



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 ASME 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

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 |

lar Attack in Austenitic Stainless Steels³

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

A 960 Specification for Common Requirements for Wrought Steel Piping Fittings⁶

E 112 Test Methods for Determining Average Grain Size⁷

E 165 Test Method for Liquid Penetrant Examination⁸

E 213 Practice for Ultrasonic Examination of Metal Pipe and Tubing⁷

2.2 ASME Standards:

ASME B16.9 Factory-Made Wrought Steel Butt-Welding Fittings⁹

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 A01.22 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.

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 01.01.

⁷ Annual Book of ASTM Standards, Vol 03.01.

⁸ Annual Book of ASTM Standards, Vol 03.03.

⁹ Available from ASME International, Three Park Avenue, New York, NY 10016-5990.

ASME B16.11 Forged Steel Fittings, Socket-Welding and Threaded⁹

ASME B16.28 Wrought Steel Butt-Welding Short Radius Elbows and Returns⁹

2.3 MSS Standards:

MSS SP-25 Standard Marking System for Valves, Fittings, Flanges, and Unions¹⁰

MSS SP-43 Standard Practice for Light Weight Stainless Steel Butt-Welding Fittings¹⁰

MSS SP-79 Socket-Welding Reducer Inserts¹⁰

MSS SP-95 Swaged(d) Nipples and Bull Plugs¹⁰

2.4 ASME Boiler and Pressure Vessel Code:

Section VIII Division I, Pressure Vessels¹¹

Section IX, Welding Qualifications¹¹

2.5 AWS Standards:

A 5.4 Specification for Corrosion-Resisting Chromium and Chromium-Nickel Steel Covered Welding Electrodes¹²

A 5.9 Specification for Corrosion-Resisting Chromium and Chromium-Nickel Steel Welding Rods and Bare Electrodes¹²

2.6 ASNT:

SNT-TC-1A(1984) Recommended Practice for Nondestructive Testing Personnel Qualification and Certification¹³

3. Common Requirements and Ordering Information

3.1 Material furnished to this specification shall conform to the requirements of Specification A 960 including any supplementary requirements that are indicated in the purchase order. Failure to comply with the common requirements of Specification A 960 constitutes nonconformance with this specification. In case of conflict between this specification and Specification A 960, this specification shall prevail.

3.2 Specification A 960 identifies the ordering information that should be complied with when purchasing material to this specification.

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. See Table 3 for a list of common names.

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.

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 ASME B16.9, B16.28, or MSS SP-79.

5.4 Grade WP fittings ordered as Class W shall meet the requirements of ASME 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 Radiographic inspection is not required on single longitudinal seam welds made by the starting pipe manufacturer if made without the addition of filler metal; and

5.4.3 Radiographic inspection is not required on longitudinal seam fusion welds made by the fitting manufacturer when all of the following conditions have been met:

5.4.3.1 no addition of filler metal,

5.4.3.2 only one welding pass per weld seam, and,

5.4.3.3 fusion welding from one side only.

5.4.4 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 ASME 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 ASME 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

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

¹⁰ Available from ASME International, Three Park Avenue, New York, NY 10016-5990.

¹² Available from American Welding Society, 550 LeJeune Rd., P.O. Box 351040, Miami, FL 33135.

¹³ Available from American Society for Nondestructive Testing, 4153 Arlington Plaza, Columbus, OH 43228-0518.

