



Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings¹

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This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers wrought stainless steel fittings for pressure piping applications.²

1.2 Several grades of austenitic stainless steel alloys are included in this specification. Grades are designated with a prefix, WP or CR, based on the applicable ANSI or MSS dimensional and rating standards, respectively.

1.3 For each of the WP stainless grades, several classes of fittings are covered, to indicate whether seamless or welded construction was utilized. Class designations are also utilized to indicate the nondestructive test method and extent of nondestructive examination (NDE). Table 1 is a general summary of the fitting classes applicable to all WP grades of stainless steel covered by this specification. There are no classes for the CR grades. Specific requirements are covered elsewhere.

1.4 This specification is expressed in both inch-pound units and in SI units. However, unless the order specifies the applicable “M” specification designation (SI units), the material shall be furnished to inch-pound units.

1.5 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 are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

1.6 This specification does not apply to cast steel fittings. Austenitic stainless steel castings are covered in Specifications A 351/A 351M, A 743/A 743M, and A 744/A 744M.

2. Referenced Documents

2.1 ASTM Standards:

A 262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels³

¹ This specification is under the jurisdiction of ASTM Committee A-1 on Steel, Stainless Steel, and Related Alloys and is the direct responsibility of Subcommittee A01.22 on Steel Forgings and Wrought Fittings for Piping Applications and Bolting Materials for Piping and Special Purpose Applications.

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² For ASME Boiler and Pressure Vessel Code applications see related Specification SA-403 in Section II of that Code.

³ *Annual Book of ASTM Standards*, Vol 01.03.

TABLE 1 Fitting Classes for WP Grades

Class	Construction	Nondestructive Examination
S	Seamless	None
W	Welded	Radiography or Ultrasonic
WX	Welded	Radiography
WU	Welded	Ultrasonic

A 351/A 351M Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure Containing Parts⁴

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products³

A 388/A 388M Practice for Ultrasonic Examination of Heavy Steel Forgings⁵

A 480/A 480M Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip³

A 743/A 743M Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application⁴

A 744/A 744M Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant for Severe Service⁴

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products³

E 112 Test Methods for Determining the Average Grain Size⁶

E 165 Test Method for Liquid Penetrant Examination⁷

2.2 ANSI Standards:⁸

ANSI B16.9 Factory-Made Wrought Steel Butt-Welding Fittings

ANSI B16.11 Forged Steel Fittings, Socket-Welding and Threaded

ANSI B16.28 Wrought Steel Butt-Welding Short Radius Elbows and Returns

2.3 MSS Standards:⁹

⁴ *Annual Book of ASTM Standards*, Vol 01.02.

⁵ *Annual Book of ASTM Standards*, Vol 01.05.

⁶ *Annual Book of ASTM Standards*, Vol 03.01.

⁷ *Annual Book of ASTM Standards*, Vol 03.03.

⁸ Available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.

⁹ Available from Manufacturers' Standardization Society of the Valve and Fittings Industry, 127 Park St., Northeast, Vienna, VA 22180.

MSS SP-25 Standard Marking System for Valves, Fittings, Flanges, and Unions

MSS SP-43 Standard Practice for Light Weight Stainless Steel Butt-Welding Fittings

MSS SP-79 Socket-Welding Reducer Inserts

MSS SP-95 Swaged(d) Nipples and Bull Plugs

2.4 *ASME Boiler and Pressure Vessel Code:*

Section VIII Division I, Pressure Vessels¹⁰

Section IX Welding Qualifications⁹

2.5 *AWS Standards:*

A 5.4 Specification for Corrosion-Resisting Chromium and Chromium-Nickel Steel Covered Welding Electrodes¹¹

A 5.9 Specification for Corrosion-Resisting Chromium and Chromium-Nickel Steel Welding Rods and Bare Electrodes¹¹

2.6 *ASNT:*

SNT-TC-1A(1984) Recommended Practice for Nondestructive Testing Personnel Qualification and Certification¹²

3. Ordering Information

3.1 It is the purchaser's responsibility to specify in the purchase order all ordering information necessary to purchase the needed material. Examples of such information include but are not limited to the following:

3.1.1 Quantity, number of fittings of each kind,

3.1.2 Description of fitting and nominal dimension (standard or special),

3.1.3 Steel composition by grade and Class designation,

3.1.4 For all Grades of WP fittings, construction and NDE Class in accordance with Table 1 (unless a Class is specified by the purchaser, any Class may be furnished at the option of the supplier).

