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Designation: A403/A403M - 13a A403/A403M - 14

Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings¹

This standard is issued under the fixed designation A403/A403M; 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.

This standard has been approved for use by agencies of the U.S. 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 SI units or inch-pound units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.6 This specification does not apply to cast steel fittings. Austenitic stainless steel castings are covered in Specifications A351/A351M, A743/A743M, and A744/A744M.

2. Referenced Documents

2.1 ASTM Standards:³

A351/A351M Specification for Castings, Austenitic, for Pressure-Containing Parts

A743/A743M Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application A744/A744M Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service

A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

A960/A960M Specification for Common Requirements for Wrought Steel Piping Fittings

E112 Test Methods for Determining Average Grain Size

E165 Practice for Liquid Penetrant Examination for General Industry

2.2 ASME Standards: ⁴

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

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

2.3 MSS Standards: ⁵

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

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 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.

⁴ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three<u>Two</u> Park Ave., New York, NY 10016-5990, http://www.asme.org.

⁵ 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.



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

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

MSS SP-97 Integrally Reinforced Forged Branch Outlet Fittings—Socket Welding, Threaded and Buttwelding Ends

2.4 ASME Boiler and Pressure Vessel Code: ⁴

Section VIII Division I, I Pressure Vessels

Section IX, IX Welding Qualifications

2.5 AWS Standards: 6

A 5.4 Specification for Corrosion-Resisting Chromium and Chromium-Nickel Steel Covered Welding Electrodes A 5.9 Specification for Corrosion-Resisting Chromium and Chromium-Nickel Steel Welding Rods and Bare Electrodes

A 5.11 Specification for Nickel and Nickel-Alloy Welding Electrodes for Shielded Metal Arc Welding

A5.14 Specification for Nickel and Nickel-Alloy Bare Welding Rods and Electrodes

2.6 ASNT: 7

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 A960/A960M including any supplementary requirements that are indicated in the purchase order. Failure to comply with the common requirements of Specification A960/A960M constitutes nonconformance with this specification. In case of conflict between this specification and Specification A960/A960M, this specification shall prevail.

3.2 Specification A960/A960M identifies the ordering information that should be complied with when purchasing material to this specification.

4. Material

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.

4.4 Grain Size—Annealed Alloys UNS N08810 and UNS N08811 shall conform to an average grain size of ASTM No. 5 or coarser.

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, ASME B16.11, MSS SP-79, MSS SP-83, MSS SP-95, or MSS SP-97.

5.4 Grade WP fittings ordered as Class W shall meet the requirements of ASME B16.9 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,

⁶ Available from American Welding Society (AWS), 550 NW LeJeune Rd., Miami, FL 33126, http://www.aws.org.

⁷ Available from American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlingate Ln., Columbus, OH 43228-0518, http://www.asnt.org.

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TABLE 2 Chemical Requirements

