



Designation: A 790/A 790M – 04

Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Pipe¹

This standard is issued under the fixed designation A 790/A 790M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This specification² covers seamless and straight-seam welded ferritic/austenitic steel pipe intended for general corrosive service, with particular emphasis on resistance to stress corrosion cracking. These steels are susceptible to embrittlement if used for prolonged periods at elevated temperatures.

1.2 Optional supplementary requirements are provided for pipe when a greater degree of testing is desired. These supplementary requirements call for additional tests to be made and, when desired, one or more of these may be specified in the order.

1.3 Appendix X1 of this specification lists the dimensions of welded and seamless stainless steel pipe as shown in ANSI B36.19. Pipe having other dimensions may be furnished provided such pipe complies with all other requirements of this specification.

1.4 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. The inch-pound units shall apply unless the *M* designation of this specification is specified in the order.

NOTE 1—The dimensionless designator NPS (nominal pipe size) has been substituted in this standard for such traditional terms as nominal diameter, size, and nominal size.

2. Referenced Documents

2.1 ASTM Standards:³

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

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 A01.10 on Stainless and Alloy Steel Tubular Products.

Current edition approved March 1, 2004. Published April 2004. Originally approved in 1981. Last previous edition approved in 2003 as A 790/A 790M – 03.

² For ASME Boiler and Pressure Vessel Code applications see related Specification SA-790 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.

- A 941 Terminology Relating to Steel, Stainless Steel, Related Alloys and Ferroalloys
- A 999/A 999M Specification for General Requirements for Alloy and Stainless Steel Pipe
- E 213 Practice for Ultrasonic Examination of Metal Pipe and Tubing
- E 309 Practice for Eddy-Current Examination of Steel Tubular Products Using Magnetic Saturation
- E 381 Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings
- E 426 Practice for Electromagnetic (Eddy-Current) Examination of Seamless and Welded Tubular Products, Austenitic Stainless Steel and Similar Alloys
- E 527 Practice for Numbering Metals and Alloys (UNS)
- 2.2 *ANSI Standards:*⁴
 - B1.20.1 Pipe Threads, General Purpose
 - B36.10 Welded and Seamless Wrought Steel Pipe
 - B36.19 Stainless Steel Pipe
- 2.3 *SAE Standard:*⁵
 - SAE J 1086
- 2.4 *Other Standard:*⁶
 - SNT-TC-1A Personal Qualification and Certification in Nondestructive Testing

3. Terminology

3.1 *Definitions*—For definitions of terms used in this specification refer to Terminology A 941.

4. Ordering Information

4.1 Orders for material under this specification should include the following, as required, to describe the desired material adequately:

- 4.1.1 Quantity (feet, metres, or number of lengths),
- 4.1.2 Name of material (ferritic/austenitic steel pipe),
- 4.1.3 Process (seamless or welded),
- 4.1.4 Grade (see Table 1),

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

⁵ Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001.

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

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

TABLE 1 Heat Treatment

UNS Designation	Temperature	Quench
S31803	1870–2010°F [1020–1100°C]	Rapid cooling in air or water
S32205	1870–2010°F [1020–1100°C]	Rapid cooling in air or water
S31500	1800–1900°F [980–1040°C]	Rapid cooling in air or water
S31200	1920–2010°F [1050–1100°C]	Rapid cooling in water
S32550	1900°F [1040°C] min	Rapid cooling in air or water
S31260	1870–2010°F [1020–1100°C]	Rapid cooling in water
S32304	1700–1920°F [925–1050°C]	Rapid cooling in air or water
S39274	1920–2060°F [1025–1125°C]	Rapid cooling in air or water
S32750	1880–2060°F [1025–1125°C]	Rapid cooling in air or water
S32760	2010–2085°F [1100–1140°C]	Rapid cooling in air or water
S32900	1700–1750°F [925–955°C]	Rapid cooling in air or water
S32950	1820–1880°F [990–1025°C]	Air cool
S39277	1975–2155°F [1080–1180°C]	Rapid cooling in air or water
S32520	1975–2050°F [1080–1120°C]	Rapid cooling in air or water
S32906	1900–1980°F [1040–1080°C]	Rapid cooling in air or water
S32003	1850–2050°F [1010–1120°C]	Rapid cooling in air or water

4.1.5 Size (NPS designator or outside diameter and schedule number of average wall thickness),

4.1.6 Length (specific or random) (see Section 11),

4.1.7 End finish (section on ends of Specification A 999/A 999M),

4.1.8 Optional requirements (product analysis, Section 9; hydrostatic test or nondestructive electric test, Section 14),

4.1.9 Test report required (section on certification of Specification A 999/A 999M),

4.1.10 Specification designation, and

4.1.11 Special requirements and any supplementary requirements selected.

5. General Requirements

5.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification A 999/A 999M unless otherwise provided herein.

6. Materials and Manufacture

6.1 Manufacture:

6.1.1 The pipe shall be made by the seamless or an automatic welding process, with no addition of filler metal in the welding operation.