3.1.4.1 For all Grades of WP fittings, unless Class S, W, WX, or WU is specified by the purchaser, any Class may be furnished at the option of the supplier,

3.1.4.2 Grade CR fittings shall not be substituted for fittings ordered to Grade WP, but WP fittings may be substituted for Grade CR fittings.

3.1.5 Supplementary requirements if any, and

3.1.6 Additional requirements (see 4.1, 12.2, and 14.1).

4. Material

4.1 The material for fittings shall consist of forgings, bars, plates, or seamless or welded tubular products that conform to the chemical requirements in Table 2.

4.2 The steel shall be melted by one of the following processes:

4.2.1 Electric furnace (with separate degassing and refining optional),

4.2.2 Vacuum furnace, or

4.2.3 One of the former followed by vacuum or electroslag-consumable remelting.

¹⁰ Available from American Society of Mechanical Engineers, 345 E. 47th St., New York, NY 10017.

¹¹ Available from American Welding Society, 550 LeJeune Rd., P.O. Box 351040, Miami, FL 33135.

¹² Available from American Society for Nondestructive Testing, 4153 Arlington Plaza, Columbus, OH 43228-0518.

4.3 If secondary melting is employed, the heat shall be defined as all ingots remelted from a primary heat.

5. Manufacture

5.1 *Forming*—Forging or shaping operations may be performed by hammering, pressing, piercing, extruding, upsetting, rolling, bending, fusion welding, machining, or by a combination of two or more of these operations. The forming procedure shall be so applied that it will not produce injurious defects in the fittings.

5.2 All fittings shall be heat treated in accordance with Section 6.

5.3 Grade WP fittings ordered as Class S shall be of seamless construction and shall meet all requirements of ANSI B16.9, B16.28, or MSS SP-79.

5.4 Grade WP fittings ordered as Class W shall meet the requirements of ANSI B16.9 or B16.28 and:

5.4.1 Shall have all pipe welds made by mill or the fitting manufacturer with the addition of filler metal radiographically examined throughout the entire length in accordance with the Code requirements stated in 5.5, and,

5.4.2 Radiography is not required on single longitudinal seam welds made by the starting pipe manufacturer or the fitting manufacturer if made without the addition of filler metal.

5.4.3 In place of radiographic examination, welds made by the fitting manufacturer may be ultrasonically examined in accordance with the Code requirements stated in 5.6.

5.5 Grade WP fittings ordered as Class WX shall meet the requirements of ANSI B16.9 or B16.28 and shall have all welds, whether made by the fitting manufacturer or the starting material manufacturer, radiographically examined throughout their entire length in accordance with Paragraph UW-51 of Section VIII, Division I, of the ASME Boiler and Pressure Vessel Code.

5.6 Grade WP fittings ordered as Class WU shall meet the requirements of ANSI B16.9 or B16.28 and shall have all welds, whether made by the fitting manufacturer or the starting material manufacturer, ultrasonically examined throughout their entire length in accordance with Appendix 12 of Section VIII, Division 1 of ASME Boiler and Pressure Vessel Code.

5.7 The radiography or ultrasonic examination of welds for this class of fittings may be done at the option of the manufacturer, either prior to or after forming.

5.8 Personnel performing NDE examinations shall be qualified in accordance with SNT-TC-1A.

5.9 Grade CR fittings shall meet the requirements of MSS SP-43 and do not require nondestructive examination.

5.10 All fittings shall have the welders, welding operators, and welding procedures qualified under the provisions of Section IX of the ASME Boiler and Pressure Vessel Code except that starting pipe welds made without the addition of filler metal do not require such qualification.

5.11 All joints welded with filler metal shall be finished in accordance with the requirements of Paragraph UW-35 (a) of Section VIII, Division I, of the ASME Boiler and Pressure Vessel Code.

