



Standard Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes¹

This standard is issued under the fixed designation A213/A213M; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification² covers seamless ferritic and austenitic steel boiler, superheater, and heat-exchanger tubes, designated Grades T5, TP304, etc. These steels are listed in **Tables 1 and 2**.

1.2 Grades containing the letter, H, in their designation, have requirements different from those of similar grades not containing the letter, H. These different requirements provide higher creep-rupture strength than normally achievable in similar grades without these different requirements.

1.3 The tubing sizes and thicknesses usually furnished to this specification are $\frac{1}{8}$ in. [3.2 mm] in inside diameter to 5 in. [127 mm] in outside diameter and 0.015 to 0.500 in. [0.4 to 12.7 mm], inclusive, in minimum wall thickness or, if specified in the order, average wall thickness. Tubing having other diameters may be furnished, provided such tubes comply with all other requirements of this specification.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard. 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

A262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels

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-213 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.

A941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys

A1016/A1016M Specification for General Requirements for Ferritic Alloy Steel, Austenitic Alloy Steel, and Stainless Steel Tubes

E112 Test Methods for Determining Average Grain Size

2.2 AWS Specifications⁴

A5.5/A5.5M Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding

A5.23/A5.23M Specification for Low-Alloy Steel Electrodes and Fluxes for Submerged Arc Welding

A5.28/A5.28M Specification for Low-Alloy Steel Electrodes for Gas Shielded Arc Welding

A5.29/A5.29M Low-Alloy Steel Electrodes for Flux Cored Arc Welding

3. Terminology

3.1 *Definitions*—For definitions of terms used in this specification, refer to Terminology **A941**.

4. Ordering Information

4.1 It shall be the responsibility of the purchaser to specify all requirements that are necessary for products under this specification. Such requirements to be considered 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 tubes),

4.1.3 Grade (**Tables 1 and 2**),

4.1.4 Condition (hot finished or cold finished),

4.1.5 Controlled structural characteristics (see **6.3**),

4.1.6 Size (outside diameter and minimum wall thickness, unless average wall thickness is specified),

4.1.7 Length (specific or random),

4.1.8 Hydrostatic Test or Nondestructive Electric Test (see **10.1**),

4.1.9 Specification designation and year of issue,

4.1.10 Increased sulfur (for machinability, see Note B, **Table 1**, and **16.3**), and

⁴ Available from American Welding Society (AWS), 550 NW LeJeune Rd., Miami, FL 33126, <http://www.aws.org>.