6.1.2 At the manufacturer's option, pipe may be either hot-finished or cold-finished.

6.1.3 The pipe shall be pickled free of scale. When bright annealing is used, pickling is not necessary.

6.2 *Discard*—A sufficient discard shall be made from each ingot to secure freedom from injurious piping and undue segregation.

6.3 All pipe shall be furnished in the heat-treated condition as shown in Table 1. For seamless pipe, as an alternate to final heat treatment in a continuous furnace or batch-type furnace, immediately following hot forming while the temperature of the pipes is not less than the specified minimum solution treatment temperature, pipes shall be individually quenched in water or rapidly cooled by other means, except for UNS S32950, which shall be air cooled.

7. Chemical Composition

7.1 The steel shall conform to the chemical requirements as prescribed in Table 2.

TABLE 2 Chemical Requirements

UNS Designation ^A	C	Mn	P	S	Si	Ni	Cr	Mo	N	Cu	Others
S31803	0.030 max	2.00 max	0.030 max	0.020 max	1.00 max	4.5–6.5	21.0–23.0	2.5–3.5	0.08–0.20	...	...
S32205	0.030 max	2.00 max	0.030 max	0.020 max	1.00 max	4.5–6.5	22.0–23.0	3.0–3.5	0.14–0.20	...	...
S31500	0.030 max	1.20–2.00	0.030 max	0.030 max	1.40–2.00	4.2–5.2	18.0–19.0	2.50–3.00	0.05–0.10	...	...
S32550	0.04 max	1.50 max	0.040 max	0.030 max	1.00 max	4.5–6.5	24.0–27.0	2.9–3.9	0.10–0.25	1.50–2.50	...
S31200	0.030 max	2.00 max	0.045 max	0.030 max	1.00 max	5.5–6.5	24.0–26.0	1.20–2.00	0.14–0.20	...	...
S31260	0.030 max	1.00 max	0.030 max	0.030 max	0.75 max	5.5–7.5	24.0–26.0	2.5–3.5	0.10–0.30	0.20–0.80	W 0.10–0.50
S32304	0.030 max	2.50 max	0.040 max	0.040 max	1.00 max	3.0–5.5	21.5–24.5	0.05–0.60	0.05–0.20	0.05–0.60	...
S39274	0.030 max	1.00 max	0.030 max	0.020 max	0.80 max	6.0–8.0	24.0–26.0	2.5–3.5	0.24–0.32	0.20–0.80	W 1.50–2.50
S32750	0.030 max	1.20 max	0.035 max	0.020 max	0.80 max	6.0–8.0	24.0–26.0	3.0–5.0	0.24–0.32	0.5 max	...
S32760	0.05 max	1.00 max	0.030 max	0.010 max	1.00 max	6.0–8.0	24.0–26.0	3.0–4.0	0.20–0.30	0.50–1.00	W 0.50–1.00 40 min ^B
S32900	0.08 max	1.00 max	0.040 max	0.030 max	0.75 max	2.5–5.0	23.0–28.0	1.00–2.00	...	...	...
S32950	0.030 max	2.00 max	0.035 max	0.010 max	0.60 max	3.5–5.2	26.0–29.0	1.00–2.50	0.15–0.35	...	...
S39277	0.025 max	0.80 max	0.025 max	0.002 max	0.80 max	6.5–8.0	24.0–26.0	3.0–4.0	0.23–0.33	1.20–2.00	W 0.8–1.2
S32520	0.030 max	1.5 max	0.035 max	0.020 max	0.80 max	5.5–8.0	24.0–26.0	3.0–5.0	0.20–0.35	0.5–3.00	...
S32906	0.030 max	1.50 max 0.80 min	0.030 max	0.030 max	0.50 max	7.5 max 5.8 min	30.0 max 28.0 min	2.60 max 1.50 min	0.40 max 0.30 min	0.80 max	...
S32003	0.030 max	2.00 max	0.030 max	0.020 max	1.00 max	3.0–4.0	19.5–22.5	1.50–2.00	0.14–0.20	...	...

^A New designation established in accordance with Practice E 527 and SAE J1086.

^B % Cr + 3.3 × % Mo + 16 × % N.

8. Heat Analysis

8.1 An analysis of each heat of steel shall be made by the steel manufacturer to determine the percentages of the elements specified.

9. Product Analysis

9.1 At the request of the purchaser's inspector, an analysis of one billet or one length of flat-rolled stock from each heat, or two pipes from each lot, shall be made by the manufacturer. A lot of pipe shall consist of the following number of lengths of the same size and wall thickness from any one heat of steel:

NPS Designator	Lengths of Pipe in Lot
Under 2	400 or fraction thereof
2 to 5, incl	200 or fraction thereof
6 and over	100 or fraction thereof

9.2 The results of these analyses shall be reported to the purchaser or the purchaser's representative and shall conform to the requirements specified in Section 7.

