



ROLF

ENGG. SOLUTIONS INC.



Manufacturer & Exporters of

**High Tensile Carbon Steel, API 5L X52 to X70 PSL 1/2, LSAW, ERW & Seamless Pipes & Fittings,
Stainless Steel, Alloy Steel Pipes & Fittings, High Nickel Alloys, Monel, Inconel, Hastelloy, SM0254,
Duplex, Super Duplex, Titanium-B2, B5 - Pipes & Fittings, Finned Tubes, Studded Pipes.**



Standard Specification for Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings¹

This standard is issued under the fixed designation A 815/A 815M; 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 two general classes, WP and CR, of wrought ferritic, ferritic/austenitic, and martensitic stainless steel fittings of seamless and welded construction covered by the latest revision of Specification **A 960/A 960M**. Fittings differing from these standards may be furnished in accordance with Supplementary Requirement S8.

1.1.1 Class WP fittings are subdivided into four subclasses: Classes WP-S, WP-W, WP-WX, and WP-WU. They are manufactured to the requirements of Specification **A 960/A 960M**, and they shall have pressure ratings compatible with **12.2**. Class WP-S fittings are those manufactured from seamless product by a seamless method of manufacture (marked with class symbol WP-S); Class WP-W fittings are those which contain welds where the fitting fabrication or construction welds have been radiographed (marked with class symbol WP-W); and Class WP-WX fittings are those which contain welds where all welds have been radiographed (marked with class symbol WP-WX); and Class WP-WU fittings are those which contain welds where all welds have been ultrasonically tested (marked with class symbol WP-WU).

1.1.2 Class CR fittings are those manufactured to the requirements of **MSS SP-43**, and they shall have pressure ratings compatible with **12.3**.

1.2 This specification does not apply to cast fittings.

1.3 Optional supplementary requirements are provided. When desired, one or more of these may be specified in the order.

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.

2. Referenced Documents

2.1 *ASTM Standards:*²

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

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

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

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

A 763 Practices for Detecting Susceptibility to Intergranular Attack in Ferritic Stainless Steels

A 960/A 960M Specification for Common Requirements for Wrought Steel Piping Fittings

E 165 Test Method for Liquid Penetrant Examination

2.2 *ASME Standards:*³

B16.9 Wrought Steel Butt-Welding Fittings

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

2.3 *MSS Standards:*⁴

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

MSS SP-79 Socket-Welding Reducer Inserts

MSS SP-83 Steel Pipe Unions, Socket-Welding and Threaded

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

2.4 *ASME Boiler and Pressure Vessel Codes:*³

Section VIII Division I, Pressure Vessels

2.5 *ASNT Standard:*⁵

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 Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

⁴ Available from Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), 127 Park St., NE, Vienna, VA 22180-4602, <http://www.mss-hq.com>.

⁵ Available from American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlington Ln., Columbus, OH 43228-0518, <http://www.asnt.org>.

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

3. Common Requirements and Ordering Information

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

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

4. Materials

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 1**.

