Designation: A 268/A 268M – 05

Standard Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service[1]

This standard is issued under the fixed designation A 268/A 268M; 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 a number of grades of nominal-wall-thickness, stainless steel tubing for general corrosion-resisting and high-temperature service. Most of these grades are commonly known as the "straight-chromium" types and are characterized by being ferromagnetic. Two of these grades, TP410 and UNS S 41500 (Table 1), are amenable to hardening by heat treatment, and the high-chromium, ferritic alloys are sensitive to notch-brittleness on slow cooling to ordinary temperatures. These features should be recognized in the use of these materials. Grade TP439 is used primarily for hot-water tank service and does not require post-weld heat treatment to prevent attack of the heat affected zone.

1.2 An optional supplementary requirement is provided, and when desired, shall be so stated in the order.

1.3 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.

2. Referenced Documents

2.1 *ASTM Standards:*[3]

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

A 763 Practices for Detecting Susceptibility to Intergranular Attack in Ferritic Stainless Steels

A 1016/A 1016M Specification for General Requirements for Ferritic Alloy Steel, Austenitic Alloy Steel, and Stainless Steel Tubes

E 213 Practice for Ultrasonic Examination of Metal Pipe and Tubing

E 273 Practice for Ultrasonic Examination of the Weld Zone of Welded Pipe and Tubing

3. Terminology

3.1 *Lot Definitions*:

3.1.1 For flange and flaring requirements, the term lot applies to all tubes prior to cutting of the same nominal size and wall thickness which are produced from the same heat of steel. When final heat treatment is in a batch-type furnace, a lot shall include only those tubes of the same size and from the same heat which are heat treated in the same furnace charge. When the final heat treatment is in a continuous furnace, the number of tubes of the same size and from the same heat in a lot shall be determined from the size of the tubes as prescribed in Table 2.

3.1.2 For tensile and hardness test requirements, the term lot applies to all tubes prior to cutting, of the same nominal diameter and wall thickness that are produced from the same heat of steel. When final heat treatment is in a batch-type furnace, a lot shall include only those tubes of the same size and the same heat which are heat treated in the same furnace charge. When the final heat treatment is in a continuous furnace, a lot shall include all tubes of the same size and heat, heat treated in the same furnace at the same temperature, time at heat, and furnace speed.

4. Ordering Information

4.1 It is the responsibility of the purchaser to specify all requirements that are necessary for material ordered under this specification. Such requirements may include, but are not limited to, the following:

4.1.1 Quantity (feet, metres, or number of lengths),

4.1.2 Name of material (seamless or welded tubes),

4.1.3 Grade (Table 1),

4.1.4 Size (outside diameter and nominal wall thickness),

[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.

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[2] For ASME Boiler and Pressure Vessel Code applications see related Specification SA-268 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 Summary of Changes section appears at the end of this standard.**

TABLE 1 Chemical Requirements

Grade	TP405	TP410	TP429	TP430	TP443	TP446–1	TP446–2[A]	. . .	TP409
UNS Designation	S40500	S41000	S42900	S43000	S44300	S44600	S44600	S40800	S40900
Element	Composition, %								
C, max	0.08	0.15	0.12	0.12	0.20	0.20	0.12	0.08	0.08
Mn, max	1.00	1.00	1.00	1.00	1.00	1.50	1.50	1.00	1.00
P, max	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.045	0.045
S, max	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.045	0.030
Si, max	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Ni	0.50 max	. . .	. . .	. . .	0.75 max	0.75 max	0.50 max	0.80 max	0.50 max
Cr	11.5–14.5	11.5–13.5	14.0–16.0	16.0–18.0	18.0–23.0	23.0–27.0	23.0–27.0	11.5–13.0	10.5–11.7
Mo	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Al	0.10–0.30	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Cu	. . .	. . .	. . .	. . .	0.90–1.25	. . .	. . .	. . .	. . .
N	. . .	. . .	. . .	. . .	. . .	0.25	0.25	. . .	. . .
Ti	. . .	. . .	. . .	. . .	. . .	. . .	. . .	12 × C min; 1.10 max	6 × C min; 0.75 max