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

TABLE 1 Chemical Composition Limits, %^A, for Low Alloy Steel

Grade	UNS Designation	Composition, %													
		Carbon	Manganese	Phosphorus	Sulfur	Silicon	Nickel	Chromium	Molybdenum	Vanadium	Boron	Niobium	Nitrogen	Aluminum	Tungsten	Other Elements
T2	K11547	0.10–0.20	0.30–0.61	0.025	0.025 ^B	0.10–0.30	...	0.50–0.81	0.44–0.65	...	...	...	...	...	...
T5	K41545	0.15	0.30–0.60	0.025	0.025	0.50	...	4.00–6.00	0.45–0.65	...	...	...	...	...	...
T5b	K51545	0.15	0.30–0.60	0.025	0.025	1.00–2.00	...	4.00–6.00	0.45–0.65	...	...	...	...	...	...
T5c	K41245	0.12	0.30–0.60	0.025	0.025	0.50	...	4.00–6.00	0.45–0.65	...	...	...	...	...	Ti 4xC–0.70
T9	K90941	0.15	0.30–0.60	0.025	0.025	0.25–1.00	...	8.00–10.00	0.90–1.10	...	...	...	...	...	...
T11	K11597	0.05–0.15	0.30–0.60	0.025	0.025	0.50–1.00	...	1.00–1.50	0.44–0.65	...	...	...	...	...	...
T12	K11562	0.05–0.15	0.30–0.61	0.025	0.025 ^B	0.50	...	0.80–1.25	0.44–0.65	...	...	...	...	...	...
T17	K12047	0.15–0.25	0.30–0.61	0.025	0.025	0.15–0.35	...	0.80–1.25	...	0.15	...	...	...	...	...
T21	K31545	0.05–0.15	0.30–0.60	0.025	0.025	0.50–1.00	...	2.65–3.35	0.80–1.06	...	...	...	...	...	...
T22	K21590	0.05–0.15	0.30–0.60	0.025	0.025	0.50	...	1.90–2.60	0.87–1.13	...	...	...	...	...	...
T23	K40712	0.04–0.10	0.10–0.60	0.030	0.010	0.50	0.40	1.90–2.60	0.05–0.30	0.20–0.30	0.0010–0.006	0.02–0.08	0.015	0.030	1.45–1.75 Ti 0.005–0.060 Ti/N ≧ 3.5 ^C
T24	K30736	0.05–0.10	0.30–0.70	0.020	0.010	0.15–0.45	...	2.20–2.60	0.90–1.10	0.20–0.30	0.0015–0.007	...	0.012	0.02	...
T36	K21001	0.10–0.17	0.80–1.20	0.030	0.025	0.25–0.50	1.00–1.30	0.30	0.25–0.50	0.02	...	0.015–0.045	0.02	0.050	...
T91	K90901	0.07–0.14	0.30–0.60	0.020	0.010	0.20–0.50	0.40	8.0–9.5	0.85–1.05	0.18–0.25	...	0.06–0.10	0.030–0.070	0.02	...
T92	K92460	0.07–0.13	0.30–0.60	0.020	0.010	0.50	0.40	8.5–9.5	0.30–0.60	0.15–0.25	0.001–0.006	0.04–0.09	0.030–0.070	0.02	1.5–2.00
T122	K91271	0.07–0.14	0.70	0.020	0.010	0.50	0.50	10.0–11.5	0.25–0.60	0.15–0.30	0.0005–0.005	0.04–0.10	0.040–0.100	0.02	1.50–2.50 Cu 0.30–1.70 Ti 0.01 Zr 0.01
T911	K91061	0.09–0.13	0.30–0.60	0.020	0.010	0.10–0.50	0.40	8.5–9.5	0.90–1.10	0.18–0.25	0.0003–0.006	0.06–0.10	0.040–0.090	0.02	0.90–1.10 Ti 0.01 Zr 0.01

^A Maximum, unless range or minimum is indicated. Where ellipses (...) appear in this table, there is no requirement, and analysis for the element need not be determined or reported.

^B It is permissible to order T2 and T12 with a sulfur content of 0.045 max. See 16.3.

^C Alternatively, in lieu of this ratio minimum, the material shall have a minimum hardness of 275 HV in the hardened condition, defined as after austenitizing and cooling to room temperature but prior to tempering. Hardness testing shall be performed at mid-thickness of the product. Hardness test frequency shall be two samples of product per heat treatment lot and the hardness testing results shall be reported on the material test report.

4.1.11 Special requirements and any supplementary requirements selected.

5. General Requirements

5.1 Product furnished to this specification shall conform to the requirements of Specification **A1016/A1016M**, including any supplementary requirements that are indicated in the purchase order. Failure to comply with the general requirements of Specification **A1016/A1016M** constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and Specification **A1016/A1016M**, this specification shall prevail.

6. Materials and Manufacture

6.1 *Manufacture and Condition*—Tubes shall be made by the seamless process and shall be either hot finished or cold finished, as specified. Grade TP347HFG shall be cold finished.

6.2 *Heat Treatment*:

6.2.1 *Ferritic Alloy and Ferritic Stainless Steels*—The ferritic alloy and ferritic stainless steels shall be reheated for heat treatment in accordance with the requirements of **Table 3**. Heat treatment shall be carried out separately and in addition to heating for hot forming.

6.2.2 *Austenitic Stainless Steels*—All austenitic tubes shall be furnished in the heat-treated condition, and shall be heat treated in accordance with the requirements of **Table 3**. Alternatively, immediately after hot forming, while the temperature of the tubes is not less than the minimum solution treatment temperature specified in **Table 3**, tubes may be individually quenched in water or rapidly cooled by other means (direct quenched).

6.3 If any controlled structural characteristics are required, these shall be so specified in the order as to be a guide as to the most suitable heat treatment.