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

TABLE 1 Chemical Requirements

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

| Composition, % | | | | | | | | | | | | | | |
|----------------------------|----------|--------|--------|-----------------|--------|--------|---------|-----------------|------------------------|------------------------|-----------|------------------------|-------------------------|--------------|
| Grade ^A | | | | | | | | | | | | | | |
| Grade WP | Grade CR | UNS | C, max | Mn ^B | P, max | S, max | Si, max | Ni ^B | Cr | Mo | Cu, max | N | Ti | Other |
| Ferritic Steels | | | | | | | | | | | | | | |
| WP27 | CR27 | S44627 | 0.010 | 0.75 | 0.020 | 0.020 | 0.40 | 0.50 | 25.0–27.5 | 0.75–1.50 | 0.20 | 0.015 max | ... | Cb 0.05–0.20 |
| WP33 | CR33 | S44626 | 0.06 | 0.75 | 0.040 | 0.020 | 0.75 | 0.50 | 25.0–27.0 | 0.75–1.50 | 0.20 | 0.040 max | 0.20–1.00 (73(C+N)) min | ... |
| WP429 | CR429 | S42900 | 0.12 | 1.0 | 0.040 | 0.030 | 0.75 | 0.50 | 14.0–16.0 | ... | ... | ... | ... | ... |
| WP430 | CR430 | S43000 | 0.12 | 1.00 | 0.040 | 0.030 | 1.00 | 0.50 | 16.0–18.0 | ... | ... | ... | ... | ... |
| WP430Ti | CR430Ti | S43036 | 0.10 | 1.00 | 0.040 | 0.030 | 1.00 | 0.75 | 16.0–19.5 | ... | ... | ... | (53C) min 0.75 max | ... |
| WP446 | CR446 | S44600 | 0.20 | 1.50 | 0.040 | 0.030 | 0.75 | 0.50 | 23.0–27.0 | ... | ... | 0.25 | ... | ... |
| Ferritic/Austenitic Steels | | | | | | | | | | | | | | |
| WPS31803 | CRS31803 | S31803 | 0.030 | 2.00 | 0.030 | 0.020 | 1.0 | 4.5–6.5 | 21.0–23.0 | 2.5–3.5 | ... | 0.08–0.20 | ... | ... |
| WPS32101 | CRS32101 | S32101 | 0.040 | 4.0–6.0 | 0.040 | 0.030 | 1.00 | 1.35–1.70 | 21.0–22.0 | 0.10–0.80 | 0.10–0.80 | 0.20–0.25 | ... | ... |
| WPS32750 | CRS32750 | S32750 | 0.030 | 1.20 | 0.035 | 0.020 | 0.8 | 6.0–8.0 | 24.0–26.0 | 3.0–5.0 | 0.5 | 0.24–0.32 | ... | ... |
| WPS32950 | CRS32950 | S32950 | 0.030 | 2.00 | 0.035 | 0.010 | 0.60 | 3.5–5.2 | 26.0–29.0 | 1.00–2.50 | ... | 0.15–0.35 | ... | ... |
| WPS32760 | CRS32760 | S32760 | 0.030 | 1.00 | 0.030 | 0.010 | 1.00 | 6.0–8.0 | 24.0–26.0 ^C | 3.0–4.0 ^C | 0.50–1.00 | 0.20–0.30 ^C | ... | W 0.50–1.00 |
| WPS39274 | CRS39274 | S32974 | 0.030 | 1.00 | 0.030 | 0.020 | 0.80 | 6.0–8.0 | 24.0–26.0 | 2.50–3.50 ^C | 0.20–0.80 | 0.24–0.32 | ... | W 1.50–2.50 |
| WPS32550 | CRS32550 | S32550 | 0.04 | 1.50 | 0.040 | 0.030 | 1.00 | 4.5–6.5 | 24.0–27.0 | 2.9–3.9 | 1.50–2.50 | 0.10–0.25 | ... | ... |
| WPS32205 | CRS32205 | S32205 | 0.030 | 2.00 | 0.030 | 0.020 | 1.00 | 4.5–6.5 | 22.0–23.0 | 3.0–3.5 | ... | 0.14–0.20 | ... | ... |
| Martensitic Steels | | | | | | | | | | | | | | |
| WP410 | CR410 | S41000 | 0.15 | 1.00 | 0.040 | 0.030 | 1.00 | 0.50 max | 11.5–13.5 | ... | ... | ... | ... | ... |
| WPS41008 | CRS41008 | S41008 | 0.08 | 1.00 | 0.040 | 0.030 | 1.00 | 0.60 | 11.5–13.5 | ... | ... | ... | ... | ... |
| WPS41500 | CRS41500 | S41500 | 0.05 | 0.50–1.00 | 0.030 | 0.030 | 0.60 | 3.5–5.5 | 11.5–14.0 | 0.50–1.00 | ... | ... | ... | W 0.50–1.00 |

^A Naming system developed and applied by ASTM International.