Grade	TP439	. . .	TP430 Ti	TP XM-27	TP XM-33[A]	18Cr-2Mo	29-4	29-4-2	26-3-3	25-4-4	...	. . .	. . .	. . .	. . .	TP468
UNS Designation	S43035	S41500[B]	S43036	S44627	S44626	S44400	S44700	S44800	S44660	S44635	S44735	S32803	S40977	S43940	S42035	S46800
Element	Composition, %															
C, max	0.07	0.05	0.10	0.01[A]	0.06	0.025	0.010	0.010	0.030	0.025	0.030	0.015[C]	0.03	0.03	0.08	0.030
Mn, max	1.00	0.5–1.0	1.00	0.40	0.75	1.00	0.30	0.30	1.00	1.00	1.00	0.5	1.50	1.00	1.00	1.00
P, max	0.040	0.03	0.040	0.02	0.040	0.040	0.025	0.025	0.040	0.040	0.040	0.020	0.040	0.040	0.045	0.040
S, max	0.030	0.03	0.030	0.02	0.020	0.030	0.020	0.020	0.030	0.030	0.030	0.005	0.015	0.015	0.030	0.030
Si, max	1.00	0.60	1.00	0.40	0.75	1.00	0.20	0.20	1.00	0.75	1.00	0.50	1.00	1.00	1.00	1.00
Ni	0.50 max	3.5–5.5	0.75 max	0.5[D] max	0.50 max	1.00 max	0.15 max	2.0–2.5	1.0–3.50	3.5–4.5	1.00 max	3.0–4.0	0.30–1.00	. . .	1.0–2.5	0.50
Cr	17.00–19.00	11.5–14.0	16.00–19.50	25.0–27.5	25.0–27.0	17.5–19.5	28.0–30.0	28.0–30.0	25.0–28.0	24.5–26.0	28.00–30.00	28.0–29.0	10.50–12.50	17.50–18.50	13.5–15.5	18.00–20.00
Mo	...	0.5–1.0	...	0.75–1.50	0.75–1.50	1.75–2.50	3.5–4.2	3.5–4.2	3.0–4.0	3.5–4.5	3.60–4.20	1.8–2.5	. . .	. . .	0.2–1.2	. . .
Al, max	0.15	. . .	...	...	...	...	...	...	...	...	...	. . .	. . .	. . .	. . .	. . .
Cu, max	...	. . .	...	0.2	0.20	...	0.15	0.15	...	...	...	. . .	. . .	. . .	. . .	. . .
N, max	0.04	. . .	...	0.015	0.040	0.035	0.020[E]	0.020[E]	0.040	0.035	0.045	0.020	0.030	. . .	. . .	0.030
Ti	0.20 + 4 (C + N) min; 1.10 max	. . .	5 × C min; 0.75 max	...	7 × (C + N) but no less than 0.20 min; 1.00 max	(Ti + Cb) 0.20 + 4 (C + N) min; 0.80 max	...	...	(Ti + Cb) = 0.20–1.00 and 6 × (C + N) min	(Ti + Cb) = 0.20 + 4 (C + N) min to 0.80 max	(Ti + Cb) = 0.20–1.00 and 6 × (C+ N) min	. . .	. . .	0.10–0.60	0.30–0.50	0.07–0.30
Cb	...	. . .	...	0.05–0.20	...	...	...	...	...	...	...	0.15–0.50[F]	. . .	(3 × %C + 0.30) min	. . .	0.10–0.60 (Ti + Cb) = 0.20 +4(C+N) min;0.80 max

[A] For small diameter or thin walls, or both, tubing, where many drawing passes are required, a carbon maximum of 0.015 % is necessary. 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. [1.2 mm] in average wall thickness (0.040 in. [1 mm] in minimum wall thickness).
[B] Plate version of CA6NM.
[C] Carbon plus nitrogen = 0.30 max.
[D] Nickel plus copper.
[E] Carbon plus nitrogen = 0.025 % max.
[F] Cb/(C + N) = 12 min.

TABLE 2 Number of Tubes in a Lot Heat Treated by the Continuous Process

Size of Tube	Size of Lot
2 in. [50.8 mm] and over in outside diameter and 0.200 in. [5.1 mm] and over in wall thickness	not more than 50 tubes
Less than 2 in. [50.8 mm] but over 1 in. [25.4 mm] in outside diameter or over 1 in. [25.4 mm] in outside diameter and under 0.200 in. [5.1 mm] in wall thickness	not more than 75 tubes
1 in. [25.4 mm] or less in outside diameter	not more than 125 tubes

4.1.5 Length (specific or random),

4.1.6 Optional requirements (hydrostatic or nondestructive electric test, Section 16),

4.1.7 Test report required (Certification Section of Specification A 1016/A 1016MA 1016/A 1016M),

4.1.8 Specification designation,

4.1.9 Intergranular corrosion test, and

4.1.10 Special requirements.

5. General Requirements

5.1 Material furnished under this specification shall conform to the applicable requirements of Specification A 1016/A 1016MA 1016/A 1016M unless otherwise provided herein.

