Designation: A 403/A 403M – 02

An American National Standard

Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings[1]

This standard is issued under the fixed designation A 403/A 403M; 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 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.

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

2. Referenced Documents

2.1 *ASTM Standards:*

A 262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels[3]

A 351/A 351M Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts[4]

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products[3]

A 388/A 388M Practice for Ultrasonic Examination of Heavy Steel Forgings[5]

A 480/A 480M Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip[3]

A 743/A 743M Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application[4]

A 744/A 744M Specification for Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service[4]

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products[3]

A 960 Specification for Common Requirements for Wrought Steel Piping Fittings[6]

E 112 Test Methods for Determining Average Grain Size[7]

E 165 Test Method for Liquid Penetrant Examination[8]

E 213 Practice for Ultrasonic Examination of Metal Pipe and Tubing[7]

2.2 *ASME Standards:*

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

---

[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.

Current edition approved June 10 2002. Published June 2002. Originally published as A 403 – 56 T. Last previous edition A 403/A 403M – 01.

[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.

Copyright © ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States.

ASME B16.11 Forged Steel Fittings, Socket-Welding and Threaded[9]
ASME B16.28 Wrought Steel Butt-Welding Short Radius Elbows and Returns[9]
2.3 *MSS Standards:*
MSS SP-25 Standard Marking System for Valves, Fittings, Flanges, and Unions[10]
MSS SP-43 Standard Practice for Light Weight Stainless Steel Butt-Welding Fittings[10]
MSS SP-79 Socket-Welding Reducer Inserts[10]
MSS SP-95 Swaged(d) Nipples and Bull Plugs[10]
2.4 *ASME Boiler and Pressure Vessel Code:*
Section VIII Division I, Pressure Vessels[11]
Section IX, Welding Qualifications[11]
2.5 *AWS Standards:*
A 5.4 Specification for Corrosion-Resisting Chromium and Chromium-Nickel Steel Covered Welding Electrodes[12]
A 5.9 Specification for Corrosion-Resisting Chromium and Chromium-Nickel Steel Welding Rods and Bare Electrodes[12]
2.6 *ASNT:*
SNT-TC-1A(1984) Recommended Practice for Nondestructive Testing Personnel Qualification and Certification[13]

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

[10] Available from Manufacturers' Standardization Society of the Valve and Fittings Industry, 127 Park St., Northeast, Vienna, VA 22180.
[11] 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_2C[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	. . .	[G]	. . .	. . .
WP321H	CR321H	S32109	0.04–0.10	2.00	0.045	0.030	1.00	9.0–12.0	17.0–19.0	. . .	[H]	. . .	. . .
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] $5X(C+N_2)$–0.70.
[H] $4X(C+N_2)$–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

[A]Naming system developed and applied by ASTM.

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

[C]Common 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	30 [205]	75 [515]
S31725		
304L, 316L	25 [170]	70 [485]
304N, 316N, S31726	35 [240]	80 [550]
XM-19	55 [380]	100 [690]
S31254	44 [300]	94 [650] to 119 [820]
S33228	27 [185]	73 [500]
S34565	60 [415]	115 [795]
Elongation Requirements		
	Longitudinal	Transverse
Standard round specimen, or small proportional specimen, or strip-type specimen, minimum % in 4 *D*	28	20

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 1⁄64 in. [0.4 mm] shall be removed.

10.4 Mechanical marks deeper than 1⁄16 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 Rehearing

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 rehearing.

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	Single grade: No classes in CR grades
CR304/304L	Multiple grades, meet chemical and mechanical properties of each
WP304-S	Single Grade: seamless
WP304-W	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 required in Section 14, the grade designation symbol shall be followed by the symbol "S2."

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.

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).