^B Maximum unless otherwise indicated.

^C % Cr + 3.3 % Mo + 16 % N = 40 min.



4.2.3 Electric furnace 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 combination of two or more of these operations. The forming procedure shall be so applied that it will not produce surface discontinuities deeper than 5 % of the specified nominal thickness of the fitting.

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

5.3 Fittings ordered as Class WP-S shall be of seamless construction and shall meet all requirements of Specification A 960/A 960M.

5.4 Fittings ordered as Class WP-W shall meet the requirements of Specification A 960/A 960M and (1) shall have all welds made by the fitting manufacturer and all pipe welds made with the addition of filler metal radiographically examined throughout the entire length in accordance with Paragraph UW-51 of Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code; and (2) shall not require radiography of the starting pipe weld if the pipe was welded without the addition of filler metal. 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 Fittings ordered as Class WP-WX shall meet the requirements of Specification A 960/A 960M 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 1 of the ASME Boiler and Pressure Vessel Code. The radiography of welds for this class of fittings can be done either prior to or after forming at the option of the manufacturer.

5.6 Fittings ordered as Class WP-WU shall meet the requirements of Specification A 960/A 960M 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 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 Fittings covered in Specification A 960/A 960M and ordered as CR shall meet the requirements of Specification A 960/A 960M and do not require nondestructive examination.

5.10 All classes of fittings shall have the welders, welding operators, and welded procedures qualified under the provisions of Specification A 960/A 960M 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 1, of the ASME Boiler and Pressure Vessel Code.

5.12 Fittings machined from bar shall be restricted to NPS 4 or smaller.

5.12.1 All caps machined from bar shall be examined by liquid penetrant in accordance with Practice E 165.

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 of 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 Heat-treatment 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, and

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 6.2 for post weld heat treatment.

5.14.1 Class WP-W—Radiographic inspection of the weld is required (see 5.4).

5.14.2 Class WP-WX—Radiographic inspection of all welds is required (see 5.5).

5.14.3 Class WP-WU—Ultrasonic inspection of all welds is required (see 5.6).

5.14.4 Class CR—Nondestructive examination is not required (see 5.9).

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 6.2 for post weld heat treatment.

5.15.1 Class WP-W—Radiographic inspection of all 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).

6. Heat Treatment

6.1 All fittings shall be heat treated in accordance with the requirements specified in Table 2.

6.2 All welding shall be done prior to the heat treatment specified in Table 2.

6.3 All fittings machined directly from forgings or bars (see 5.12), previously heat treated in accordance with the requirements specified in Table 2, need not be reheated.



TABLE 2 Heat Treatment

| Stainless Steel | All WP and CR Grades | Temperature | Cooling | Tempering Temperature |
|---------------------------------|----------------------|--------------------------------|---|---------------------------|
| Ferritic Ferritic/Austenitic | All | \$ 1200 °F [650 °C] | As appropriate for grade | Not specified |
| | S31803 | 1870–2010 °F [1020–1100 °C] | Water quench or rapidly cooled by other means | Not required |
| | S32101 | 1870 °F [1020 °C] min | Water quench or rapidly cooled by other means | Not required |
| | S32205 | 1870–2010 °F [1020–1100 °C] | Water quench | Not required |
| | S32750 | 1920–2060 °F [1025–1125 °C] | Water quench or rapidly cooled by other means | Not required |
| | S32760 | 2010–2085 °F [1100–1140 °C] | Water quench or rapidly cooled by other means | Not required |
| | S39274 | 1920–2060 °F [1025–1125 °C] | Water quench or rapidly cooled by other means | Not required |
| | S32550 | 1950–1975 °F [1065–1080 °C] | Water quench | Not required |
| | S32950 | Not specified | Not specified | Not required |
| | S41000 | \$ 1200°F [650°C] | Not specified | Not specified |
| Martensitic | S41008 | >1200°F [650°C] | In still air | Not specified |
| | S41500 | \$ 1750 °F [955 °C] | as appropriate for grade Air cool to # 200 °F [95 °C] prior to any optional intermediate temper and prior to final temper. | 1050–1150 °F [565–620 °C] |

7. Chemical Composition

7.1 The chemical composition of each cast or heat shall be determined and shall conform to the requirements of the chemical composition for the respective grades of materials listed in Table 1. Methods and practices relating to chemical analyses required by this specification shall be in accordance with Methods, Practices, and Definitions A 751. Product analysis tolerances in accordance with Table 3 are applicable.

7.2 Except as listed below, in fittings of welded construction, the composition of the deposited weld shall conform to the same requirements as the base metal.

7.2.1 Welds on S32950 base metal shall be made with nominal 26 % Cr, 8 % Ni, 2 % Mo weld metal.

7.2.2 Welds on S31803 base metal shall conform to the same requirements as the base metal or shall be made with nominal 22 % Cr, 8 to 10 % Ni, 3 % Mo weld metal.

8. Tensile Requirements Tensile Requirements

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.

8.2 At least one tension test per heat shall be made on material representative of the fitting, including weld metal when filler metal is added, and in the same condition of heat treatment as the finished fitting it represents.

8.3 The fittings manufacturer shall perform a tensile test on material representative of the finished fitting. Records of the tensile test made on the starting material may be certification

that the material of hot-finished fittings meets the tensile requirements of this specification provided the heat treatments are the same.

9. Hardness Requirements

9.1 Fittings shall not exceed the maximum hardness shown in Table 4.

10. Dimensions

10.1 The sizes, shapes, and dimensions of the fittings covered by ASME B16.9, ASME B16.11, MSS SP-43, MSS SP-79, MSS-SP-83, or MSS-SP-95 shall be as specified in those standards.

10.2 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 S8.

11. Workmanship, Finish, and Appearance

11.1 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 11.3 and 11.4, and shall have a workmanlike finish.

11.2 Surface discontinuities deeper than 5 % of the specified nominal wall thickness, except as defined in 11.3 and 11.4, 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.

TABLE 3 Product Analysis Tolerances for Higher Alloy and Stainless Steels^A

| Elements | Limit or Maximum of Specified Range, % | Tolerance Over the Maximum Limit or Under the Minimum Limit |
|-----------------------|--|---|
| Carbon | 0.030, incl over 0.030 to 0.20, incl | 0.005 0.01 |
| Manganese | to 1.00, incl over 1.00 to 3.00, incl over 3.00 to 6.00 over 6.00 to 10.00 | 0.03 0.04 0.05 0.06 |
| Phosphorus | to 0.040, incl | 0.005 |
| Sulfur | to 0.030, incl | 0.005 |
| Silicon | to 1.00, incl over 1.00 to 1.40, incl | 0.05 0.10 |
| Chromium | over 4.00 to 10.00, incl over 10.00 to 15.00, incl over 15.00 to 20.00, incl over 20.00 to 27.50, incl | 0.10 0.15 0.20 0.25 |
| Nickel | to 1.00, incl over 1.00 to 5.00, incl over 5.00 to 10.00, incl over 10.00 to 20.00, incl over 20.00 to 22.00, incl | 0.03 0.07 0.10 0.15 0.20 |
| Molybdenum | over 0.20 to 0.60, incl over 0.60 to 2.00, incl over 2.00 to 7.00, incl | 0.03 0.05 0.10 |
| Titanium | all ranges | 0.05 |
| Copper | to 0.50 | 0.03 |
| Nitrogen | to 0.19, incl over 0.19 to 0.25 over 0.25 to 0.35 over 0.35 to 0.45 | 0.01 0.02 0.03 0.04 |
| Columbium Tungsten | 0.05 to 0.20, incl to 1.00 | 0.01 0.04 |

^A This table does not apply to heat analysis.