5.12 Fittings machined from bar shall be restricted to NPS 4 or smaller. Elbows, return bends, tees, and header tees shall not

TABLE 2 Chemical Requirements

NOTE 1—Where an ellipsis (...) appears in this Table, there is no requirement

Grade ^A		Composition, %										
Grade WP	Grade CR	C ^B	Mn ^B	P ^B	S ^B	Si ^B	Ni	Cr	Mo	Ti	N ₂ ^C	Others
WP 304	CR 304	0.08	2.00	0.045	0.030	1.00	8.0–11.0	18.0–20.0	...	...	...	...
WP 304H	CR 304H	0.04–0.10	2.00	0.045	0.030	1.00	8.0–11.0	18.0–20.0	...	...	...	...
WP 304L	CR 304L	0.035 ^D	2.00	0.045	0.030	1.00	8.0–13.0	18.0–20.0	...	...	...	...
WP 304LN	CR 304LN	0.030	2.00	0.045	0.030	0.75	8.0–10.5	18.0–20.0	...	...	0.10–0.16	...
WP 304N	CR 304N	0.08	2.00	0.045	0.030	0.75	8.0–11.0	18.0–20.0	...	...	0.10–0.16	...
WP 309	CR 309	0.15	2.00	0.045	0.030	1.00	12.0–15.0	22.0–24.0	...	...	...	...
WP 310	CR 310	0.15	2.00	0.045	0.030	1.50	19.0–22.0	24.0–26.0	...	...	...	...
WP 316	CR 316	0.08	2.00	0.045	0.030	1.00	10.0–14.0	16.0–18.0	2.00–3.00	...	...	...
WP 316H	CR 316H	0.04–0.10	2.00	0.045	0.030	1.00	10.0–14.0	16.0–18.0	2.00–3.00	...	...	...
WP 316LN	CR 316LN	0.030	2.00	0.045	0.030	0.75	11.0–14.0	16.0–18.0	2.00–3.00	...	0.10–0.16	...
WP 316L	CR 316L	0.035 ^D	2.00	0.045	0.030	1.00	10.0–16.0 ^E	16.0–18.0	2.00–3.00	...	...	...
WP 316N	CR 316N	0.08	2.00	0.045	0.030	0.75	11.0–14.0	16.0–18.0	2.00–3.00	...	0.10–0.16	...
WP 317	CR 317	0.08	2.00	0.045	0.030	1.00	11.0–15.0	18.0–20.0	3.0–4.0	...	...	...
WP 317L	CR 317L	0.030	2.00	0.045	0.030	1.00	11.0–15.0	18.0–20.0	3.0–4.0	...	...	...
WP 321	CR 321	0.08	2.00	0.045	0.030	1.00	9.0–13.0	17.0–20.0	...	^F	...	...
WP 321H	CR 321H	0.04–0.10	2.00	0.045	0.030	1.00	9.0–13.0	17.0–20.0	...	^G	...	...
WP 347	CR 347	0.08	2.00	0.045	0.030	1.00	9.0–13.0	17.0–20.0	...	...	...	^H
WP 347H	CR 347H	0.04–0.10	2.00	0.045	0.030	1.00	9.0–13.0	17.0–20.0	...	...	...	^I
WP 348	CR 348	0.08	2.00	0.045	0.030	1.00	9.0–13.0	17.0–20.0	...	...	...	Ta ^H = 0.10 max
WP 348H	CR 348H	0.04–0.10	2.00	0.045	0.030	1.00	9.0–13.0	17.0–20.0	...	...	...	Ta ^I = 0.10 max
WP XM-19	CR XM-19	0.060	4.0–6.0	0.040	0.030	1.00	11.5–13.5	20.5–23.5	1.50–3.00	...	0.20–0.40	^J
WP S31254	CR S31254	0.020	1.00	0.030	0.010	0.80	17.5–18.5	19.5–20.5	6.0–6.5	...	0.18–0.22	Cu 0.50–1.00
WP S31725	CR S31725	0.030	2.00	0.045	0.030	0.75	13.5–17.5	18.0–20.0	4.0–5.0	...	0.10 max	Cu 0.75 max
WP S31726	CR S31726	0.030	2.00	0.045	0.030	0.75	13.5–17.5	17.0–20.0	4.0–5.0	...	0.10–0.20	Cu 0.75 max
WP S34565	CR S34565	0.03	5.0–7.0	0.030	0.010	1.00	16.0–18.0	23.0–25.0	4.0–5.0	...	0.4–0.6	Cb = 0.1 max
WP S33228	CR S33228	0.04–0.08	1.0	0.020	0.015	0.30	31.0–33.0	26.0–28.0	...	...	...	Ce 0.05–0.10 Al 0.025 Cb 0.6–1.0

^A See Section 15 for marking requirements.

^B Maximum, unless otherwise indicated.

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

^D For small diameter or thin walls, or both, where many drawing passes are required, a carbon maximum of 0.040 % is necessary in grades TP 304L and TP 316L. Small outside diameter tubes are defined as those less than 0.500 in. [12.7 mm] in outside diameter and light wall tubes as those less than 0.049 in. [1.24 mm] in average wall thickness.

^E On pierced tubing, the nickel may be 11.0–16.00 %.

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

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

^H The columbium plus tantalum content shall be not less than ten times the carbon content and not more than 1.10 %.

^I The columbium plus tantalum content shall be not less than eight times the carbon content and not more than 1.00 %.

^J Columbium plus tantalum, 0.10–0.30 %; vanadium, 0.10–0.30 %.

be machined directly from bar stock.

5.12.1 All caps machined from bar shall be examined by liquid penetrant in accordance with Supplementary Requirement S7.

5.13 Weld buildup is permitted to dimensionally correct unfilled areas produced during cold forming of stub ends. Radiographic examination of the weld buildup shall not be required provided that all the following steps are adhered to:

5.13.1 The weld procedure and welders or welding operators meet the requirements of 5.10.

5.13.2 Annealing is performed after welding and prior to machining.

5.13.3 All weld surfaces are liquid penetrant examined in accordance with Appendix 8 of Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code.

5.13.4 Repair of areas in the weld is permitted, but 5.13.1, 5.13.2, and 5.13.3 must be repeated.

5.14 Stub ends may be produced with the entire lap added as weld metal to a straight pipe section provided the welding satisfies the requirements of 5.10 for qualifications and 6.4 post weld heat treatment.

 5.14.1 *Grade WP Class W*—Radiographic inspection of the weld is required. See 5.4.

 5.14.2 *Grade WP Class WX*—Radiographic inspection of all welds is required. See 5.5.

 5.14.3 *Grade WP Class WU*—Ultrasonic inspection of all welds is required. See 5.6.

 5.14.4 *Grade CR*—Nondestructive examination is not required. See 5.12.1.

5.15 Stub ends may be produced with the entire lap added by the welding of a ring, made from plate or bar of the same alloy grade and composition, to the outside of a straight section of pipe, provided the weld is double welded, is a full penetration joint, satisfies the requirements of 5.10 for qualifications and 6.3 for post weld heat treatment.

 5.15.1 *Class WP-W*—Radiographic inspection of the welds, made with the addition of filler metal, is required (see 5.4).

 5.15.2 *Class WP-WX*—Radiographic inspection of all welds, made with or without the addition of filler metal, is required (see 5.5).

 5.15.3 *Class WP-WU*—Ultrasonic inspection of all welds,

made with or without the addition of filler metal, is required (see 5.6).

5.15.4 Clas CR nondestructive examination is not required (see 5.9).

5.16 After final heat treatment, all “H-Grade” steel fittings shall have a grain size of 7 or coarser in accordance with Test Methods E 112.

6. Heat Treatment

6.1 All fittings shall be furnished in the heat-treated condition. The heat-treat procedure, except for those grades listed in 6.2, shall consist of solution annealing the fittings at a minimum temperature of 1900°F [1040°C] until the chromium carbides go into solution, and then cooling at a sufficient rate to prevent reprecipitation.

6.2 Grades 321H, 347H, and 348H shall be solution annealed at 1925°F [1050°C] minimum. S31254 shall be solution annealed at 2100°F [1150°C] minimum. S33228 shall be solution annealed at 2050°F [1120°C], minimum. S34565 shall be solution annealed in the range 2050°F [1120°C] to 2140°F [1170°C]. The maximum temperature for solution annealing grades 321, 321H, 347, and 347H under 6.1 and 6.2 shall be 2100°F [1150°C].