TABLE 2 Chemical Requirements

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

| Grade ^A | | | Composition, % | | | | | | | | | | | |
|--------------------|----------|-----------------|--------------------|-----------------|----------------|----------------|-----------------|------------------------|-----------|-----------|-----|-------------------------------|---|--|
| Grade WP | Grade CR | UNS Designation | C ^B | Mn ^B | P ^B | S ^B | Si ^B | Ni | Cr | Mo | Ti | N ₂ C ^C | Others | |
| WPXM-19 | CRXM-19 | S20910 | 0.06 | 4.0–6.0 | 0.045 | 0.030 | 1.00 | 11.5–13.5 | 20.5–23.5 | 1.50–3.00 | ... | 0.20–0.40 | ^D | |
| WP304 | CR304 | S30400 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 | 8.0–11.0 | 18.0–20.0 | ... | ... | ... | ... | |
| WP304L | CR304L | S30403 | 0.030 ^E | 2.00 | 0.045 | 0.030 | 1.00 | 8.0–12.0 | 18.0–20.0 | ... | ... | ... | ... | |
| WP304H | CR304H | S30409 | 0.04–0.10 | 2.00 | 0.045 | 0.030 | 1.00 | 8.0–11.0 | 18.0–20.0 | ... | ... | ... | ... | |
| WP304N | CR304N | S30451 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 | 8.0–11.0 | 18.0–20.0 | ... | ... | 0.10–0.16 | ... | |
| WP304LN | CR304LN | S30453 | 0.030 | 2.00 | 0.045 | 0.030 | 1.00 | 8.0–11.0 | 18.0–20.0 | ... | ... | 0.10–0.16 | ... | |
| WP309 | CR309 | S30900 | 0.20 | 2.00 | 0.045 | 0.030 | 1.00 | 12.0–15.0 | 22.0–24.0 | ... | ... | ... | ... | |
| WP310S | CR310S | S31008 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 | 19.0–22.0 | 24.0–26.0 | ... | ... | ... | ... | |
| WPS31254 | CRS31254 | 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 | |
| WP316 | CR316 | S31600 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 | 10.0–14.0 | 16.0–18.0 | 2.00–3.00 | ... | ... | ... | |
| WP316L | CR316L | S31603 | 0.030 ^E | 2.00 | 0.045 | 0.030 | 1.00 | 10.0–14.0 ^F | 16.0–18.0 | 2.00–3.00 | ... | ... | ... | |
| WP316H | CR316H | S31609 | 0.04–0.10 | 2.00 | 0.045 | 0.030 | 1.00 | 10.0–14.0 | 16.0–18.0 | 2.00–3.00 | ... | ... | ... | |
| WP316N | CR316N | S31651 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 | 10.0–13.0 | 16.0–18.0 | 2.00–3.00 | ... | 0.10–0.16 | ... | |
| WP316LN | CR316LN | S31653 | 0.030 | 2.00 | 0.045 | 0.030 | 1.00 | 10.0–13.0 | 16.0–18.0 | 2.00–3.00 | ... | 0.10–0.16 | ... | |
| WP317 | CR317 | S31700 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 | 11.0–15.0 | 18.0–20.0 | 3.0–4.0 | ... | ... | ... | |
| WP317L | CR317L | S31703 | 0.030 | 2.00 | 0.045 | 0.030 | 1.00 | 11.0–15.0 | 18.0–20.0 | 3.0–4.0 | ... | ... | ... | |
| WPS31725 | CRS31725 | S31725 | 0.030 | 2.00 | 0.045 | 0.030 | 1.00 | 13.5–17.5 | 18.0–20.0 | 4.0–5.0 | ... | 0.20 | ... | |
| WPS31726 | CRS31726 | S31726 | 0.030 | 2.00 | 0.045 | 0.030 | 1.00 | 13.5–17.5 | 17.0–20.0 | 4.0–5.0 | ... | 0.10–0.20 | ... | |
| WP321 | CR321 | S32100 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 | 9.0–12.0 | 17.0–19.0 | ... | ... | ... | ... | |
| WP321H | CR321H | S32109 | 0.04–0.10 | 2.00 | 0.045 | 0.030 | 1.00 | 9.0–12.0 | 17.0–19.0 | ... | ... | ... | ... | |
| WPS33228 | CRS33228 | S33228 | 0.04–0.08 | 1.00 | 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 | |
| WPS34565 | CRS34565 | S34565 | 0.030 | 5.0–7.0 | 0.030 | 0.010 | 1.00 | 16.0–18.0 | 23.0–25.0 | 4.0–5.0 | ... | 0.40–0.60 | Cb 0.10 | |
| WP347 | CR347 | S34700 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 | 9.0–12.0 | 17.0–19.0 | ... | ... | ... | ^I | |
| WP347H | CR347H | S34709 | 0.04–0.10 | 2.00 | 0.045 | 0.030 | 1.00 | 9.0–12.0 | 17.0–19.0 | ... | ... | ... | ^J | |
| WP348 | CR348 | S34800 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 | 9.0–12.0 | 17.0–19.0 | ... | ... | ... | Cb+Ta=10×(C)–1.10 Ta 0.10 Co 0.20 | |
| WP348H | CR348H | S34809 | 0.04–0.10 | 2.00 | 0.045 | 0.030 | 1.00 | 9.0–12.0 | 17.0–19.0 | ... | ... | ... | Cb+Ta=8×(C)–1.10 Ta 0.10 Co 0.20 | |

^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 Columbium 0.10–0.30 %; Vanadium, 0.10–0.30 %.

^E 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. [12.7 mm] in outside diameter and light wall tubes as those less than 0.049 in. [1.24 mm] in average wall thickness.

^F On pierced tubing, the nickel may be 11.0–16.0 %.

^G 5X(C+N₂)–0.70.

^H 4X(C+N₂)–0.70.

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

^J The columbium content shall be not less than eight times the carbon content and not more than 1.10 %.

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 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 S52 in Specification A 960.