11.3 Surface checks (fish scale) deeper than $\frac{1}{64}$ in. [0.4 mm] shall be removed.

11.4 Mechanical marks deeper than $\frac{1}{16}$ in. [1.6 mm] shall be removed.

11.5 When the removal of a surface discontinuity reduces the wall thickness below $87\frac{1}{2}\%$ of the specified nominal wall thickness at any point, the fitting shall be subject to rejection or to repair as provided in 11.6.

11.6 Repair by Welding:

11.6.1 Repair welding, of the base metal by the manufacturer, is permissible for fittings made to the dimensional standards listed in 10.1 or for other standard fittings made for stock. Prior approval of the purchaser is required to repair special fittings made to the purchaser's requirements. Repair by welding shall neither exceed 10 % of the outside surface area of the fitting nor $33\frac{1}{3}\%$ of the nominal wall thickness.

11.6.2 The welding procedure and welders shall be qualified in accordance with Specification A 960/A 960M.

11.6.3 The alloy content (carbon, chromium, nickel, molybdenum, columbium, and titanium) of the deposited weld metal

TABLE 4 Tensile and Hardness Requirements

| All WP and CR Grades | Yield Strength, min, ksi [MPa] | Tensile Strength, ^A ksi [MPa] | Elongation in 2 in. [50 mm] or 4D, min, % | HB max |
|------------------------------------|--------------------------------|--|---|--------|
| <i>Ferritic Steels:</i> | | | | |
| S44627 | 40 [275] | 65 [450]–90 [620] | 20.0 | 190 |
| S44626 | 45 [310] | 68 [470]–93 [640] | 20.0 | 241 |
| S42900 | 35 [240] | 60 [415]–85 [585] | 20.0 | 190 |
| S43000 | 35 [240] | 65 [450]–90 [620] | 20.0 | 190 |
| S43036 | 35 [240] | 60 [415]–85 [585] | 20.0 | 190 |
| S44600 | 40 [275] | 70 [485]–95 [655] | 18.0 | 207 |
| <i>Ferritic/Austenitic Steels:</i> | | | | |
| S31803 | 65 [450] | 90 [620] | 20.0 | 290 |
| S32101 | 65 [450] | 94 [650] | 30.0 | 290 |
| S32205 | 65 [450] | 95 [655] | 20.0 | 290 |
| S32750 | 80 [550] | 116 [800]–140 [965] | 15.0 | 310 |
| S32760 | 80 [550] | 109 [750]–130 [895] | 25.0 | 270 |
| S32950 | 70 [485] | 100 [690] | 15.0 | 290 |
| S39274 | 80 [550] | 116 [800] | 15.0 | 310 |
| S32550 | 80 [550] | 110 [760] | 15.0 | 302 |
| <i>Martensitic Steels:</i> | | | | |
| S41000 | 30 [205] | 70 [485]–95 [655] | 20.0 | 207 |
| S41008 | 30 [205] | 60 [415] | 22.0 | 183 |
| S41500 | 90 [620] | 110 [760]–135 [930] | 15.0 | 295 |

^AMinimum unless otherwise indicated.

shall be within the same percentage range as permitted for the base metal. (**Warning**—When selecting the filler metal and welding procedure, consideration should be given to their effect on corrosion resistance in service.)

11.6.4 Surface discontinuities deeper than 5 % of the specified nominal wall thickness shall be removed by mechanical means or thermal cutting or gouging methods. Cavities prepared for welding shall be examined by the liquid penetrant method of Practice E 165. No cracks shall be permitted in the prepared cavities.

11.6.5 The weld repair shall be permanently identified with the welder's stamp or symbol in accordance with Specification A 960/A 960M.

11.6.6 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 shall be permitted in the weld or surrounding $\frac{1}{2}$ in. [13 mm] of base metal.

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

11.7 The fittings shall be cleaned free of scale.

12. Hydrostatic Tests

12.1 Hydrostatic testing is not required by this specification.

12.2 Each fitting of Class WP 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.

12.3 Each fitting of Class CR, except tees covered in 12.3.1, shall be capable of withstanding without failure, leakage, or



impairment of serviceability, a test pressure based on the ratings in **MSS SP-43**.