9.3 If the analysis of one of the tests specified in 8.1 or 9.1 does not conform to the requirements specified in Section 7, an analysis of each billet or pipe from the same heat or lot may be made, and all billets or pipe conforming to the requirements shall be accepted.

10. Tensile and Hardness Properties

10.1 The material shall conform to the tensile and hardness properties prescribed in Table 3.

11. Lengths

11.1 Pipe lengths shall be in accordance with the following regular practice:

11.1.1 Unless otherwise agreed upon, all sizes from NPS ½ to and including NPS 8 are available in a length up to 24 ft (see Note 2) with the permissible range of 15 to 24 ft (see Note 2). Short lengths are acceptable and the number and minimum length shall be agreed upon between the manufacturer and the purchaser.

NOTE 2—This value applies when the inch-pound designation of this specification is the basis of purchase. When the *M* designation of this specification is the basis of purchase, the corresponding metric value(s) shall be agreed upon between the manufacturer and purchaser.

11.1.2 If definite cut lengths are desired, the lengths required shall be specified in the order. No pipe shall be less than the specified length and no more than ¼ in. [6 mm] over it.

11.1.3 No jointers are permitted unless otherwise specified.

12. Workmanship, Finish, and Appearance

12.1 The finished pipes shall be reasonably straight and shall have a workmanlike finish. Imperfections may be removed by grinding, provided the wall thicknesses are not decreased to less than that permitted, in the Permissible Variations in Wall Thickness Section of Specification A 999/A 999M.

13. Mechanical Tests Required

13.1 *Transverse or Longitudinal Tension Test*—One tension test shall be made on a specimen for lots of not more than 100 pipes. Tension tests shall be made on specimens from 2 pipes for lots of more than 100 pipes.

13.2 *Mechanical Testing Lot Definition*—The term *lot* for mechanical tests applies to all pipe of the same nominal size and wall thickness (or schedule) that is produced from the same heat of steel and subjected to the same finishing treatment as defined as follows:

13.2.1 Where the heat treated condition is obtained, consistent with the requirements of 6.3, in a continuous heat treatment furnace or by directly obtaining the heat treated condition by quenching after hot forming, the lot shall include all pipe of the same size and heat, heat treated in the same furnace at the same temperature, time at heat, and furnace speed or all pipe of the same size and heat, hot formed and quenched in the same production run.

13.2.2 Where final heat treatment is obtained, consistent with the requirements of 6.3, in a batch-type heat-treatment furnace equipped with recording pyrometers and automatically controlled within a 50°F [30°C] or smaller range, the lot shall be the larger of (a) each 200 ft [60 m] or fraction thereof or (b) that pipe heat treated in the same batch furnace charge.

13.2.3 Where the final heat treatment is obtained, consistent with the requirements of 6.3, in a batch-type heat-treatment furnace not equipped with recording pyrometers and automatically controlled within a 50°F [30°C] or smaller range, the term *lot* for mechanical tests applies to the pipe heat treated in the same batch furnace charge, provided that such pipe is of the same nominal size and wall thickness (or schedule) and is produced from the same heat of steel.

13.3 *Flattening Test*—For pipe heat treated in a batch-type furnace, flattening tests shall be made on 5 % of the pipe from each heat-treated lot. For pipe heat treated by the continuous

TABLE 3 Tensile and Hardness Requirements

UNS Designation	Tensile Strength, min, ksi [MPa]	Yield Strength, min, ksi [MPa]	Elongation in 2 in. or 50 mm, min, %	Hardness, max	
				Brinell	HRC
S31803	90 [620]	65 [450]	25	290	30
S32205 ^A	95 [655]	65 [450]	25	290	30
S31500	92 [630]	64 [440]	30	290	30
S32550	110 [760]	80 [550]	15	297	31
S31200	100 [690]	65 [450]	25	280	...
S31260 ^B	100 [690]	65 [450]	25	...	...
S32304	87 [600]	58 [400]	25	290	30
S39274	116 [800]	80 [550]	15	310	...
S32750	116 [800]	80 [550]	15	300	32
S32760	109–130 [750–895]	80 [550]	25	270	...
S32900	90 [620]	70 [485]	20	271	28
S32950 ^C	100 [690]	70 [480]	20	290	30
S39277	120 [825]	90 [620]	25	290	30
S32520	112 [770]	80 [550]	25	310	...
S32906					
Wall below 0.40 in. (10 mm)	116 [800]	94 [650]	25	300	32
Wall 0.40 in. (10 mm) and above	109 [750]	80 [550]	25	300	32
S32003	90 [620]	65 [450]	25	290	30

^A Prior to A 790/A 790M – 04, the value for the tensile strength of S32205 was 90 ksi [620 MPa].

^B Prior to A 790/A 790M – 87, the values for S31260 were: 92 ksi tensile strength, 54 ksi yield strength, and 30 % elongation.

^C Prior to A 790/A 790M – 89, the tensile strength value was 90 ksi for UNS S32950.