WPXM-19 CRXM WP20CB CR20 WP6XN CR62 WP6XN CR6X WP700 CR70 WPNIC CRNM WPNIC10 CRNM WPNIC11 CRNM WPNIC11 CRNM WPNIC11 CRNM WPNIC11 CRNM WP904L CR90 WP1925 CR19 WP304 CR30 WP316 CR31 WP316 CR31 WP316 CR31 WP317 CR31 WP3172 CR33 WPS31726 <	R700	R UNS Des- ignation S20910 N08020 N08367 N08700 N08800 N08810 N08811	C ^B 0.06 0.07 0.030 0.04 0.10 0.05- 0.10	Mn ^{<i>B</i>} 4.0–6.0 2.00 2.00 2.00 1.50	P ^B 0.045 0.045 0.040 0.040 0.045	S ^B 0.030 0.035 0.030 0.030	1.00	Ni 11.5–13.5 32.0–38.0		Mo 1.50-3.00	Ti 	N ^C 0.20– 0.40	Others D
NP20CB CR20 NP6XN CR6X NP700 CR70 NPNIC CRNI NPNIC10 CRNI NPNIC11 CRNI NPNIC11 CRNI NP904L CR90 NP1925 CR19 NP304 CR30 NP304 CR31 NP316 CR31 NP316 CR31 NP317 CR31 NP3172 CR33 NPS31726 CR53 NPS31727 CR53 NPS31728 <	R20CB R6XN R700 RNIC RNIC10 RNIC11 R904L R1925	N08020 N08367 N08700 N08800 N08810	0.07 0.030 0.04 0.10	2.00 2.00 2.00	0.045 0.040 0.040	0.035	1.00						D
NP6XN CR6X NP700 CR70 NPNIC CRNI NPNIC10 CRNI NPNIC11 CRNI NPNIC11 CRNI NPNIC11 CRNI NPNIC11 CRNI NPNIC11 CRNI NPNIC11 CRNI NP1925 CR19 NP1925N CR19 NP304 CR30 NP305 CR31 NP315 CR31 NP316 CR31 NP317 CR31 NP3172 CR33 NPS31727 CR53 NPS31727 CR53 NPS31720 CR33 NPS31721 CR32 NP3212 <td>R6XN R700 RNIC RNIC10 RNIC11 R904L R1925</td> <td>N08367 N08700 N08800 N08810</td> <td>0.030 0.04 0.10</td> <td>2.00 2.00</td> <td>0.040 0.040</td> <td>0.030</td> <td></td> <td>32.0–38.0</td> <td>19.0–21.0</td> <td>0.00.0.00</td> <td></td> <td></td> <td></td>	R6XN R700 RNIC RNIC10 RNIC11 R904L R1925	N08367 N08700 N08800 N08810	0.030 0.04 0.10	2.00 2.00	0.040 0.040	0.030		32.0–38.0	19.0–21.0	0.00.0.00			
VP700 CR70 VPNIC CRNI VPNIC10 CRNI VPNIC11 CRNI VP904L CR90 VP304 CR30 VP304 CR30 VP304L CR30 VP304L CR30 VP304L CR30 VP304L CR30 VP304L CR30 VP304L CR31 VP315 CR31 VP316 CR31 VP316L CR31 VP317 CR31 VPS31725 CR53 VPS31726 CR53 VPS31727 CR53 VPS31720 CR53 VPS31721 CR32	R700 RNIC RNIC10 RNIC11 R904L R1925	N08700 N08800 N08810	0.04 0.10	2.00	0.040		1.00			2.00–3.00			Cu 3.0-4.0 Cb 8XC min, 1.00 max
VPNIC10 CRNI VPNIC11 CRNI VPNIC11 CRNI VP1925 CR19 VP1925 CR19 VP1925N CR19 VP304L CR30 VP304L CR31 VP316L CR31 VP316L CR31 VP316L CR31 VP317C CR33 VP3172C CR53 VPS31726 CR53 VPS31727 CR53 VPS31720 CR53 VP3211 CR32 VPS3228 CR53 VPS34565 CR53 VPS34565 CR53	RNIC10 RNIC11 R904L R1925	N08810		1.50	0.045		1.00	23.5–25.5 24.0–26.0		6.0–7.0 4.3–5.0		0.18–0.25	Cu 0.75 Cu0.50 Cb 8XC min
VPNIC11 CRNI VP904L CR90 VP1925 CR19 VP1925N CR19 VP304 CR30 VP304 CR31 VP316 CR31 VP316 CR31 VP316 CR31 VP316 CR31 VP317 CR31 VP3172 CR33 VPS31726 CR53 VPS31727 CR53 VPS31730 CR32 VPS321720 CR32 VPS3212 CR33 VPS34565 CR53 VPS34565	RNIC11 R904L R1925		0.05- 0.10			0.015	1.00	30.0–35.0	19.0–23.0	0.1	5–0.60		Al 0.15–0.60 Cu 0.75 Fe 39.5 min