6. Manufacture

6.1 The tubes shall be made by the seamless or welded process with no filler metal added.

7. Heat Treatment

7.1 As a final heat treatment, tubes shall be reheated to a temperature of 1200 °F [650 °C] or higher and cooled (as appropriate for the grade) to meet the requirements of this specification.

7.2 The martensitic grade UNS S 41500 shall be reheated to a temperature of 950 °F [510 °C] or higher and cooled as appropriate to meet the requirements of this specification.

8. Chemical Composition

8.1 The steel shall conform to the chemical requirements prescribed in Table 1.

9. Product Analysis

9.1 An analysis of either one billet or one length of flatrolled stock or one tube shall be made from each heat. The chemical composition thus determined shall conform to the requirements specified.

9.2 The product analysis tolerance of the Chemical Requirements Table of A 480 /A 480MA 480/A 480M shall apply. The product analysis tolerance is not applicable to the carbon content for material with a specified maximum carbon of 0.04 % or less.

9.3 If the original test for product analysis fails, retests of two additional billets, lengths of flat-rolled stock or tubes shall be made. Both retests for the elements in question shall meet the requirements of the specification; otherwise all remaining material in the heat or lot shall be rejected or, at the option of the producer, each billet or tube may be individually tested for acceptance. Billets, lengths of flat-rolled stock or tubes which do not meet the requirements of the specification shall be rejected.

10. Tensile Requirements

10.1 The material shall conform to the tensile properties prescribed in Tables 3 and 4.

11. Hardness Requirements

11.1 The tubes shall have a hardness number not to exceed those prescribed in Table 5.

12. Permissible Variations in Dimensions

12.1 Variations in outside diameter, wall thickness, and length from those specified shall not exceed the amounts prescribed in Table 6.

TABLE 3 Tensile Requirements

Grade and UNS Designation	Tensile strength, min, ksi [MPa]	Yield strength, min, ksi [MPa]	Elongation[A,B] in 2 in. or 50 mm, min, %
TP405 S40500	60 [415]	30 [205]	20
. . . S40800	55 [380]	30 [205]	20
TP410 S41000	60 [415]	30 [205]	20
TP429, TP430, and TP430 Ti S429000, S 43000, and S 43036	60 [415]	35 [240]	20
TP443 S44300	70 [485]	40 [275]	20
TP446-1 S44600	70 [485]	40 [275]	18
TP446-2 S44600	65 [450]	40 [275]	20
TP409 S40900	55 [380]	25 [170]	20
TP439 S43035	60 [415]	30 [205]	20
. . . S41500	115 [795]	90 [620]	15
TPXM-27 S44627	65 [450]	40 [275]	20
TPXM-33 S44626	68 [470]	45 [310]	20
18Cr-2Mo S44400	60 [415]	40 [275]	20
29-4 and 29-4-2 S44700 and S44800	80 [550]	60 [415]	20
26-3-3 S44660	85 [585]	65 [450]	20
25-4-4 S44635	90 [620]	75 [515]	20
. . . S44735	75 [515]	60 [415]	18
28-2-3.5 S32803	87 [600]	72 [500]	16
S40977	65 [450]	41 [280]	18
S43940	62 [430]	36 [250]	18
S42035	80 [550]	55 [380]	16
TP468 S46800	60 [415]	30 [205]	22

[A] For tubing smaller than ½ in. [12.7 mm] in outside diameter, the elongation values given for strip specimens in Table 2 shall apply. Mechanical property requirements do not apply to tubing smaller than ⅛ in. [3.2 mm] in outside diameter or with walls thinner than 0.015 in. [0.4 mm].

[B] For longitudinal strip tests a deduction of 0.90 % for TP446–1 and S 44735 and 1.00 % for all other grades shall be made from the basic minimum elongation for each 1/32 in. [0.8 mm] decrease in wall thickness below 5/16 in. [8 mm]. The following table gives the computed minimum values: