Designation: ~~A213/A213M – 13~~ A213/A213M – 14

Used in USDOE-NE standards

Standard Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes[1]

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 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 U.S. Department of Defense.

1. Scope*

1.1 This specification[2] 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 ⅛ 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

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 Specifications*[4]

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:

---

[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 ~~April 1, 2013~~March 1, 2014. Published ~~May 2013~~March 2014. Originally approved in 1939. Last previous edition approved in ~~2011~~2013 as A213/A213M-~~11a.~~13. DOI: ~~10.1520/A0213_A0213M-13.~~10.1520/A0213_A0213M-14.

[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.

[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	...	Ti 0.06–0.10
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	...	Cu 0.50–0.80
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	...	Ti 0.01 Zr 0.01
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	Ti 0.01 Zr 0.01
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.

TABLE 2 Chemical Composition Limits, %[A], for Austenitic and Ferritic Stainless Steel

Grade	UNS Designation	Composition											
		Carbon	Manganese	Phosphorus	Sulfur	Silicon	Chromium	Nickel	Molybdenum	Nitrogen[B]	Niobium	Titanium	Other Elements
TP201	S20100	0.15	5.5–7.5	0.060	0.030	1.00	16.0–18.0	3.5–5.5	...	0.25	...	...	...
TP202	S20200	0.15	7.5–10.0	0.060	0.030	1.00	17.0–19.0	4.0–6.0	...	.025	...	...	...
XM-19	S20910	0.06	4.0–6.0	0.045	0.030	1.00	20.5–23.5	11.5–13.5	1.50–3.00	0.20–0.40	0.10–0.30	...	V 0.10–0.30
[C]	S21500	0.06–0.15	5.5–7.0	0.045	0.030	0.20–1.00	14.0–16.0	9.0–11.0	0.80–1.20	...	0.75–1.25	...	B 0.003–0.009, V 0.15–0.40
[C]	S25700	0.02	2.00	0.025	0.010	6.5–8.0	8.0–11.5	22.0–25.0	0.50	...	...	...	...
TP304	S30400	0.08	2.00	0.045	0.030	1.00	18.0–20.0	8.0–11.0	...	...	...	...	...
TP304L	S30403	0.035[D]	2.00	0.045	0.030	1.00	18.0–20.0	8.0–12.0	...	...	...	...	...
TP304H	S30409	0.04–0.10	2.00	0.045	0.030	1.00	18.0–20.0	8.0–11.0	...	...	...	...	...
[C]	S30432	0.07–0.13	1.00	0.040	0.010	0.30	17.0–19.0	7.5–10.5	...	0.05–0.12	0.30–0.60	...	Al 0.003–0.030, B 0.001–0.010, Cu 2.5–3.5
[C]	S30434	0.07–0.14	2.00	0.040	0.010	1.00	17.5–19.5	9.0–12.0	...	...	0.10–0.40[E]	0.10–0.25[E]	B 0.001–0.004 Cu 2.50–3.50
TP304N	S30451	0.08	2.00	0.045	0.030	1.00	18.0–20.0	8.0–11.0	...	0.10–0.16	...	...	...
TP304LN	S30453	0.035[D]	2.00	0.045	0.030	1.00	18.0–20.0	8.0–11.0	...	0.10–0.16	...	...	...
[C]	S30615	0.016–0.24	2.00	0.030	0.030	3.2–4.0	17.0–19.5	13.5–16.0	...	...	...	...	Al 0.8–1.5
[C]	S30815	0.05–0.10	0.80	0.040	0.030	1.40–2.00	20.0–22.0	10.0–12.0	...	0.14–0.20	...	...	Ce 0.03–0.08
TP309S	S30908	0.08	2.00	0.045	0.030	1.00	22.0–24.0	12.0–15.0	...	...	...	...	...
TP309H	S30909	0.04–0.10	2.00	0.045	0.030	1.00	22.0–24.0	12.0–15.0	...	...	...	...	...
TP309LMoN	S30925	0.025	2.00	0.040	0.030	0.70	23.0–26.0	13.0–16.0	0.5–1.2	0.25–0.40	...	...	...
TP309Cb	S30940	0.08	2.00	0.045	0.030	1.00	22.0–24.0	12.0–16.0	...	...	10xC–1.10	...	...
TP309HCb	S30941	0.04–0.10	2.00	0.045	0.030	1.00	22.0–24.0	12.0–16.0	...	...	10xC-1.10	...	...
...	S30942	0.03–0.10	2.00	0.040	0.030	1.00	21.0–23.0	14.5–16.5		0.10–0.20	0.50–0.80		B=0.001–0.005
[C]	S31002	0.02	2.00	0.020	0.015	0.15	24.0–26.0	19.0–22.0	0.10	0.10	...	...	...
TP310S	S31008	0.08	2.00	0.045	0.030	1.00	24.0–26.0	19.0–22.0	...	...	...	...	...
TP310H	S31009	0.04–0.10	2.00	0.045	0.030	1.00	24.0–26.0	19.0–22.0	...	...	...	...	...
TP310MoCbN	S31025	0.10	1.50	0.030	0.030	1.00	19.5–23.0	23.0–26.0	1.0–2.0	0.10–0.25	0.10–0.40	0.20	B 0.002–0.010
	~~S31035~~	~~0.04–0.10~~	~~0.60~~	~~0.030~~	~~0.015~~	~~0.40~~	~~21.5–23.5~~	~~23.5–26.5~~	~~...~~	~~0.15–0.30~~	~~0.30–0.60~~	~~...~~	~~W 2.0–4.0 Co 1.0–2.0 Cu 2.0–3.5 B 0.002–0.008~~
	S31035	0.04–0.10	0.60	0.025	0.015	0.40	21.5–23.5	23.5–26.5	...	0.20–0.30	0.40–0.60	...	W 3.0–4.0 Co 1.0–2.0 Cu 2.5–3.5 B 0.002–0.008
TP310Cb	S31040	0.08	2.00	0.045	0.030	1.00	24.0–26.0	19.0–22.0	...	...	10xC-1.10	...	...
TP310HCb	S31041	0.04–0.10	2.00	0.045	0.030	1.00	24.0–26.0	19.0–22.0	...	...	10xC-1.10	...	...
TP310HCbN	S31042	0.04–0.10	2.00	0.045	0.030	1.00	24.0–26.0	19.0–22.0	...	0.15–0.35	0.20–0.60	...	...
TP310MoLN	S31050	0.025	2.00	0.020	0.030	0.40	24.0–26.0	21.0–23.0	2.00–3.00	0.10–0.16	...	...	...

