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Used in USDOE-NE Standards

Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service[1]

This standard is issued under the fixed designation A 234/A 234M; 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[2] covers wrought carbon steel and alloy steel fittings of seamless and welded construction covered by the latest revision of ASME B16.9, B16.11, MSS-SP-79, MSS-SP-83, and MSS-SP-95. These fittings are for use in pressure piping and in pressure vessel fabrication for service at moderate and elevated temperatures. Fittings differing from these ASME and MSS standards shall be furnished in accordance with Supplementary Requirement S58 of Specification A 960/A 960M.

1.2 Optional supplementary requirements are provided for fittings where a greater degree of examination is desired. When desired, one or more of these supplementary requirements may be specified in the order.

1.3 This specification does not cover cast welding fittings or fittings machined from castings. Cast steel welding fittings are governed by Specifications A 216/A 216M and A 217/A 217M.

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 In addition to those reference documents listed in Specification A 960/A 960M, the following list of standards apply to this specification.

2.2 *ASTM Standards:* [3]

A 216/A 216M Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service

A 217/A 217M Specification for Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service

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

2.3 *ASME Standards:*[4]

B16.9 Steel Butt-Welding Fittings

B16.11 Forged Steel Fittings, Socket Welding and Threaded

2.4 *ASME Boiler and Pressure Vessel Code:*[4]

Section V Nondestructive Examination

Section VIII, Division 1, Pressure Vessels

Section IX Welding Qualifications

2.5 *MSS Standards:*[5]

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

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

2.6 *ASNT Standard:*

SNT-TC-1A Recommended Practice for Nondestructive Testing Personnel Qualification and Certification[6]

3. Ordering Information

3.1 See Specification A 960/A 960M.

4. General Requirements

4.1 Product furnished to this specification shall conform to the requirements of Specification A 960/A 960M, including

[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-234 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 Park Ave., New York, NY 10016-5990.

[5] Available from Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), 127 Park St., NE, Vienna, VA 22180-4602.

[6] Available from American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlingate Ln., Columbus, OH 43228-0518.

***A Summary of Changes section appears at the end of this standard.**

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any supplementary requirements that are indicated in the purchase order. Failure to comply with the requirements of Specification A 960/A 960M constitutes non-conformance with this specification. In case of a conflict between the requirements of this specification and Specification A 960/A 960M, this specification shall prevail.

5. Materials

5.1 The material for fittings shall consist of killed steel, forgings, bars, plates, seamless or fusion-welded tubular products with filler metal added and shall conform to the chemical requirements of Table 1. Unless otherwise specified for carbon steel plates, the steel may be made to either coarse grain or fine grain practice. Grade WP9 shall be made to fine grain practice.

5.2 A starting material specification that specifically requires the addition of any element beyond those listed for the materials in Table 1 for the applicable grade of material is not permitted. This does not preclude the use of deoxidizers or the judicious use of elements for grain size control.

6. Manufacture

6.1 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 imperfections in the fittings.

NOTE 1—Fittings NPS-4 and under may be machined from hot-forged or rolled, cold-sized, and straightened bar stock having the chemical composition of the Grade in Table 1 and the mechanical properties of the Grade in Table 2. Heat treatment shall be in accordance with Section 7. All caps machined from bar stock shall be examined by liquid penetrant or magnetic particle in accordance with S52 or S53 in Specification A 960/A 960M.

6.2 All welds including welds in tubular products from which fittings are made shall be (*1*) made by welders, welding operators, and welding procedures qualified under the provisions of ASME Section IX, (*2*) heat treated in accordance with Section 7 of this specification, and (*3*) radiographically examined throughout the entire length of each weld in accordance with Article 2, ASME Section V with acceptance limits in accordance with Paragraph UW-51 of ASME Section VIII, Division 1 of the ASME Boiler & Pressure Vessel Code. In place of radiographic examination, welds may be ultrasonically examined in accordance with Appendix 12 of Section VIII. The NDE of welds in Grades WPB, WPC, WP1, WP11 Class 1,

TABLE 1 Chemical Requirements

NOTE 1—All requirements are maximum unless otherwise indicated.
NOTE 2—Where an ellipsis (...) appears in this table, there is no requirement.