6.3 A solution annealing temperature above 1950°F [1065°C] may impair the resistance to intergranular corrosion after subsequent exposure to sensitizing conditions in 321, 321H, 347, 347H, 348, and 348H. When specified by the purchaser, a lower temperature stabilization or resolution anneal shall be used subsequent to the initial high temperature solution anneal (see Supplemental Requirement S10).

6.4 All welding shall be done prior to heat treatment.

6.5 Fittings machined directly from solution-annealed forgings and bar stock need not be resolution annealed.

7. Chemical Composition

7.1 The chemical composition of each cast or heat used shall be determined and shall conform to the requirements of the chemical composition for the respective grades of materials listed in Table 2. The ranges as shown have been expanded to include variations of the chemical analysis requirements that are listed in the various specifications for starting materials (pipe, tube, plate, bar, and forgings) normally used in the manufacturing of fittings to this specification. Methods and practices relating to chemical analyses required by this specification shall be in accordance with Test Methods, Practices, and Terminology A 751. Product analysis tolerances in accordance with Specification A 480/A 480M are applicable.

7.2 The steel shall not contain any unspecified elements for the ordered grade to the extent that it conforms to the requirements of another grade for which that element is a specified element having a required minimum content.

7.3 In fittings of welded construction, the alloy content (carbon, chromium, nickel, molybdenum, columbium, and tantalum) of the deposited weld metal shall conform to that required of the base metal or for equivalent weld metal as given in the AWS filler metal specification A 5.4 or A 5.9 (Type 348 weld metal is listed in AWS A 5.9 but not in AWS A 5.4). Exceptions are when welding on Types 304L and 304 base metals, the deposited weld metal shall correspond, respec-

tively, to AWS E308L(ER308L) and E308 (ER308), when welding on Type 321 base metal, the weld metal shall correspond to AWS Type E347 (ER347 or ER321); and, when welding on S31725, S31726, S31254 or S33228 osited weld metal shall correspond either to the alloy content of the base metal or to AWS A5.11 E NiCrMo-3 (UNS W86112) (AWS A5.14 Ni Cr Mo-3 (UNS N06625)).

7.3.1 Supplementary Requirement S8 may be specified where 16-8-2 filler metal is required for joining thick sections of Types 316, 321, or 347 and has adequate corrosion resistance for the intended service.

8. Tensile Properties

8.1 The tensile properties of the fitting material shall conform to the requirements of Table 3. The testing and reporting shall be performed in accordance with Methods and Definitions A 370.

8.1.1 Specimens cut either longitudinally or transversely shall be acceptable for the tensile test.

8.1.2 While Table 3 specifies elongation requirements for both longitudinal and transverse specimens, it is not the intent that both requirements apply simultaneously. Instead, it is intended that only the elongation requirement that is appropriate for the specimen used be applicable.

8.2 Records of the tension test made on the starting material shall be certification that the material of the fitting meets the requirements of this specification provided that heat treatments are the same.

8.3 If the raw material was not tested, or if the heat treatment of the raw material was different than the heat treatment of the fitting, the fitting manufacturer shall perform at least one tension test per heat on material representative of the fitting, and in the same condition of heat treatment as the fitting it represents. Qualification of welding procedures shall be in accordance with 5.8.

8.4 If a tension test through the weld is desired, Supplementary Requirement S2 should be specified.

9. Hydrostatic Tests

9.1 Hydrostatic testing is not required by this specification.

TABLE 3 Tensile Requirements

All WP and CR Grades	Yield Strength, min,	Tensile Strength, min,
	ksi [MPa]	ksi [MPa]
304, 304LN, 304H, 309, 310, 316, 316LN, 316H, 317, 317L, 321, 321H, 347, 347H, 348, 348H	30 [205]	75 [515]
S31725		
304L, 316L	25 [170]	70 [485]
304N, 316N, S31726	35 [240]	80 [550]
XM-19	55 [380]	100 [690]
S31254	44 [300]	94 [650] to 119 [820]
S33228	27 [185]	73 [500]
S34565	60 [415]	115 [795]
Elongation Requirements		
	Longitudinal	Transverse
Standard round specimen, or small proportional specimen, or strip-type specimen, minimum % in 4 D	28	20

9.2 All Grade WP fittings shall be capable of withstanding without failure, leakage, or impairment of serviceability, a test pressure equal to that prescribed for the specified matching pipe or equivalent material.

9.3 All Grade CR fittings, except tees covered in 9.3.1, shall be capable of withstanding without failure, leakage, or impairment of serviceability, a test pressure based on the ratings in MSS SP-43.

9.3.1 Grade CR tees fabricated using intersection welds shall be capable of passing a hydrostatic test based on 70 % of the ratings in MSS SP-43.

10. Surface Quality

10.1 Fittings supplied under this specification shall be examined visually. Selected typical surface discontinuities shall be explored for depth. The fittings shall be free from surface discontinuities that penetrate more than 5 % of the specified nominal wall thickness, except as defined in 10.3 and 10.4, and shall have a workmanlike finish.

10.2 Surface discontinuities deeper than 5 % of the specified nominal wall thickness, except as defined in 10.3 and 10.4, shall be removed by the manufacturer by machining or grinding to sound metal, and the repaired areas shall be well faired. The wall thickness at all points shall be at least 87½ % of the specified nominal wall thickness, and the diameters at all points shall be within the specified limits.

10.3 Surface checks (fish scale) deeper than ¼ in. [0.4 mm] shall be removed.

10.4 Mechanical marks deeper than ¼ in. [1.6 mm] shall be removed.

10.5 When the removal of a surface discontinuity reduces the wall thickness below 87½ % of the specified nominal wall thickness at any point, the fitting shall be subject to rejection or to repair as provided in 10.6.

10.6 *Repair by Welding:*

10.6.1 Repair of unacceptable imperfections in the base metal is permissible for fittings made to the dimensional standards listed in 1.1 or for other standard fittings made for stock by the manufacturer. Prior approval of the purchaser is required to repair special fittings made to the purchaser's requirements. Welding of unacceptable imperfections in no case shall be permitted when the depth of defect exceeds 33⅓ % of the nominal wall thickness or the defect area exceeds 10 % of the surface area of the fitting.

10.6.2 The welding procedure and welders shall be qualified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code.

10.6.3 The composition of the weld deposits shall be in accordance with 7.3 and in accordance with the procedure qualification for the applicable material.

10.6.4 Unacceptable imperfections shall be removed by mechanical means or by thermal cutting or gouging methods. Cavities prepared for welding shall be examined with liquid penetrant in accordance with Practice E 165. No cracks are permitted in the prepared cavities. Personnel performing NDE examinations shall be qualified in accordance with SNT-TC-1A.

10.6.5 The weld repair shall be permanently identified with the welder's stamp or symbol in accordance with Section VIII

of the ASME Boiler and Pressure Vessel Code.

10.6.6 Weld repair area(s) shall be blended uniformly to the base metal and shall be examined by liquid penetrant in accordance with Practice E 165. No cracks are permitted in the weld or surrounding ½ in. [12.7 mm] of base metal. Personnel performing NDE examinations shall be qualified in accordance with SNT-TC-1A.

10.6.7 After weld repair, material shall be heat treated in accordance with Section 6 .

10.7 The fittings shall be free of scale and shall be passivated.

11. Dimensions

11.1 For fittings covered by ANSI B16.9, ANSI B16.11, ANSI B16.28, MSS SP-43, or MSS SP-79, the sizes, shapes, and dimensions of the fittings shall be as specified in those standards.

11.1.1 Fittings of size or shape differing from these standards, but meeting all other requirements of this specification, may be furnished in accordance with Supplementary Requirement S9.

12. Inspection

12.1 The manufacturer shall afford the purchaser's inspector all reasonable facilities necessary to satisfy him that the material is being furnished in accordance with this specification. Inspection by the purchaser shall not interfere unnecessarily with the manufacturer's operations. All examinations and inspections shall be made at the place of manufacture, unless otherwise agreed upon.