TABLE 2 *Continued*

Grade	UNS Designation	Composition											
		Carbon	Manga-nese	Phospho-rus	Sulfur	Silicon	Chromium	Nickel	Molybdenum	Nitrogen[B]	Niobium	Titanium	Other Elements
[C]	S31060	0.05–0.10	1.00	0.040	0.030	0.50	22.0–24.0	10.0–12.5	...	0.18–0.25	...	...	Ce + La 0.025–0.070 B 0.001–0.010
[C]	S31254	0.020	1.00	0.030	0.010	0.80	19.5–20.5	17.5–18.5	6.0–6.5	0.18–0.22	...	...	Cu 0.50–1.00
[C]	S31272	0.08–0.12	1.50–2.00	0.030	0.015	0.30–0.70	14.0–16.0	14.0–16.0	1.00–1.40	...	...	0.30–0.60	B 0.004–0.008
[C]	S31277	0.020	3.00	0.030	0.010	0.50	20.5–23.0	26.0–28.0	6.5–8.0	0.30–0.40	...	...	Cu 0.50–1.50
TP316	S31600	0.08	2.00	0.045	0.030	1.00	16.0–18.0	10.0–14.0	2.00–3.00	...	...	...	...
TP316L	S31603	0.035[D]	2.00	0.045	0.030	1.00	16.0–18.0	10.0–14.0	2.00–3.00	...	...	...	...
TP316H	S31609	0.04–0.10	2.00	0.045	0.030	1.00	16.0–18.0	11.0–14.0	2.00–3.00	...	...	...	...
TP316Ti	S31635	0.08	2.00	0.045	0.030	0.75	16.0–18.0	10.0–14.0	2.00–3.00	0.10	...	5X (C + N)–0.70	...
TP316N	S31651	0.08	2.00	0.045	0.030	1.00	16.0–18.0	10.0–13.0	2.00–3.00	0.10–0.16	...	...	...
TP316LN	S31653	0.035[D]	2.00	0.045	0.030	1.00	16.0–18.0	10.0–13.0	2.00–3.00	0.10–0.16	...	...	...
TP317	S31700	0.08	2.00	0.045	0.030	1.00	18.0–20.0	11.0–15.0	3.0–4.0	...	...	...	...
TP317L	S31703	0.035	2.00	0.045	0.030	1.00	18.0–20.0	11.0–15.0	3.0–4.0	...	...	...	...
TP317LM	S31725	0.03	2.00	0.045	0.030	1.00	18.0–20.0	13.5–17.5	4.0–5.0	0.20	...	...	Cu 0.75
TP317LMN	S31726	0.03	2.00	0.045	0.030	1.00	17.0–20.0	13.5–17.5	4.0–5.0	0.10–0.20	...	...	Cu 0.75
[C]	S32050	0.030	1.50	0.035	0.020	1.00	22.0–24.0	20.0–23.0	6.0–6.8	0.21–0.32	...	...	Cu 0.40
TP321	S32100	0.08	2.00	0.045	0.030	1.00	17.0–19.0	9.0–12.0	...	...	...	5(C + N)–0.70	...
TP321H	S32109	0.04–0.10	2.00	0.045	0.030	1.00	17.0–19.0	9.0–12.0	...	...	...	4(C + N)–0.70	...
[C]	S32615	0.07	2.00	0.045	0.030	4.8–6.0	16.5–19.5	19.0–22.0	0.30–1.50	...	...	...	Cu 1.50–2.50
[C]	S33228	0.04–0.08	1.00	0.020	0.015	0.30	26.0–28.0	31.0–33.0	...	...	0.60–1.00	...	Ce 0.05–0.10, Al 0.025
[C]	S34565	0.030	5.0–7.0	0.030	0.010	1.00	23.0–25.0	16.0–18.0	4.0–5.0	0.40–0.60	0.10	...	...
TP347	S34700	0.08	2.00	0.045	0.030	1.00	17.0–20.0	9.0–13.0	...	...	10xC–1.10	...	...
TP347W	S34705	0.05	2.00	0.040	0.030	1.00	17.0–20.0	8.00–11.0	...	0.10–0.25	0.25–0.50	...	V 0.20–0.50 W 1.50–2.60
TP347H	S34709	0.04–0.10	2.00	0.045	0.030	1.00	17.0–19.0	9.0–13.0	...	...	8xC–1.10	...	...
TP347HFG	S34710	0.06–0.10	2.00	0.045	0.030	1.00	17.0–19.0	9.0–13.0	...	...	8xC–1.10	...	...
TP347LN	S34751	0.005–0.020	2.00	0.045	0.030	1.00	17.0–19.0	9.0–13.0	...	0.06–0.10	0.20–0.50[F]	...	...
TP348	S34800	0.08	2.00	0.045	0.030	1.00	17.0–19.0	9.0–13.0	...	...	[G]	...	Co 0.20, Ta 0.10
TP348H	S34809	0.04–0.10	2.00	0.045	0.030	1.00	17.0–19.0	9.0–13.0	...	...	[H]	...	Co 0.20, Ta 0.10
...	S35045	0.06–0.10	1.50	0.045	0.015	1.00	25.0–29.0	32.0–37.0	...	...	...	0.15–0.60	Al 0.15–0.60 Cu 0.75
XM-15	S38100	0.08	2.00	0.030	0.030	1.50–2.50	17.0–19.0	17.5–18.5	...	...	...	...	...
...	S38815	0.030	2.00	0.040	0.020	5.5–6.5	13.0–15.0	15.0–17.0	0.75–1.50	...	...	...	Cu 0.75–1.50 Al 0.30
Alloy 20	N08020	0.070	2.00	0.045	0.035	1.00	19.0-21.0	32.0-38.0	2.00-3.00	...	[M]	...	Cu 3.00-4.00
[C]	N08367	0.030	2.00	0.040	0.030	1.00	20.0-22.0	23.5-25.5	6.00-7.00	0.18-0.25	...	...	Cu 0.75

TABLE 2 *Continued*

Grade	UNS Designation	Composition											
		Carbon	Manga-nese	Phospho-rus	Sulfur	Silicon	Chromium	Nickel	Molybdenum	Nitrogen[B]	Niobium	Titanium	Other Elements
800	N08800	0.10	1.50	0.045	0.015	1.00	19.0–23.0	30.0–35.0	...	...			Cu 0.75 Al 0.15–0.60 Ti 0.15–0.60 Fe[I] 39.5 min
800H	N08810	0.05–0.10	1.50	0.045	0.015	1.00	19.0–23.0	30.0–35.0	...	...			Cu 0.75 Al 0.15–0.60 Ti 0.15–0.60 Fe[I] 39.5 min
...	N08811	0.06–0.10	1.50	0.045	0.015	1.00	19.0–23.0	30.0–35.0	...	...			Cu 0.75 Al 0.15–0.60[J] Ti 0.15–0.60[J] Fe[I] 39.5 min
	N08904	0.020	2.00	0.040	0.030	1.00	19.0–23.0	23.0–28.0	4.0–5.0	0.10			Cu 1.00–2.00
...	N08925	0.020	1.00	0.045	0.030	0.50	19.0–21.0	24.0–26.0	6.0–7.0	0.10–0.20	...	...	Cu 0.80–1.50
...	N08926	0.020	2.00	0.030	0.010	0.50	19.0–21.0	24.0–26.0	6.0–7.0	0.15–0.25	...	...	Cu 0.50–1.50
TP444	S44400	0.03	1.00	0.040	0.030	1.00	17.5–19.5	[K]	1.75–2.50	0.035	...	[L]	...

[A]Maximum, unless a range or minimum is indicated. Where ellipses (...) appear in this table, there is no minimum and analysis for the element need not be determined or reported.
[B]The method of analysis for Nitrogen shall be a matter of agreement between the purchaser and the producer.
[C]For these alloys, there is no common grade designation. The UNS number uniquely identifies these alloys.
[D]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, TP304LN, TP316L, and TP316LN.
[E]Grade S30434 shall have (Ti + ½ Nb) of not less than 2 times and not more than 4 times the carbon content.
[F]Grade TP347LN shall have an Nb content of not less than 15 times the carbon content.
[G]Grade TP348 shall have an Nb + Ta content of not less than 10 times the carbon content and not more than 1.10%.
[H]Grade TP348H shall have an Nb + Ta content of not less than 8 times the carbon content and not more than 1.10%.
[I]Iron shall be determined arithmetically by difference of 100 minus the sum of the other specified elements.
[J](Al + Ti) 0.85–1.20.
[K]Grade TP444 shall have Ni + Cu = 1.00 max.
[L]Grade TP444 shall have Ti + Nb = 0.20 + 4(C + N)–0.80.
[M]N08020 shall have an Nb + Ta content of not less than 8 times the carbon content and not more than 1.00%.

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
4.1.11 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.

7. Chemical Composition

7.1 *Composition Requirements:*
7.1.1 The alloy steels shall conform to the chemical requirements given in Table 1.
7.1.2 The stainless steels shall conform to the chemical requirements given in Table 2.

7.2 *Product Analysis:*
7.2.1 An analysis of either one billet or one tube shall be made from each heat. The chemical composition thus determined shall conform to the requirements specified.
7.2.2 If the original test for product analysis fails, retests of two additional billets 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 shall be rejected or, at the option of the producer, each billet or tube may be individually tested for acceptance. Billets or tubes that do not meet the requirements of the specification shall be rejected.

8. Grain Size

8.1 Grain size shall be as given in Table 3, as determined in accordance with Test Methods E112.

8.2 Grain size determinations, to demonstrate compliance with 8.1, shall be made on one end of one finished tube from each lot. See 15.1.

9. Mechanical Properties

9.1 *Tensile Requirements:*
9.1.1 The material shall conform to the requirements as to tensile properties given in Table 4.
9.1.2 Table 5 gives the computed minimum elongation values for each 1/32-in. [0.8-mm] decrease in wall thickness. Where the wall thickness lies between two values shown in Table 5, the minimum elongation value shall be determined by the following equations. For Grades T23, T24, T91, T92, T122, T911, and S44400: $E = 32t + 10.00$ [$E = 1.25t + 10.00$]. For Grade T36: $E = 32t + 5.0$ [$E = 1.25t + 5.0$]. For all other ferritic alloy grades: $E = 48t + 15.00$ [$E = 1.87t + 15.00$].