Grade and Marking Symbol[A]	Composition, %									
	Carbon	Manganese	Phosphorus, max	Sulfur, max	Silicon	Chromium	Molybdenum	Nickel	Copper	Others
WPB[B,C,D,E,F]	0.30 max	0.29–1.06	0.050	0.058	0.10 min	0.40 max	0.15 max	0.40 max	0.40 max	Vanadium 0.08 max
WPC[C,D,E,F]	0.35 max	0.29–1.06	0.050	0.058	0.10 min	0.40 max	0.15 max	0.40 max	0.40 max	Vanadium 0.08 max
WP1	0.28 max	0.30–0.90	0.045	0.045	0.10–0.50	. . .	0.44–0.65	. . .	. . .	. . .
WP12 CL1, WP12 CL2	0.05–0.20	0.30–0.80	0.045	0.045	0.60 max	0.80–1.25	0.44–0.65	. . .	. . .	. . . . . .
WP11 CL1	0.05–0.15	0.30–0.60	0.030	0.030	0.50–1.00	1.00–1.50	0.44–0.65	. . .	. . .	. . .
WP11 CL2, WP11 CL3	0.05–0.20	0.30–0.80	0.040	0.040	0.50–1.00	1.00–1.50	0.44–0.65	. . .	. . .	. . . . . .
WP22 CL1, WP22 CL3	0.05–0.15	0.30–0.60	0.040	0.040	0.50 max	1.90–2.60	0.87–1.13	. . .	. . .	. . . . . .
WP5 CL1, WP5 CL3	0.15 max	0.30–0.60	0.040	0.030	0.50 max	4.0–6.0	0.44–0.65	. . .	. . .	. . . . . .
WP9 CL1, WP9 CL3	0.15 max	0.30–0.60	0.030	0.030	1.00 max	8.0–10.0	0.90–1.10	. . .	. . .	. . .
WPR	0.20 max	0.40–1.06	0.045	0.050	. . .	. . .	. . .	1.60–2.24	0.75–1.25	. . .
WP91	0.08–0.12	0.30–0.60	0.020	0.010	0.20–0.50	8.0–9.5	0.85–1.05	0.40 max	. . .	Vanadium 0.18–0.25 Columbium 0.06–0.10 Nitrogen 0.03–0.07 Aluminum 0.02 max[G] Titanium 0.01 max[G] Zirconium 0.01 max[G]
WP911	0.09–0.13	0.30–0.60	0.020	0.010	0.10–0.50	8.5–9.5	0.90–1.10	0.40 max	. . .	Vanadium 0.18–0.25 Columbium 0.060–0.10 Nitrogen 0.04–0.09 Aluminum 0.02 max[G] Boron 0.0003–0.006 Tungsten 0.90–1.10 Titanium 0.01 max[G] Zirconium 0.01 max[G]

[A] When fittings are of welded construction, the grade and marking symbol shown above shall be supplemented by letter "W".
[B] Fittings made from bar or plate may have 0.35 max carbon.
[C] Fittings made from forgings may have 0.35 max carbon and 0.35 max silicon with no minimum.
[D] For each reduction of 0.01 % below the specified carbon maximum, an increase of 0.06 % manganese above the specified maximum will be permitted, up to a maximum of 1.35 %.
[E] The sum of Copper, Nickel, Chromium, and Molybdenum shall not exceed 1.00 %.
[F] The sum of Chromium and Molybdenum shall not exceed 0.32 %.
[G] Applies both to heat and product analyses.

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TABLE 2 Tensile Requirements

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

Grade and Marking Symbol	WPB	WPC, WP11 CL2, WP12 CL2	WP1	WP11 CL1, WP22 CL1, WP5 CL1 WP9 CL1	WPR	WP11 CL3, WP22 CL3 WP5 CL3 WP9 CL3	WP91	WP911	WP12 CL1
Tensile strength, range ksi [MPa]	60–95 [415–655]	70–95 [485–655]	55–80 [380–550]	60–85 [415–585]	63–88 [435–605]	75–100 [520–690]	85–110 [585–760]	90–120 [620–840]	60–85 [415–585]
Yield strength, min, ksi [MPa] (0.2 % offset or 0.5 % extension-under-load)	35 [240]	40 [275]	30 [205]	30 [205]	46 [315]	45 [310]	60 [415]	64 [440]	32 [220]

	Elongation Requirements					
	Grades					
	All Grades except WPR, WP91, and WP911		WPR		WP91 WP911	
	Longi-tudinal	Trans-verse	Longi-tudinal	Trans-verse	Longi-tudinal	Trans-verse
Elongation:						
Standard round specimen, or small proportional specimen, min % in 4 D	22	14	20	...	20	...
Rectangular specimen for wall thickness 5/16 in. [7.94 mm] and over, and for all small sizes tested in full section; min % in 2 in. [50 mm]	30	20[A]	28	...	...	...
Rectangular specimen for wall thickness less than 5/16 in. [7.94 mm]; min % in 2 in. [50 mm] (½-in. [12.7-mm] wide specimen)	[B]	[B]	[B]	...	...	...