12.2 Other tests, when agreed upon, shall be made from material of the lots covered in the order.

13. Rejection and Rehearing

13.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the tests, the producer or supplier may make claim for rehearing.

13.2 Fittings that develop defects in shop working or application operations may be rejected. Upon rejection, the manufacturer shall be notified promptly in writing.

14. Test Reports

14.1 Test reports are required for all fittings covered by this specification. Each test report shall include the following information:

14.1.1 The year-date of the specification to which the fitting was furnished,

14.1.2 Heat number or serial number traceable to a heat number,

14.1.3 Chemical analyses for all starting materials,

14.1.4 Mechanical properties of all starting materials,

14.1.5 For construction with filler metal added, weld metal chemical analysis,

14.1.6 For welded fittings, construction method, weld process and procedure specification number,

14.1.7 Heat treatment type,

14.1.8 Results of all nondestructive examinations,

14.1.9 Results of all tests required by Supplementary Requirements and the order, and

14.1.10 Statement that the fitting was manufactured, sampled, tested and inspected in accordance with the specification and was found to meet the requirements.

15. Product Marking

15.1 All fittings shall have the prescribed information stamped or otherwise suitably marked on each fitting in accordance with the latest edition of MSS SP-25. See Table 4 for marking examples of grades and classes.

15.2 Marking paint or ink shall not contain harmful amounts of chlorides, metals, or metallic salt, such as zinc or copper, that cause corrosive attack on heating. On wall thicknesses thinner than 0.083 in. [2.1 mm], no metal impression stamps shall be used. Vibrating pencil marking is acceptable.

15.3 The prescribed information for butt-welding fittings shall be: the manufacturer's name or trademark (see Note 1),

schedule number or nominal wall thickness designation, size, grade (see Table 2), class, and the heat number or manufacturer's heat identification. The class S marking need not be added to the material grade for threaded or socket-welded fittings.

15.4 The prescribed information for threaded or socket-welding fittings shall be: the manufacturer's name or trademark (see Note 1), pressure class or schedule number, grade (see Table 2) and class, and heat number or manufacturer's heat identification.

NOTE 1—For purposes of identification marking, the manufacturer is considered the organization that certifies that the piping component complies with this specification.

15.5 Fittings meeting the chemical and mechanical property requirements of Table 2 and Table 3 for more than one grade designation may be marked with more than one class or grade designation, such as WP304/304H; WP304/304L; WP304/304L/304N, WP316/316L, etc.

15.6 *Bar Coding*—In addition to the requirements in 15.1, 15.2, 15.3, 15.4, and 15.5, bar coding is acceptable as a supplemental identification method. The purchaser may specify in the order a specific bar coding system to be used. The bar coding system, if applied at the discretion of the supplier, should be consistent with one of the published industry standards for bar coding. If used on small fittings, the bar code may be applied to the box or a substantially applied tag.

16. Keywords

16.1 austenitic stainless steel; corrosive service applications; pipe fittings; steel; piping applications; pressure containing parts; stainless steel fittings

TABLE 4 Product Marking Examples for Grades and Classes

Grade and Class Marking	Description
CR304 CR304/304L	Single grade: No classes in CR grades Multiple grades, meet chemical and mechanical properties of each
WP304-S WP304-W	Single Grade: seamless Single Grade; welded: RT or UT pipe welds with filler metal and all fitting manufacturer's welds
WP304-WX	Single grade: welded: RT all welds with or without filler metal
WP304-WU	Single grade; welded: UT all welds with or without filler metal
WP304-304L-S	Multiple grades: meet chemical and mechanical properties of each: seamless

SUPPLEMENTARY REQUIREMENTS

One or more of the supplementary requirements described below 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. Supplementary requirement details not fully described shall be agreed upon between the purchaser and the supplier.

S1. Product Analysis (Note S1.1)

S1.1 A product analysis shall be made for each heat of base metal and, if of welded construction, from each lot number of welding material of the fittings offered for delivery and shall conform to the requirements specified in Section 4.