VP904L CR90 VP1925 CR19 VP1925N CR19 VP304 CR30 VP304L CR30 VP304L CR30 VP304L CR30 VP304H CR30 VP304LN CR30 VP304LN CR30 VP304LN CR30 VP304LN CR30 VP304LN CR31 VP316L CR31 VP316L CR31 VP316L CR31 VP316L CR31 VP316L CR31 VP316L CR31 VP317 CR31 VP317 CR31 VP317Z CR33 VPS31725 CR53 VPS31727 CR53 VPS31730 CR32 VPS321053 CR53 VPS3212 CR32 VPS33228 CR53 VPS34565 CR53 VPS347 CR34	R904L R1925	N08811		1.50	0.045	0.015	1.00	30.0–35.0	19.0–23.0	0.1	5–0.60		Al 0.15–0.60 Cu 0.75 Fe 39.5 min
VP1925 CR19 VP1925N CR19 VP304L CR30 VP304L CR30 VP304L CR30 VP304L CR30 VP304L CR30 VP304N CR30 VP304N CR30 VP304N CR30 VP304LN CR30 VP304C CR30 VP304C CR30 VP304C CR30 VP304LN CR30 VP304C CR31 VP316 CR31 VP316L CR31 VP316N CR31 VP316N CR31 VP316N CR31 VP317C CR33 VPS31725 CRS3 VPS31726 CR33 VPS31727 CR33 VPS31730 CR33 VPS31726 CR33 VPS31726 CR33 VPS31727 CR33 VPS31728 CR33 VPS31720 CR33 V	R1925		0.60- 0.10	1.50	0.040	0.015	1.00	30.0–35.0	19.0–23.0	0.1	5–0.60		Al 0.15–0.60 Cu 0.75 Fe 39.5 min
VP1925 CR19 VP1925N CR19 VP304L CR30 VP304L CR30 VP304L CR30 VP304L CR30 VP304L CR30 VP304N CR30 VP304N CR30 VP304N CR30 VP304LN CR30 VP304C CR30 VP304C CR30 VP304C CR30 VP304LN CR30 VP304C CR31 VP316 CR31 VP316L CR31 VP316N CR31 VP316N CR31 VP316N CR31 VP316N CR31 VP317C CR33 VPS31725 CRS3 VPS31727 CR33 VPS31720 CR33 VPS3121 CR32 VPS3228 CR53 VPS34565 CR53 VPS347 CR34	R1925	N08904	0.020	2.00	0.045	0.035	1.00	23.0–28.0	19.0–23.0	4.0-5.0		0.10	Cu 1.0–2.0
VP1925N CR19 VP304 CR30 VP304L CR30 VP304H CR30 VP304H CR30 VP304H CR30 VP304N CR30 VP304N CR30 VP304N CR30 VP304N CR30 VP304LN CR30 VP304C CR31 VP304C CR33 VP316 CR31 VP316L CR31 VP316L CR31 VP316L CR31 VP316L CR31 VP317L CR31 VP317Z CR33 VPS31725 CRS3 VPS31726 CRS3 VPS31727 CRS3 VPS31730 CR33 VPS321 CR32 VPS33228 CRS3 VPS34565 CRS3 VPS34565 CRS3		N08925	0.020	1.00	0.045	0.030		24.0-26.0		6.0–7.0	-		Cu 0.8-1.5
VP304 CR30 VP304L CR30 VP304H CR30 VP304H CR30 VP304H CR30 VP304N CR30 VP304LN CR30 VP304LN CR30 VP304LN CR30 VP304LN CR30 VP304LN CR30 VP305 CR31 VP316 CR31 VP316L CR31 VP316L CR31 VP316L CR31 VP316L CR31 VP316L CR31 VP317 CR31 VP317 CR31 VPS31725 CRS3 VPS31726 CRS3 VPS31727 CRS3 VPS31730 CR32 VP321 CR32 VP33228 CR53 VPS33228 CR53 VPS34565 CR53 VPS347 CR34		N08926	0.020	2.00	0.030	0.010		24.0-26.0		6.0–7.0			Cu 0.5-1.5
VP304H CR30 VP304N CR30 VP304LN CR30 VP304LN CR30 VP304LN CR30 VP304LN CR30 VP309 CR30 VP310S CR31 VP316L CR31 VP317 CR31 VPS31725 CR53 VPS31726 CR53 VPS31727 CRS3 VPS31720 CR32 VP321 CR32 VP33228 CR53 VPS34565 CR53 VPS34565 CR53 VP347 CR34	R304	S30400	0.08	2.00	0.045	0.030		8.0-11.0	18.0-20.0				
VP304N CR30 VP304LN CR30 VP309 CR30 VP310S CR31 VP310S CR31 VP310S CR31 VP31254 CR53 VP316 CR31 VP316L CR31 VP316L CR31 VP316L CR31 VP316L CR31 VP316L CR31 VP316LN CR31 VP317 CR31 VP317 CR33 VPS31725 CR53 VPS31726 CR53 VPS31727 CR53 VPS31720 CR53 VPS31721 CR32 VP3211 CR32 VPS3228 CR53 VPS34565 CR53 VPS34565 CR53 VPS347 CR34	R304L	S30403	0.030 ^E	2.00	0.045	0.030	1.00	8.0-12.0	18.0-20.0				