[A] WPB and WPC fittings manufactured from plate shall have a minimum elongation of 17 %.

[B] For each 1/32 in. [0.79 mm] decrease in wall thickness below 5/16 in. [7.94 mm], a deduction of 1.5 % for longitudinal and 1.0 % for transverse from the values shown above is permitted. The following table gives the minimum value for various wall thicknesses.

Wall Thickness		Grades			
		All Grades except WPR, WP91 and WP911		WPR	WP91 and WP911
in.	[mm]	Longitudinal	Transverse	Longitudinal	Longitudinal
5/16 (0.312)	7.94	30.0	20.0	28.0	20
9/32 (0.281)	7.14	28.5	19.0	26.5	19
1/4 (0.250)	6.35	27.0	18.0	25.0	18
7/32 (0.219)	5.56	25.5	...	23.5	17
3/16 (0.188)	4.76	24.0	...	22.0	16
5/32 (0.156)	3.97	22.5	...	20.5	15
1/8 (0.125)	3.17	21.0	...	19.0	14
3/32 (0.094)	2.38	19.5	...	17.5	13
1/16 (0.062)	1.59	18.0	...	16.0	12

Note—This table gives the computed minimum % elongation value for each 1/32 in. [0.79 mm] decrease in wall thickness. Where the wall thickness lies between two values above, the minimum elongation value is determined by the following equations:

Direction of Test	Equation
Longitudinal	$E = 48t + 15.00$
Transverse	$E = 32t + 10.00$

where:
E = elongation in 2 in. or [50 mm], %, and
t = actual thickness of specimen, in. [mm].

WP11 Class 2, WP11 Class 3, WP12 Class 1, WP12 Class 2, and WPR may be performed either prior to or after forming. NDE of welds in Grades WP5, WP9, WP91, WP911, WP22 Class 1, and WP22 Class 3 shall be done after forming.

6.3 Personnel performing NDE examinations shall be qualified in accordance with SNT-TC-1A.

6.4 The welded joints of the fittings shall be finished in accordance with the requirements of Paragraph UW-35 (*a*) of ASME Section VIII, Division 1.

6.5 All butt-weld tees manufactured by cold-forming method(s) shall be liquid penetrant or magnetic particle examined by one of the methods specified in Supplementary Requirement S52 or S53 in Specification A 960/A 960M. This examination shall be performed after final heat treat. Only the side wall area of the tees need be examined. This area is defined by a circle that covers the area from the weld bevel of the branch outlet to the center line of the body or run. Internal and external surfaces shall be examined when size permits accessibility. No cracks shall be permitted. Other imperfections shall be treated in accordance with Section 13 on Surface Quality. After the removal of any crack, the tee(s) shall be re-examined by the original method. Acceptable tees shall be marked with the symbol PT or MT, as applicable, to indicate compliance.

6.6 Stubends 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

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pipe, provided the weld is double welded, is a full penetration joint, satisfies the requirements of 6.2 for qualifications and 7.3.3 for post weld heat treatment.

7. Heat Treatment

7.1 *Heat Treatment Procedures*—Fittings, after forming at an elevated temperature, shall be cooled to a temperature below the critical range under suitable conditions to prevent injurious defects caused by too rapid cooling, but in no case more rapidly than the cooling rate in still air. Heat treatment temperatures specified are metal (part) temperatures. Heat-treated fittings shall be treated according to paragraph 7 in Specification A 960/A 960M.

7.2 *WPB, WPC, and WPR Fittings*:

7.2.1 Hot-formed WPB, WPC, and WPR fittings upon which the final forming operation is completed at a temperature above 1150 °F [620 °C] and below 1800 °F [980 °C] need not be heat treated provided they are cooled in still air.

7.2.2 Hot-formed or forged WPB, WPC, and WPR fittings finished at temperature in excess of 1800 °F [980 °C] shall subsequently be annealed, normalized, or normalized and tempered. Hot-forged fittings NPS 4 or smaller need not be heat treated.

7.2.3 WPB, WPC, and WPR fittings over NPS 12, produced by locally heating a portion of the fitting stock to any temperature for forming, shall be subsequently annealed, normalized, or normalized and tempered. Fittings such as elbows, tees, header tees, reducers and lap joint stub ends with a carbon content less than 0.26 %, NPS 12 and under, shall not require heat treatment after forming a locally heated portion of the fitting.

