

SA-403/SA-403M

Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings

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

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.

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 non-destructive test method and extent of non-destructive 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.

A. Manufacture :-

1. 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.
2. Grade WP fittings ordered as Class W shall meet the requirements of ASME B16.9 and:
 - i. 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 'point A.3', and,
 - ii. 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
 - iii. Radiographic inspection is not required on longitudinal seam fusion welds made by the fitting manufacturer when all of the following conditions have been met:
 - a. No addition of filler metal,
 - b. Only one welding pass per weld seam, and,
 - c. Fusion welding from one side only.
 - iv. In place of radiographic examination, welds made by the fitting manufacturer may be ultrasonically examined in accordance with the Code requirements stated in 'point A.4'.
3. 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.
4. 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. Grade CR fittings shall meet the requirements of MSS SP-43 and do not require non-destructive examination.

Table 1

Class	Construction	Non-destructive Examination
S	Seamless	None
W	Welded	Radiography or Ultrasonic
WX	Welded	Radiography
WU	Welded	Ultrasonic

B. Heat Treatment :-

1. The heat-treat procedure, except for those grades listed in ‘point B.2’, shall consist of solution annealing the fittings at the temperatures listed for each grade in Table 2 until the chromium carbides go into solution, and then cooling at a sufficient rate to prevent reprecipitation.
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 at 1500 to 1600 °F [815 to 870 °C] for a minimum of 2h/in. [4.7 min/mm] of thickness shall be used subsequent to the initial high-temperature solution anneal and then cooling in the furnace or in air.

Table 2

Grade WP ^A	Grade CR ^A	UNS Designation	Solution Anneal Temperature, min °F [°C] ^B	Quench Media
WPXM-19	CRXM-19	S20910	1900 [1040]	water or other rapid cool
WP20CB	CR20CB	N08020	1700–1850 [927–1010]	water or other rapid cool
WP6XN	CR6XN	N08367	2025 [1107]	water or other rapid cool
WP700	CR700	N08700	2025–2100 [1107–1150]	water or other rapid cool
WPNIC	CRNIC	N08800	1800–1900 [983–1038] ^C	water or other rapid cool
WPNIC10	CRNIC10	N08810	2100–2150 [1147–1177] ^C	water or other rapid cool
WPNIC11	CRNIC11	N08811	2100–2150 [1147–1177] ^C	water or other rapid cool
WP904L	CR904L	N08904	1985–2100 [1085–1150]	water or other rapid cool
WP1925	CR1925	N08925	1800–1900 [983–1038]	water or other rapid cool
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
WPS31266	CRS31266	S31266	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	S31703	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 [1080–1180]	water or other rapid cool
WPS31730	CRS31730	S31730	1900 [1040]	water or other rapid cool
WPS32053	CRS32053	S32053	1975–2155 [1080–1180]	water or other rapid cool
WP321	CR321	S32100	1900 [1040]	water or other rapid cool
WP321H	CR321H	S32109	1925 [1050]	water or other rapid cool
WPS33228	CRS33228	S33228	2050–2160 [1120–1180]	water or other rapid cool
WPS34565	CRS34565	S34565	2050–2140 [1120–1170]	water or other rapid cool
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

^A Naming system developed and applied by ASTM International.

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

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

C. Grain Size :-

1. Annealed Alloys UNS N08810 and UNS vN08811 shall conform to an average grain size of ASTM No. 5 or coarser.
2. After final heat treatment, all “H-Grade” steel fittings shall have a grain size of 7 or coarser in accordance with Test Methods E112.

D. Chemical Composition :-

The steel shall conform to the chemical composition in Table 3.

Table 3^A

Grade WP	Grade CR	UNS Designation	C ^B	Mn ^B	P ^B	S ^B	Si ^B	Ni	Cr	Mo	Ti	N ^C	Others
WPXM-19	CRXM-19	S20910	0.06	4.0–6.0	0.045	0.03	1	11.5–13.5	20.5–23.5	1.5–3.0	...	0.20–0.4	D
WP20CB	CR20CB	N08020	0.07	2	0.045	0.035	1	32.0–38.0	19.0–21.0	2.0–3.0	...		Cu 3.0-4.0 Cb [8×C min, 1.00 max]
WP6XN	CR6XN	N08367	0.03	2	0.04	0.03	1	23.5–25.5	20.0–22.0	6.0–7.0	...	0.18–0.25	Cu 0.75
WP700	CR700	N08700	0.04	2	0.04	0.03	1	24.0–26.0	19.0–23.0	4.3–5.0			Cu0.50 Cb 8×C min
WPNIC	CRNIC	N08800	0.1	1.5	0.045	0.015	1	30.0–35.0	19.0–23.0	...	0.15–0.60	...	Al 0.15–0.60 Cu 0.75 Fe 39.5 min
WPNIC10	CRNIC10	N08810	0.05–0.1	1.5	0.045	0.015	1	30.0–35.0	19.0–23.0	...	0.15–0.60	...	Al 0.15–0.60 Cu 0.75 Fe 39.5 min
WPNIC11	CRNIC11	N08811	0.60–0.1	1.5	0.04	0.015	1	30.0–35.0	19.0–23.0	...	0.15–0.60	...	Al 0.15–0.60 Cu 0.75 Fe 39.5 min
WP904L	CR904L	N08904	0.02	2	0.045	0.035	1	23.0–28.0	19.0–23.0	4.0–5.0	...	0.1	Cu 1.0–2.0
WP1925	CR1925	N08925	0.02	1	0.045	0.03	0.5	24.0–26.0	19.0–21.0	6.0–7.0	0.10–0.20		Cu 0.8-1.5
WP1925N	CR1925N	N08926	0.02	2	0.03	0.01	0.5	24.0–26.0	19.0–21.0	6.0–7.0	...	0.15–0.25	Cu 0.5-1.5
WP304	CR304	S30400	0.08	2	0.045	0.03	1	8.0–11.0	18.0–20.0	...	...	...	...
WP304L	CR304L	S30403	0.030 ^E	2	0.045	0.03	1	8.0–12.0	18.0–20.0	...	...	...	...
WP304H	CR304H	S30409	0.04–0.10	2	0.045	0.03	1	8.0–11.0	18.0–20.0	...	...	...	...
WP304N	CR304N	S30451	0.08	2	0.045	0.03	1	8.0–11.0	18.0–20.0	...	...	0.10–0.16	...

WP304LN	CR304LN	S30453	0.03	2	0.045	0.03	1	8.0–11.0	18.0–20.0	...	...	0.10–0.16	...
WP309	CR309	S30900	0.2	2	0.045	0.03	1	12.0–15.0	22.0–24.0	...	...	...	...
WP310S	CR310S	S31008	0.08	2	0.045	0.03	1	19.0–22.0	24.0–26.0	...	...	...	...
WPS31254	CRS31254	S31254	0.02	1	0.03	0.01	0.8	17.5–18.5	19.5–20.5	6.0–6.5	...	0.18–0.25	Cu 0.50–1.00
WPS31266	CRS31266	S31266	0.03	2.0–4.0	0.035	0.02	1	21.0–24.0	23.0–25.0	5.2–6.2	...	0.35–0.60	Cu 1.00–2.50 W 1.50–2.50
WP316	CR316	S31600	0.08	2	0.045	0.03	1	10.0–14.0	16.0–18.0	2.0–3.0	...	...	...
WP316L	CR316L	S31603	0.030 ^E	2	0.045	0.03	1	10.0–14.0 ^F	16.0–18.0	2.0–3.0	...	...	...
WP316H	CR316H	S31609	0.04–0.10	2	0.045	0.03	1	10.0–14.0	16.0–18.0	2.0–3.0	...	...	...
WP316N	CR316N	S31651	0.08	2	0.045	0.03	1	10.0–13.0	16.0–18.0	2.0–3.0	...	0.10–0.16	...
WP316LN	CR316LN	S31653	0.03	2	0.045	0.03	1	10.0–13.0	16.0–18.0	2.0–3.0	...	0.10–0.16	...
WP317	CR317	S31700	0.08	2	0.045	0.03	1	11.0–15.0	18.0–20.0	3.0–4.0	...	...	...
WP317L	CR317L	S31703	0.03	2	0.045	0.03	1	11.0–15.0	18.0–20.0	3.0–4.0	...	...	...
WPS31725	CRS31725	S31725	0.03	2	0.045	0.03	1	13.5–17.5	18.0–20.0	4.0–5.0	...	0.2	...
WPS31726	CRS31726	S31726	0.03	2	0.045	0.03	1	13.5–17.5	17.0–20.0	4.0–5.0	...	0.10–0.2	...
WPS31727	CRS31727	S31727	0.03	1	0.03	0.03	1	14.5–16.5	17.5–19.0	3.8–4.5	...	0.15–0.21	Cu 2.8–4.0
WPS31730	CRS31730	S31730	0.03	2	0.04	0.01	1	15.0–16.5	17.0–19.0	3.0–4.0	...	0.045	Cu 4.0–5.0
WPS32053	CRS32053	S32053	0.03	1	0.03	0.01	1	24.0–26.0	22.0–24.0	5.0–6.0	...	0.17–0.22	...
WP321	CR321	S32100	0.08	2	0.045	0.03	1	9.0–12.0	17.0–19.0	...	G	...	...
WP321H	CR321H	S32109	0.04–0.10	2	0.045	0.03	1	9.0–12.0	17.0–19.0	...	H	...	...
WPS33228	CRS33228	S33228	0.04–0.08	1	0.02	0.015	0.3	31.0–33.0	26.0–28.0	...	...	...	Ce 0.05–0.10, Al 0.025, Cb 0.6–1.0
WPS34565	CRS34565	S34565	0.03	5.0–7.0	0.03	0.01	1	16.0–18.0	23.0–25.0	4.0–5.0	...	0.40–0.6	Cb 0.10
WP347	CR347	S34700	0.08	2	0.045	0.03	1	9.0–12.0	17.0–19.0	...	...	...	I
WP347H	CR347H	S34709	0.04–0.10	2	0.045	0.03	1	9.0–12.0	17.0–19.0	...	...	...	J
WP347LN	CR347LN	S34751	0.005–0.02	2	0.045	0.03	1	9.0–13.0	17.0–19.0	...	...	...	Cb 0.20–0.50, ^K , N 0.06–0.10 ^C
WP348	CR348	S34800	0.08	2	0.045	0.03	1	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	0.045	0.03	1	9.0–12.0	17.0–19.0	...	...	...	Cb+Ta=8×(C)–1.10, Ta 0.10, Co 0.20
WPS38815	CRS38815	S38815	0.03	2	0.04	0.02	5.5– 6.5	15.0–17.0	13.0–15.0	0.75– 1.50	...	...	Cu 0.75–1.50, Al 0.30

^A Where an ellipsis (...) appears in this table, there is no requirement and the element need neither be analyzed for or reported.

^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 Ti [5× (C+N) min–0.70 max].

^H Ti [4×(C+N) min–0.70 max].

^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 %.

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

E. Tensile Properties :-

1. The tensile properties of the fitting material shall conform to the requirements of Table 4.
2. The testing and reporting shall be performed in accordance with Specification A960/A960M.

Table 4

All WP and CR Grades	Yield Strength, min, ksi [MPa]	Tensile Strength, min, ksi [MPa]
304, 304LN, 304H, 309, 310S, 316, 316LN, 316H, 317, 317L, 347, 347H, 347LN, 348, 348H, 321, 321H	30[205]	75[515]
S31266	61[420]	109[750]
S31725		
S31727	36[245]	80[550]
S31730	25[175]	70[480]
S32053	43[295]	93[640]
304L, 316L	25[170]	70[485]
304N, 316N, S31726	35[240]	80[550]
XM-19	55[380]	100[690]
N08020	35[240]	80[550]
N08367	45[310]	95[655]

N08700	35[240]	80[550]
N08800	25[205]	65[520]
N08810	25[170]	65[450]
N08811	25[170]	65[450]
N08904	31[220]	71[490]
N08925	43[295]	87[600]
N08926	43[295]	94[650]
S31254	44[300]	94 [650] to 119 [820]
S33228	27[185]	73[500]
S34565	60[415]	115[795]
S38815	37[255]	78[540]
Elongation Requirements		
	Longitudinal	Transverse
Standard round specimen, or small proportional specimen, or strip- type specimen, minimum % in 4 D ^A	28	20

^A S38815 Elongation in 2 in. — 30 % min.

F. Hydrostatic Tests :-

1. 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.
2. All Grade CR fittings, except tees covered in 'point F.3', shall be capable of withstanding without failure, leakage, or impairment of serviceability, a test pressure based on the ratings in MSS SP-43.
3. 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.