WP304LN CR30 WP309 CR30 WP310S CR31 WP316 CR31 WP316 CR31 WP316 CR31 WP316 CR31 WP316 CR31 WP316 CR31 WP316N CR31 WP316N CR31 WP316LN CR31 WP317C CR33 WP3172 CR33 WPS31726 CRS3 WPS31727 CRS3 WPS31728 CRS3 WPS31729 CR33 WPS31720 CR33 WPS3121 CR32 WPS3228 CR33 WPS34565 CRS3 WPS34565 CRS3 WPS347 CR34	R304H	S30409	0.04-0.10	2.00	0.045	0.030	1.00	8.0-11.0	18.0-20.0				
WP309 CR30 WP310S CR31 WP311254 CRS3 WP316 CR31 WP316L CR31 WP316L CR31 WP316H CR31 WP316H CR31 WP316L CR31 WP316L CR31 WP316L CR31 WP317 CR31 WP317L CR33 WP317Z CRS3 WPS31725 CRS3 WPS31727 CRS3 WPS31720 CRS3 WPS31721 CR32 VPS32053 CR53 WP321 CR32 WPS33228 CRS3 WPS34565 CRS3 WPS34565 CRS3 WPS347 CR34	R304N	S30451	0.08	2.00	0.045	0.030	1.00	8.0-11.0	18.0–20.0			0.10-	
VP310S CR31 VPS1254 CRS3 VP316 CR31 VP316L CR31 VP316H CR31 VP316H CR31 VP316H CR31 VP316N CR31 VP316LN CR31 VP317 CR31 VP317 CR31 VPS31725 CRS3 VPS31726 CRS3 VPS31727 CRS3 VPS31728 CRS3 VPS31729 CRS3 VPS31720 CRS3 VPS31721 CR32 VP321 CR32 VPS3218 CRS3 VPS33228 CRS3 VPS34565 CRS3 VPS34565 CRS3 VPS47 CR34	R304LN	S30453	0.030	2.00	0.045	0.030	1.00	8.0–11.0	18.0–20.0			0.16 0.10– 0.16	
VPS31254 CRS3 VP316 CR31 VP316L CR31 VP316H CR31 VP316N CR31 VP316L CR31 VP316N CR31 VP316LN CR31 VP316LN CR31 VP317 CR31 VP317 CR33 VPS31725 CRS3 VPS31726 CRS3 VPS31727 CRS3 VPS31730 CR33 VP321 CR32 VPS322053 CR53 VPS33228 CRS3 VPS34565 CRS3 VPS34565 CRS3 VPS347 CR34	R309	S30900	0.20	2.00	0.045	0.030	1.00	12.0-15.0	22.0-24.0				
NP316 CR31 NP316L CR31 NP316H CR31 NP316N CR31 NP316N CR31 NP316LN CR31 NP316LN CR31 NP317 CR31 NP317 CR31 NPS31725 CRS3 NPS31726 CRS3 NPS31727 CRS3 NPS31726 CRS3 NPS31727 CRS3 NPS31720 CRS3 NPS31721 CR32 NP321 CR32 NPS33228 CRS3 NPS34565 CRS3 NPS34565 CRS3 NPS347 CR34	R310S	S31008	0.08	2.00	0.045	0.030	1.00	19.0-22.0	24.0-26.0				
VP316L CR31 VP316H CR31 VP316N CR31 VP316LN CR31 VP316LN CR31 VP317 CR31 VP317 CR31 VP317 CR31 VP317 CR31 VP317 CR31 VPS31725 CRS3 VPS31726 CRS3 VPS31727 CRS3 VPS31730 CR33 VP321 CR32 VPS3228 CRS3 VPS34565 CRS3 VPS34565 CRS3 VPS34565 CRS3	RS31254	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– 0.25	Cu 0.50-1.00
WP316H CR31 WP316N CR31 WP316LN CR31 WP316LN CR31 WP317 CR31 WP317 CR31 WP317L CR31 WP317L CR31 WP317L CR33 WPS31725 CRS3 WPS31726 CRS3 WPS31727 CRS3 WPS31730 CR32 WP321 CR32 WPS33228 CRS3 WPS34565 CRS3 WPS34565 CRS3 WPS34565 CRS3		S31600	0.08	2.00	0.045	0.030		10.0-14.0		2.00-3.00			
WP316N CR31 WP316LN CR31 WP317 CR31 WP317L CR31 WP317L CR31 WP317L CR31 WP317L CR31 WPS31725 CRS3 WPS31726 CRS3 WPS31726 CRS3 WPS31727 CRS3 WPS31730 CRS3 WPS32053 CRS3 WPS321 CR32 WPS3228 CRS3 WPS34565 CRS3 WPS34565 CRS3 WPS347 CR34		S31603	0.030 ^E	2.00	0.045	0.030		10.0–14.0 ^F		2.00-3.00			