7.2.4 Cold-formed WPB, WPC, and WPR fittings, upon which the final forming operation is completed at a temperature below 1150 °F [620 °C], shall be normalized, or shall be stress relieved at 1100 to 1275 °F [595 to 690 °C].

7.2.5 WPB, WPC, and WPR fittings produced by fusion welding and having a nominal wall thickness at the welded joint of ¾ in. [19 mm] or greater shall be post-weld heat treated at 1100 to 1250 °F [595 to 675 °C], or in accordance with 7.2.6.

7.2.6 At the option of the manufacturer, WPB and WPC fittings produced by any of the methods in Section 6 may be annealed, normalized, or normalized and tempered.

7.3 *Fittings Other than WPB, WPC, and WPR*:

7.3.1 Fittings of Grades WP1, WP11 Class 1, WP11 Class 2, WP11 Class 3, WP12 Class 1, WP12 Class 2, WP22 Class 1, WP22 Class 3, WP5, and WP9 shall be furnished in the full-annealed, isothermal-annealed, or normalized and tempered condition. If normalized and tempered, the tempering temperature for WP11 Class 1, WP11 Class 2, WP11 Class 3, WP12 Class 1, and WP12 Class 2 shall not be less than 1150 °F [620 °C]; for Grades WP5, WP9, WP22 Class 1, and WP22 Class 3 the tempering temperature shall not be less than 1250 °F [675 °C].

7.3.2 Fittings of Grades WP1, WP12 Class 1, or WP12 Class 2 either hot formed or cold formed may be given a final heat treatment at 1200 °F [650 °C] instead of the heat treatment specified in 7.3.1.

7.3.3 Fittings in all thicknesses produced by fusion welding after the heat treatment specified in 7.3.1 shall be post-weld heat treated at a temperature not less than prescribed above for tempering except that Grade WP1 is required to be post-weld heat treated only when the nominal wall thickness at the welded joint is ½ in. [13 mm] or greater.

7.3.4 Except when Supplementary Requirement S1 is specified by the purchaser, Grade WP91 shall be normalized at 1900 °F [1040 °C] minimum, and 1975 °F [1080 °C] maximum, and tempered in the temperature range of 1350 °F [730 °C] to 1470 °F [800 °C] as a final heat treatment.

7.3.5 Grade WP911 shall be normalized in the temperature range of 1900 to 1975 °F [1040 to 1080 °C], and tempered in the temperature range of 1365 to 1435 °F [740 to 780 °C] as a final heat treatment.

7.4 *WPB and WPC Fittings Made from Bar*— Cold-finished bars reduced in cross-sectional area more than 10 % by cold drawing or cold rolling are not acceptable for use in the manufacture of these fittings unless the bars have been either stress relieved in the temperature range of 1100 to 1250 °F [595 to 675 °C], normalized, normalized and tempered, or fully annealed. Mechanical testing must be performed subsequent to the final heat-treating operation.

7.5 Liquid quenching followed by tempering shall be permitted for all grades when approved by the purchaser. Minimum tempering temperature shall be 1100 °F [595 °C] for WPB, WPC, and WPR, 1150 °F [620 °C] for Grades WP1, WP11 Class 1, WP11 Class 2, WP11 Class 3, WP 12 Class 1, and WP12 Class 2 and 1250 °F [675 °C] for Grades WP5, WP9, WP22 Class 1, and WP22 Class 3, and 1350 °F [730 °C] for Grade WP91 and WP911.

8. Chemical Composition

8.1 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 materials listed in Table 1. The ranges as shown have been expanded to include variations of the chemical analysis requirements that are listed in the various specifications for the starting materials (pipe, tube, plate, bar, and forgings) normally used in the manufacturing of fittings to this specification.

8.2 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.

8.3 Weld metal used in the construction of carbon-steel fittings shall be mild steel analysis No. A1 of Table QW-442, Section IX of the ASME Boiler and Pressure Vessel Code, No. A2 may be used for Grade WPCW.

8.4 The molybdenum and chromium content of the deposited weld metal of alloy steel fittings shall be within the same percentage range as permitted for the base metal.

9. Tensile Requirements

9.1 The tensile properties of the fitting material shall conform to the requirements listed in Table 2.

9.1.1 Specimens cut either longitudinally or transversely shall be acceptable for the tension test.

9.1.2 While Table 2 specifies elongation requirements for both longitudinal and transverse specimens, it is not the intent that both requirements apply simultaneously. Instead, it is

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intended that only the elongation requirement that is appropriate for the specimen used be applicable.