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 6.3 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

TABLE 3 Common Names

| Grade WP ^A | Grade CR ^A | UNS Designation | Type ^B |
|-----------------------|-----------------------|-----------------|---------------------|
| WPXM-19 | CRXM-19 | S20910 | XM-19 ^C |
| WP304 | CR304 | S30400 | 304 |
| WP304L | CR304L | S30403 | 304L |
| WP304H | CR304H | S30409 | 304H |
| WP304N | CR304N | S30451 | 304N |
| WP304LN | CR304LN | S30453 | 304LN |
| WP309 | CR309 | S30900 | 309 |
| WP310S | CR310S | S31008 | 310S |
| WPS31254 | CRS31254 | S31254 | ... |
| WP316 | CR316 | S31600 | 316 |
| WP316L | CR316L | S31603 | 316L |
| WP316H | CR316H | S31609 | 316H |
| WP316N | CR316N | S31651 | 316N |
| WP316LN | CR316LN | S31653 | 316LN |
| WP317 | CR317 | S31700 | 317 |
| WP317L | CR317L | S31703 | 317L |
| WPS31725 | CRS31725 | S31725 | 317LM ^C |
| WPS31726 | CRS31726 | S31726 | 317LMN ^C |
| WP321 | CR321 | S32100 | 321 |
| WP321H | CR321H | S32109 | 321H |
| WPS33228 | CRS33228 | S33228 | ... |
| WPS34565 | CRS34565 | S34565 | ... |
| WP347 | CR347 | S34700 | 347 |
| WP347H | CR347H | S34709 | 347H |
| WP348 | CR348 | S34800 | 348 |
| WP348H | CR348H | S34809 | 348H |

^ANaming system developed and applied by ASTM.

^BUnless otherwise indicated, a grade designation originally assigned by the American Iron and Steel Institute (AISI).

^CCommon name, not a trademark widely used, not associated with any one producer.

penetration joint, satisfies the requirements of 5.10 for qualifications and 6.2 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 Class 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. For H grades, separate solution heat treatments are required for solution annealing; in-process heat treatments are not permitted as a substitute for the separate solution annealing treatments. 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 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, and 347H. When specified by the purchaser, a lower temperature stabilization or resolution anneal shall be used subsequent to the initial high-temperature solution anneal

(see Supplementary Requirement S2).

6.3 All welding shall be done prior to heat treatment.

6.4 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, respectively, 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 S1 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 4. The testing and reporting shall be performed in accordance with Test 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 4 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

**TABLE 4 Tensile Requirements**

| All WP and CR Grades | Yield Strength, min, ksi [MPa] | Tensile Strength, min, ksi [MPa] |
|---|-----------------------------------|-------------------------------------|
| 304, 304LN, 304H, 309, 310, 316, 316LN, 316H, 317, 317L, 321, 321H, 347, 347H, 348, 348H S31725 | 30 [205] | 75 [515] |
| 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 |

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 S51 in Specification A 960 should be specified.

9. Hydrostatic Tests

9.1 Hydrostatic testing is not required by this specification.

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 ASME B16.9, ASME B16.11, ASME 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 S58 Specification A 960.

12. Rejection and Reheating

12.1 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 reheating.

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

13. Test Reports

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

- 13.1.1 The year-date of the specification to which the fitting was furnished,
- 13.1.2 Heat number or serial number traceable to a heat number,
- 13.1.3 Chemical analyses for all starting materials,
- 13.1.4 Mechanical properties of all starting materials,
- 13.1.5 For construction with filler metal added, weld metal chemical analysis,
- 13.1.6 For welded fittings, construction method, weld process and procedure specification number,
- 13.1.7 Heat treatment type,
- 13.1.8 Results of all nondestructive examinations,
- 13.1.9 Results of all tests required by Supplementary Requirements and the order, and
- 13.1.10 Statement that the fitting was manufactured, sampled, tested and inspected in accordance with the specification and was found to meet the requirements.

14. Product Marking

- 14.1 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 5 for marking examples of grades and classes.
- 14.2 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.
- 14.3 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.

TABLE 5 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 |

14.4 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.

14.5 Fittings meeting the chemical and mechanical property requirements of Table 2 and Table 4 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.

14.6 *Bar Coding*—In addition to the requirements in 14.1, 14.2, 14.3, 14.4, and 14.5, 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.

15. Keywords

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

SUPPLEMENTARY REQUIREMENTS

One or more of the supplementary requirements described below or appearing in Specification A 960 may be included 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. Special Filler Metal

S1.1 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.

S2. Stabilization Treatment

S2.1 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 followed by the symbol “S2.” required in Section 14, the grade designation symbol shall be

SUMMARY OF CHANGES

This section identifies the location of changes to this specification that have been incorporated since the last issue, A 403/A 403M-01.

- (1) Revised heat treatment requirements in 6.1 for H grades to agree with ASME SA403. (2) Deleted Supplementary Requirements in this specification (A 403/A 403M) currently in Specification A 960.

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