WP316LN CR31 NP317 CR31 NP317L CR31 NPS31725 CRS3 NPS31726 CRS3 NPS31727 CRS3 NPS31730 CRS3 NPS32053 CRS3 NPS311720 CRS3 NPS31720 CRS3 NPS32053 CRS3 NPS321 CR32 NPS321H CR32 NPS33228 CRS3 NPS34565 CRS3 NPS34565 CRS3		S31609	0.04–0.10	2.00	0.045	0.030		10.0-14.0		2.00-3.00			
NP317 CR31 NP317L CR31 NP317Z CRS3 NPS31726 CRS3 NPS31727 CRS3 NPS31727 CRS3 NPS31726 CRS3 NPS31727 CRS3 NPS31720 CRS3 NPS31721 CR32 NP321 CR32 NP321H CR32 NPS33228 CRS3 NPS34565 CRS3 NPS34565 CRS3 NPS347 CR34	R316N	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-	
NP317L CR31 NPS31725 CRS3 NPS31726 CRS3 NPS31727 CRS3 NPS31720 CRS3 NPS31730 CRS3 NPS31721 CRS3 NPS32053 CRS3 NP321 CR32 NP3221H CR32 NPS33228 CRS3 NPS34565 CRS3 NPS34565 CRS3 NP347 CR34	R316LN	S31653	0.030	2.00	0.045	0.030	1.00	10.0–13.0	16.0–18.0	2.00-3.00		0.16 0.10– 0.16	
WPS31725 CRS3 WPS31726 CRS3 WPS31727 CRS3 WPS31730 CRS3 WPS32053 CRS3 WPS21 CR32 WPS322053 CR33 WPS21 CR32 WPS322053 CRS3 WPS21 CR32 WPS3258 CRS3 WPS34565 CRS3 WPS34565 CRS3 WPS47 CR34	R317	S31700	0.08	2.00	0.045	0.030	1.00	11.0-15.0	18.0-20.0	3.0-4.0			
WPS31726 CRS3 WPS31727 CRS3 WPS31730 CRS3 WPS32053 CRS3 WPS321 CR32 WPS321H CR32 WPS3228 CRS3 WPS34565 CRS3 WPS34565 CRS3 WPS347 CR34	R317L cite	S31703	0.030	2.00 0/010	0.045	0.030	1.00	11.0-15.0	18.0-20.0	3.0-4.0	-0f0/2	stm-a4()3-a403m-14
WPS31727 CRS3 MPS31730 CRS3 WPS32053 CRS3 WPS321 CR32 WP321 CR32 WP3221H CR32 WPS3228 CRS3 WPS34565 CRS3 WPS34565 CRS3 WPS347 CR34	RS31725	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	
WPS31730 CRS3 WPS32053 CR32 WP321 CR32 WP321H CR32 WPS3228 CRS3 WPS34565 CRS3 WPS34565 CRS3 WP347 CR34	RS31726		0.030	2.00	0.045	0.030		13.5–17.5		4.0–5.0		0.10– 0.20	
NPS32053 CRS3 NP321 CR32 NP321H CR32 NP321H CR33 NPS33228 CRS3 NPS34565 CRS3 NP347 CR34	RS31727 RS31730		0.030	1.00	0.030 0.040	0.030		14.5–16.5 15.0–16.5		3.8–4.5 3.0–4.0		0.15– 0.21 0.045	Cu 2.8–4.0 Cu 4.0–5.0
NP321H CR32 NPS33228 CRS3 NPS34565 CRS3 NP347 CR34	RS32053	S32053	0.030	1.00	0.030	0.010	1.00	24.0-26.0	22.0-24.0	5.0-6.0	<u></u> 	0.17	
WPS33228 CRS3 WPS34565 CRS3 WP347 CR34		S32100	0.08	2.00	0.045	0.030		9.0-12.0	17.0-19.0		G H		
NPS34565 CRS3 NP347 CR34		S32109	0.04-0.10 0.04-0.08	2.00	0.045	0.030		9.0-12.0	17.0-19.0				Co 0 05 0 10
WP347 CR34					0.020	0.015		31.0–33.0					Ce 0.05–0.10 Al 0.025 Cb 0.6–1.0
	RS34565		0.030	5.0-7.0	0.030	0.010		16.0–18.0		4.0–5.0		0.40- 0.60	Cb 0.10
		S34700	0.08	2.00	0.045	0.030		9.0-12.0	17.0-19.0				J
	R347H R347LN	S34709 S34751	0.04–0.10 0.005– 0.020	2.00 2.00	0.045 0.045	0.030 0.030		9.0–12.0 9.0–13.0	17.0–19.0 17.0–19.0				Cb 0.20–0.50, ^{<i>K</i>} N 0.06–0.10 ^{<i>C</i>}
WP348 CR34	R348	S34800	0.08	2.00	0.045	0.030	1.00	9.0–12.0	17.0–19.0				Cb+Ta=10×(C)-1.1 Ta 0.10
WP348H CR34		S34809	0.04–0.10	2.00	0.045	0.030	1.00	9.0–12.0	17.0–19.0				Co 0.20 Cb+Ta=8×(C)-1.10 Ta 0.10
	പാ40ല												Co 0.20
WPS38815 CRS3		S38815	0.030	2.00	0.040	0.020	5.5-6.5	5 13.0-17.0	13.0-15.0	0.75-1.50			Cu 0.75-1.50 Al 0.30