9.2 One tension test shall be made on each heat of material and in the same condition of heat treatment as the finished fittings it represents. The sample thickness shall not vary more than ¼ in. [6 mm] from the fitting wall thickness it represents.

9.3 When cold-formed fittings are furnished, samples of the raw material shall be normalized or stress relieved as required in 7.2.4. Tension tests conducted on these heat-treated samples shall be considered to be the tensile properties of the cold-formed fittings.

9.4 Records of the tension tests shall be certification that the material of the fitting meets the tensile requirements of this specification provided the heat treatments are the same. If the raw material was not tested, or the fitting is not in the same condition of heat treatment, the fitting manufacturer shall perform the required test on material representative of the finished fitting from each heat of starting material.

10. Hardness

10.1 Fittings shall be capable of meeting the following hardness requirements, if tested:

10.1.1 Fittings of Grades WP5, WP9, and WPR—217 HB maximum.

10.1.2 Fittings of Grade WP91 and WP911—248 HB maximum.

10.1.3 Fittings of all other grades—197 HB maximum.

10.2 When actual hardness testing of the fittings is required, see Supplementary Requirement S57 in Specification A 960/A 960M.

11. Hydrostatic Tests

11.1 See Specification A 960/A 960M.

12. Dimensions

12.1 Butt-welding fittings and butt-welding short radius elbows and returns purchased in accordance with this specification shall conform to the dimensions and tolerances given in the latest revision of ASME B16.9. Steel socket-welding and threaded fittings purchased in accordance with this specification shall conform to the sizes, shapes, dimensions, and tolerances specified in the latest revision of ASME B16.11, MSS-SP-79, or MSS-SP-83.

12.2 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 S58 in Specification A 960/A 960M.

13. Surface Quality

13.1 See Specification A 960/A 960M.

14. Repair by Welding

14.1 See Specification A 960/A 960M.

15. Inspection

15.1 See Specification A 960/A 960M.

15.2 Other tests, when required by agreement, shall be made from material of the lots covered in the order.

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16. Rejection and Rehearing

16.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the producer or supplier promptly in writing. In case of dissatisfaction with the results of the tests, the producer or supplier may make claim for a rehearing.

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

17. Certification

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

17.1.1 Chemical analysis results, Section 8 (Table 1). When the amount of an element is less than 0.02 %, the analysis for that element may be reported as "<0.02 %."

17.1.2 Tensile property results, Section 9 (Table 2), report the yield strength and ultimate strength in ksi [MPa] and elongation in percent,

17.1.3 Hardness acceptable in accordance with Section 10,

17.1.4 Type heat treatment, if any, Section 7,

17.1.5 Seamless or welded,

17.1.6 Starting material, specifically pipe, plate, etc.,

17.1.7 Statement regarding radiographic or ultrasonic examination, 6.2,

17.1.8 Any supplemental testing required by the purchase order,

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

17.1.10 The specification number, year of issue, revision letter (if any), grade and class of the fittings.

18. Product Marking

18.1 All fittings shall have the prescribed information stamped or otherwise suitably marked on each fitting in accordance with the Standard Marking System for Valves, Fittings, Flanges and Unions (MSS-SP-25, latest edition).

18.2 The prescribed information for butt-welding fittings shall be: The manufacturer's name or trademark (see Note 2), schedule number or nominal wall thickness designation, size, fitting designation in accordance with Annex A1 and the heat number or manufacturer's heat identification.

NOTE 2—For purposes of identification marking, the manufacturer is considered the organization that certifies the piping component complies with this specification.

18.3 The prescribed information for threaded or socket-welding fittings shall be: The manufacturer's name or trademark (see Note 2), pressure class or schedule number and fitting designation in accordance with Annex A1, and the heat number or the manufacturer's heat identification.

18.4 Specification number, year of issue and revision letter are not required to be marked on fittings.

18.5 *Bar Coding*—In addition to the requirements in 18.1, 18.2, 18.3 and 18.4, 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,

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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.

19. Keywords

19.1 pipe fittings—steel; piping applications; pressure containing parts; pressure vessel service; temperature service applications—elevated

SUPPLEMENTARY REQUIREMENTS

These requirements shall not be considered unless specified in the order, in which event, the supplementary requirements specified shall be made at the place of manufacture, unless otherwise agreed upon, at the purchaser's expense. The test specified shall be witnessed by the purchaser's inspector before shipment of material, if so specified in the order.