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

13. Rejection

13.1 Unless otherwise specified, any rejection based on tests by the purchaser shall be reported to the manufacturer within 30 working days from the receipt of samples or test reports by the purchaser.

13.2 Each fitting that develops surface discontinuities deeper than 5 % of the specified nominal wall thickness in shop working or application operations may be rejected and the manufacturer so notified.

14. Rehearing

14.1 Test samples that represent fittings rejected by the purchaser shall be preserved for four weeks from the date of the rejection report. In case of dissatisfaction with the test results, the manufacturer may make claim for a rehearing within the period that the samples are preserved.

15. Certification

15.1 When requested by the purchaser, the manufacturer shall provide a certificate of conformance to this specification (including year date). In addition, if requested to provide test reports, the manufacturer shall also provide the following where applicable:

15.1.1 Chemical results, Section 7 (**Table 1**),

15.1.2 Tensile results, Section 8 (**Table 4**). Report yield strength and ultimate tensile strength in ksi [MPa], and elongation in percent,

15.1.3 Type of heat treatment, Section 6,

15.1.4 Starting material; plate, bar, pipe (specify welded or seamless), forging,

15.1.5 Seamless or welded construction,

15.1.6 Any supplemental testing required by the purchase order, and

15.1.7 Heat identification.

16. Test Reports

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

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

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

16.1.3 Chemical analysis for all starting materials,

16.1.4 Mechanical properties of all starting materials,

16.1.5 For construction with filler metal added, weld metal specification number,

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

16.1.7 Heat treatment type,

16.1.8 Results of all nondestructive examinations,

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

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

17. Keywords

17.1 corrosive service applications; ferritic/austenitic stainless steel; ferritic stainless steel; martensitic stainless steel; pipe fittings-steel; piping applications; pressure containing parts; stainless steel fittings

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 8.

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.

S2. Tension Test (Note S1.1)

S2.1 One tension test shall be made on one fitting or representative test piece (**Note S2.1**) per lot (**Note S2.2**) 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 S2.1—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 tubular products shall have a cross section approximately the same as that of the finished product. The test piece for fittings of welded construction shall be prepared to the same weld procedures and from the same heats of materials as the fittings it represents.

NOTE S2.2—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 controlled 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 S1.1)

S3.1 An intergranular corrosion bend test shall be made on one fitting or representative test piece (Note S2.1) per lot (Note S2.2) 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 Practices A 262 or Practices A 763, as applicable.

S4. Ultrasonic Test

S4.1 Each fitting or 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/A 388M. Acceptance limits shall be specified by the purchaser.

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 fitting 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 RMS (root-mean-square) or 6.3 μin . AA (arithmetical average). All other surfaces shall be suitable for ultrasonic testing.

S7. Liquid Penetrant Test

S7.1 All surfaces shall be liquid penetrant tested. The method shall be in accordance with Practice E 165.

S8. Special Fittings

S8.1 Partial compliance fittings of size and shape not conforming to the dimensional requirements of ASME B16.9, B16.11, or MSS SP-79 shall meet all other requirements of this specification. In addition to the marking required in Section 16, the grade designation symbol shall be followed by the symbol “S8.”

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this specification since the last issue, A 815/A 815M – 07, that may impact the use of this specification. (Approved September 1, 2007)

(1) Added S32101 requirements to Table 1, Table 2, and Table 4.

(2) Corrected the Yield Strength for S32205, revised headings, and added new footnote A in Table 4.

Committee A01 has identified the location of selected changes to this specification since the last issue, A 815/A 815M – 04, that may impact the use of this specification. (Approved April 1, 2007)

(1) Added MSS-SP-83 and MSS-SP-95 to 10.1 and Referenced Documents.

(3) Added “All WP and CR Grades” to Tables 2 and 4.

(2) Added Grade “WP” and “CR” to Ferritic/Austenitic Steels in Table 1.

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