^A See Section <u>1415</u> 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 %.

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^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+N) min-0.70 max.

^H 4X(C+N) min-0.70 max.

¹ 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 %.

^{*K*}The columbium content shall be not less than 15 times the carbon content.

Grade WP ^A Grade CR ^A UNS Designation Type ^B WPXM-19 CRXM-19 S20910 XM-19 ^C WP20CB CR20CB N08020 WP6XN CR6KN N08267 WP700 CR700 N08700 WPNIC10 CRNIC N08800 800 ^C WPNIC10 CRNIC1 N08810 800 ^{LC} WPNIC10 CRNIC11 N08811 WP904L CR904L N08926 WP304 CR304H S30400 304L WP304L CR304H S30409 304H WP304L CR304H S30409 304H WP304L CR304H S30409 304H WP304L CR304H S30409 304H WP305 CR310S S31600 316 WP305 CR310S S31600 316 WP316L CR316H S31603 316H WP316L CR317L S31725 317		TABLE 3 Common Names				
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^A Naming system developed and applied by ASTM International.

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

 $^{\ensuremath{\mathcal{C}}}$ Common name, not a trademark widely used, not associated with any one producer.

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 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 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 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 A960/A960M.

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 Section 6 for 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 Section 6 for post weld heat treatment.

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

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

5.15.3 *Grade WP Class WU*—Ultrasonic inspection of all welds, made with or without the addition of filler metal, is required (see 5.6).

5.15.4 Grade 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 E112.

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 the temperatures listed for each grade in Table 4 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.