S2. Tension Test (Note S1.1)

S2.1 One tension test shall be made on one fitting or representative test piece (Note S1.2) per lot (Note S1.3) of fittings. If the fittings are of welded construction, the tension specimen shall include the weld and be prepared so that the weld is at the midlength of the specimen.

NOTE S1.1—If the results of any of the tests specified in Supplementary Requirements S1, S2, or S3 do not conform to requirements, retests may be made at the manufacturer's expense on additional fittings or representative test pieces of double the original number from the same heat or lot as defined in Supplementary Requirements S1, S2, or S3, each of which

shall conform to the requirements specified.

NOTE S1.2—Where the test specimen for the tension or intergranular corrosion bend test cannot be taken from a fitting due to size limitations, a representative test piece shall be obtained. The test piece shall be from the same lot it represents and shall have approximately the same amount of working. In addition, these pieces representing fittings manufactured from bars, plate, or forgings shall have a cross section equal to the greatest cross section of the fitting, and test pieces representing fittings manufactured from pipe shall have an outside diameter and wall thickness equal to those of the fitting. The test piece for fittings of welded construction shall be prepared to the same weld procedures and from the same heat of materials as the fittings it represents.

NOTE S1.3—A lot shall consist of all fittings of the same type, size, and wall thickness, manufactured from one heat of material (and, if fabrication welding is performed using one lot number of electrode or one heat of weld wire), and heat treated using the same heat-treat cycle in either a continuous or batch-type furnace controlling within a range of 50°F [28°C] and equipped with recording pyrometers so that complete records of heat treatment are available.

S3. Intergranular Corrosion Bend Test (Note 1)

S3.1 One intergranular corrosion bend test shall be made on one fitting or representative test piece (Note S1.1) per lot (Note S1.2) of fittings. If the fittings are of welded construction, the bend specimen shall include the weld and be prepared so that the weld is at the midlength location of the specimen. Specimens containing a weld 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.

S3.2 Types 304L, 316L, 317L, 321, 347, and 348 shall be tested after a heat treatment capable of producing sensitization. In the case of the other chromium-nickel steels (Series 300), the test shall be conducted on specimens representative of the material in the annealed condition.

S4. Ultrasonic Test

S4.1 Each fitting of the raw material from which each fitting is made shall be ultrasonically tested to determine its soundness. The method, where applicable, shall be in accordance with Practice A 388. Acceptance limits shall be specified by the purchaser. Personnel performing the examination shall be qualified in accordance with SNT-TC-1A.

S5. Photomicrographs

S5.1 Photomicrographs at 100 diameters shall be made, for information only, of the actual base metal structure from one fitting as furnished in each lot. The photomicrographs shall be identified as to fittings size, wall thickness, lot identification, and heat. The definition of "lot" shall be as specified by the purchaser.

S6. Surface Finish

S6.1 Machined surfaces shall have a maximum roughness

of 250 μin . [6.4 μm] arithmetical average. All other surfaces shall be suitable for ultrasonic test.

S7. Liquid Penetrant Test

S7.1 All surfaces shall be liquid penetrant tested. The method shall be in accordance with Practice E 165. Personnel performing the examination shall be qualified in accordance with SNT-TC-1A.

S8. Special Filler Metal

S8.1 Filler metal shall be AWS Type E16-8-2 or ER 16-8-2 (AWS Specifications A 5.4 and A 5.9, respectively). Fittings welded with 16-8-2 weld metal shall be marked WP ___ HRW or CR ___ HRW, as appropriate.

S9. Special Fittings

S9.1 Partial compliance fittings of size and shape not conforming to the dimensional requirements of ANSI B16.9, B16.11B16.28 MSS SP-79, or MSS SP-95 shall meet all other requirements of this specification. In addition to the marking required in Section 15, the grade designation symbol shall be followed by the symbol "S9".

S10. Stabilization Treatment

S10.1 Subsequent to the solution anneal required by 6.2, Grades 321, 321H, 347, 347H, 348, and 348H shall be given a stabilization heat treatment at 1500 to 1600°F [815 to 870°C] for a minimum of 2h/in. [4.7 min/mm] of thickness and then cooling in the furnace or in air. In addition to the marking required in Section 15, the grade designation symbol shall be followed by the symbol "S10."

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