annual Book of ASTM Standards,* Vol 01.01.

[4] *Annual Book of ASTM Standards,* Vol 01.05.

[5] *Annual Book of ASTM Standards,* Vol 03.01.

[6] Available from American Welding Society, 2501 N.W. 7th St., Miami, FL 33125.

[7] Available from Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.

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TABLE 1 Chemical Requirements

Grade	UNS Designation[A]	Carbon max[B]	Manganese, max	Phosphorus, max	Composition, %							
					Sulfur, max	Silicon, max	Chromium	Nickel		Titanium	Columbium Plus Tantalus	Nitrogen, max
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 E 527 and SAE J1086, Practice for Numbering Metals and Alloys (UNS).
[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 %.

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.

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 A 240 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.

6.5.2 The welded joints may show a reinforcing bead no greater than 1/16 in. (1.6 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. exclusive	400
3–8 in. exclusive	300
8–14 in. exclusive	200
14 in. 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 A 370.

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

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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)

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 ⅛ in. (3 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 ¼ in. (6 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 A 370.

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.

10. Permissible Variations in Tubular Products Dimensions

10.1 *Lengths*—Tubular products are normally furnished in mill lengths 10 ft (3 m) and over. If specific lengths are ordered, no length shall be under the length specified and not more than ¼ in. (6 mm) over that specified.

10.2 *Straightness*—Using a 10-ft (3-m) straightedge placed so that both ends are in contact with the length, a maximum of a 0.25-in. (6-mm) gap is allowable.

10.3 *Diameter Tolerance*—Refer to the applicable table in Specification A 999/A 999M.

10.4 *Wall Thickness*—Wall thickness tolerance shall be ±12.5 %.

11. Workmanship

11.1 Finished products shall have smooth ends free of burrs. Tubular products shall be free of injurious defects and shall have a workmanlike finish. Surface imperfections, such as handling marks, straightening marks, light mandrel and die marks, shallow pits, and scale patterns, will not be considered as serious defects, provided the imperfections are removable within the allowable wall thickness tolerance. The removal of surface imperfections is not required.

12. Inspection

12.1 The inspector representing the purchaser shall have entry at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works that concern the manufacture of the material ordered. The manufacturer shall afford the inspector all reasonable facilities to satisfy him that the material is being furnished in accordance with this specification. All required tests and inspections shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be conducted so as not to interfere unnecessarily with the operation of the works.

13. Rejection

13.1 Each length of tube received from the manufacturer may be inspected by the purchaser. If it does not meet the requirements of this specification based on the inspection and test method as outlined, the length may be rejected and the manufacturer shall be notified. Disposition of rejected lengths shall be a matter of agreement between the manufacturer and the purchaser.

14. Certification

14.1 A certification that the material conforms to the requirements of this specification shall be the basis of acceptance of the material. When requested by the purchaser, the manufacturer shall report to the purchaser or his representative the results of any supplemental test requirements.

15. Product Marking

15.1 Each length of tube shall be legibly marked with the manufacturer's name or brand, specified size, heat number, this specification number, grade of material, and the letters *HT-O* to indicate that the pipe was not heat treated.

15.2 For small-diameter tubes and pieces under 3 ft (0.90 m) in length, the information specified in 15.1 shall be marked on a tag securely attached to the bundle or box in which the pieces are shipped.

16. Packaging

16.1 Tubular products may be shipped loose. The manufacturer may, at his option, box, crate, or package in secure lifts or bundles to ensure safe delivery as specified in Practices A 700.

17. Keywords

17.1 austenitic stainless steel; stainless steel tubing; steel tubing; welded steel tubing

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SUPPLEMENTARY REQUIREMENTS

One or more of the following supplementary requirements may be included in the purchaser's inquiry or in the order or contract. When so included, a supplementary requirement shall have the same force as if it were in the body of the specification. Details of a supplementary requirement shall be agreed to between the manufacturer and the purchaser.

S1. Etching Tests

S1.1 An etching test, when specified, shall be made on a transverse section from one end of one length from each 2500 ft (760 m) or fraction thereof from each heat of steel or as specified by the purchaser. An etching test in accordance with Test Method E 340 shall be made. The test shall show sound, homogeneous, and reasonable uniform material, free of injurious laminations, cracks, and similar objectionable defects. If the specimen of any length shows objectional defects, one retest shall be permitted from the same end. If this fails, the length shall be rejected.

S2. Intergranular Corrosion Bend Test

S2.1 One intergranular corrosion bend test shall be made on a welded section from one end of one length from each 2500 ft (760 m) or fraction thereof from each heat of steel or as specified by the purchaser. The specimen shall be bent so that the location of weld is at the point of maximum bend. The method of testing shall be in accordance with Practice E of Practices A 262.

S3. Packaging Requirements

S3.1 The ends shall be protected with wooden or plastic plugs.

S4. Hydrostatic Test

S4.1 Each length shall be subjected to a hydrostatic test in accordance with Specification A 999/A 999M, section on Hydrostatic Test Requirements.

S5. Flattening Test

S5.1 One flattening test shall be made to represent each lot (see Note 1) of finished product. Crop ends may be used.

S5.2 Evidence of laminated or unsound material that is revealed during the flattening test shall be cause for rejection.

S5.3 Superficial ruptures resulting from surface imperfections shall not be cause for rejection.

S5.4 A section of welded pipe not less than 4 in. (100 mm) in length shall be flattened cold between parallel plates in two steps. The weld shall be placed 90° from the direction of the applied force. During the first step, which is a test for ductility, no cracks or breaks on the inside or outside surfaces shall occur until the distance between the plates is less than one half of the outside diameter of the pipe. During the second step, which is a test for soundness, the flattening shall be continued until the specimen breaks or the opposite walls of the pipe meet.

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