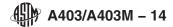


TABLE 4 Heat Treatment

Grade WP ^A	Grade CR ^A	UNS Designation	Solution Anneal Temperature, min °F [°C	Quench Media
WPXM-19	CRXM-19	S20910	1900 [1040]	water or other rapid cool
WP20CB	CR20CB	N08020	1700–1850	water or other rapid cool
	01.2002		[927–1010]	
WP6XN	CR6XN	N08367	2025 [1107]	water or other rapid cool
WP700	CR700	N08700	2025–2100	water or other rapid cool
	000		[1107–1150]	
WPNIC	CRNIC	N08800	1800–1900	water or other rapid cool
		100000	[983–1038] ^C	
WPNIC10	CRNIC10	N08810	2100–2150	water or other rapid cool
	01111010		[1147–1177] ^C	
WPNIC11	CRNIC11	N08811	2100–2150	water or other rapid cool
WINIOTI	ormorr	100011	[1147–1177] ^C	water of other rapid coor
WP904L	CR904L	N08904	1985–2100	water or other rapid cool
WF904L	CH904L	100904	[1085–2100	water of other rapid coor
WP1925	CR1925	N08925		water or other repid cool
WP 1925	CR1925	1008925	1800–1900	water or other rapid cool
		Nooooo	[983–1038]	
WP1925N	CR1925N	N08926	2150 [1177]	water or other rapid cool
WP304	CR304	S30400	1900 [1040]	water or other rapid cool
WP304L	CR304L	S30403	1900 [1040]	water or other rapid cool
WP304H	CR304H	S30409	1900 [1040]	water or other rapid cool
WP304N	CR304N	S30451	1900 [1040]	water or other rapid cool
WP304LN	CR304LN	S30453	1900 [1040]	water or other rapid cool
WP309	CR309	S30900	1900 [1040]	water or other rapid cool
WP310S	CR310S	S31008	1900 [1040]	water or other rapid cool
WPS31254	CR31254	S31254	2100 [1150]	water or other rapid cool
WP316	CR316	S31600	1900 [1040]	water or other rapid cool
WP316L	CR316L	S31603	1900 [1040]	water or other rapid cool
WP316H	CR316H	S31609	1900 [1040]	water or other rapid cool
WP316N	CR316N	S31651	1900 [1040]	water or other rapid cool
WP316LN	CR316LN	S31653	1900 [1040]	water or other rapid cool
WP317	CR317	S31700	1900 [1040]	water or other rapid cool
WP317L	CR317L	\$31703	1900 [1040]	water or other rapid cool
WPS31725	CRS31725	S31725	1900 [1040]	water or other rapid cool
WPS31726	CRS31726	S31726	1900 [1040]	water or other rapid cool
WPS31727	CRS31727	S31727	1975-2155	water or other rapid cool
	onconter	001121	[1080–1180]	
WPS31730	CRS31730	S31730	1900 [1040]	water or other rapid cool
WPS32053	CRS32053	S32053	1975–2155	water or other rapid cool
WI 002000	011002000	0000000	[1080–1180]	water of other rapid coor
WP321	CR321	S32100	1900 [1040]	water or other rapid cool
WP321H	CR321H	S32100		water or other rapid cool
			1925 [1050]	
WPS33228	CRS33228	AS33228 A403/A40	2050-2160	water or other rapid cool
where tandard	Is iteh a CRS34565 standa	rds/sist/\$34565 eb8-4151	_49ed [1120–1180]	e0f0/astm-a403-a403m-14
WPS34565	CR534565	534565	2050-2140	water or other rapid cool
	00047	00.1700	[1120–1170]	
WP347	CR347	S34700	1900 [1040]	water or other rapid cool
WP347H	CR347H	S34709	1925 [1050]	water or other rapid cool
WP347LN	CR347LN	S34751	1900 [1040]	water or other rapid cool
WP348	CR348	S34800	1900 [1040]	water or other rapid cool
WP348H	CR348H	S34809	1925 [1050]	water or other rapid cool
WPS38815	CRS38815	S38815	1950 [1065]	water or other rapid cool

^ANaming system developed and applied by ASTM International.

^BWhere a range of temperature is not listed, the single value shown shall be the minimum required temperature.

^oHeat Treatment is highly dependent on intended service temperature; consult material manufacturer for specific heat treatments for end use temperature.

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 A751. Product analysis tolerances in accordance with Specification A960/A960M 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