S1. Alternative Heat Treatment—Grade WP91

S1.1 Grade WP91 shall be normalized in accordance with 7.3.4 and tempered at a temperature, to be specified by the purchaser, less than 1350 °F [730 °C]. It shall be the purchaser's responsibility to subsequently temper the entire fitting in the temperature range of 1350 °F [730 °C] to 1470 °F [800 °C] as a final heat treatment. All mechanical tests shall be made on material heat treated in accordance with 7.3.4. The certification shall reference this supplementary requirement indicating the actual tempering temperature applied. The notation "S1'' shall be included with the required marking of the fitting.

S2. Restricted Vanadium Content

S2.1 The vanadium content of the fittings shall not exceed 0.03 %.

S3. Carbon Equivalent

S3.1 For grades WPB and WPC, the maximum carbon equivalent (C.E.), based on heat analysis and the following formula, shall be 0.50.

$$\text{C.E.} = \text{C} + \frac{\text{Mn}}{6} + \frac{\text{Cr} + \text{Mo} + \text{V}}{5} + \frac{\text{Ni} + \text{Cu}}{15}$$

S3.2 A lower maximum carbon equivalent may be agreed upon between the purchaser and the supplier.

S3.3 The C.E. shall be reported on the test report.

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ANNEX

(Mandatory Information)

A1. FITTING DESIGNATION FOR MARKING PURPOSES

TABLE A1.1 Fitting Designation for Marking Purposes

Grade	Class	Construction	Mandatory Marking
WPB		W (Welded construction)	WPBW[A]
		S (Seamless construction)	WPB
WPC		W (Welded construction)	WPCW[A]
		S (Seamless construction)	WPC
WP1		W (Welded construction)	WP1W[A]
		S (Seamless construction)	WP1
WP12	CL1	W (Welded construction)	WP12 CL1W[A]
		S (Seamless construction)	WP12 CL1
	CL2	W (Welded construction)	WP12 CL2W[A]
		S (Seamless construction)	WP12 CL2
WP11	CL1	W (Welded construction)	WP11 CL1W[A]
		S (Seamless construction)	WP11 CL1
	CL2	W (Welded construction)	WP11 CL2W[A]
		S (Seamless construction)	WP11 CL2
	CL3	W (Welded construction)	WP11 CL3W[A]
		S (Seamless construction)	WP11 CL3
WP22	CL1	W (Welded construction)	WP22 CL1W[A]
		S (Seamless construction)	WP22 CL1
	CL3	W (Welded construction)	WP22 CL3W[A]
		S (Seamless construction)	WP22 CL3
WP5	CL1	W (Welded construction)	WP5 CL1W[A]
		S (Seamless construction)	WP5 CL1
	CL3	W (Welded construction)	WP5 CL3 W[A]
		S (Seamless construction)	WP5 CL3
WP9	CL1	W (Welded construction)	WP9 CL1 W[A]
		S (Seamless construction)	WP9 CL1
	CL3	W (Welded construction)	WP9 CL3 W[A]
		S (Seamless construction)	WP9 CL3
WPR		W (Welded construction)	WPR W[A]
		S (Seamless construction)	WPR
WP91		W (Welded construction)	WP91W[A]
		S (Seamless construction)	WP91

[A] Add "U" to marking if welds are ultrasonic inspected in lieu of radiography.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this specification since the last issue, A 234/A 234M – 06a, that may impact the use of this specification. (Approved March 1, 2007)

(*1*) Added MSS-SP-83 to 1.1 and 12.1.
(*2*) Revised 2.6 to delete the year date of SNT-TC-1A.
(*3*) Revised 17.1.9.

Committee A01 has identified the location of selected changes to this specification since the last issue, A 234/A 234M – 06, that may impact the use of this specification. (Approved September 1, 2006)

(*1*) Reduced Al maximum and added maximums for Ti and Zr for Grades WP91 and WP911 in Table 1 and applied maximums of these elements to both heat and product analyses.
(*2*) Revised tempering heat treatment in S1 from a minimum to a range.

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Committee A01 has identified the location of selected changes to this specification since the last issue, A 234/A 234M – 05a, that may impact the use of this specification. (Approved May 1, 2006)

(*1*) Revised 17.1.
(*2*) Added 17.1.9 to add mandatory reporting requirements.
(*3*) Reworded and removed 17.2 and replaced with 17.1.10.

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