



Designation: A 240/A 240M – 99b

Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels¹

This standard is issued under the fixed designation A 240/A 240M; 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 specification² covers chromium, chromium-nickel, and chromium-manganese-nickel stainless and heat-resisting steel plate, sheet, and strip for pressure vessels.

1.2 Some steels covered by this specification, especially the chromium steels, because of their particular alloy content and specialized properties, may require special care in their fabrication and welding. Specific procedures are of fundamental importance, and it is presupposed that all parameters will be in accordance with approved methods capable of producing the desired properties in the finished fabrication.

1.3 The values stated in either inch-pound units or SI units are to be regarded separately as standard. 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.

1.4 This specification and the applicable material specifica-

tions are expressed in both inch-pound and SI units. However, unless the order specifies the applicable “M” specification designation (SI units), the material shall be furnished in inch-pound units.

2. Referenced Documents

2.1 ASTM Standards:

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products³

A 480/A 480M Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip³

A 923 Test Methods for Detecting Detrimental Intermetallic Phase in Wrought Duplex Austenitic/Ferritic Stainless Steels³

E 112 Test Methods for Determining Average Grain Size⁴

E 527 Practice for Numbering Metals and Alloys (UNS)⁵

2.2 SAE Standard:

J 1086 Practice for Numbering Metals and Alloys (UNS)⁶

¹ This specification is under the jurisdiction of ASTM Committee A-1 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.17 on Flat Stainless Steel Products.

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² For ASME Boiler and Pressure Vessel Code applications see related Specification SA-240 in Section II of that Code.

³ Annual Book of ASTM Standards, Vol 01.03.

⁴ Annual Book of ASTM Standards, Vol 03.01.

⁵ Annual Book of ASTM Standards, Vol 01.01.

⁶ Available from Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096.

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3. General Requirements

3.1 The following requirements for orders for material furnished under this specification shall conform to the applicable requirements of the current edition of Specification A 480/A 480M.

- 3.1.1 Definitions,
- 3.1.2 General requirements for delivery,
- 3.1.3 Ordering information,
- 3.1.4 Process,
- 3.1.5 Special tests,
- 3.1.6 Heat treatment,
- 3.1.7 Dimensions and permissible variations,
- 3.1.8 Workmanship, finish and appearance,
- 3.1.9 Number of tests/test methods,
- 3.1.10 Specimen preparation,
- 3.1.11 Retreatment,
- 3.1.12 Inspection,
- 3.1.13 Rejection and reheating,
- 3.1.14 Material test report,
- 3.1.15 Certification, and
- 3.1.16 Packaging, marking, and loading.

4. Chemical Composition

4.1 The steel shall conform to the requirements as to chemical composition specified in Table 1, and shall conform to applicable requirements specified in Specification A 480/A 480M.

5. Mechanical Properties

5.1 The material shall conform to the mechanical properties specified in Table 2.

5.2 When specified by the purchaser, Charpy impact tests shall be performed in accordance with Supplementary Requirement S1.

6. Materials for High-Temperature Service

6.1 The austenitic *H* Types shall conform to an average grain size of ASTM No. 7 or coarser as measured by Test Methods E 112.

6.2 Supplementary Requirement S2 shall be invoked when non-*H* grade austenitic stainless steels are ordered for ASME Code applications for service above 1000°F [540°C].

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TABLE 1 Chemical Composition Requirements, %^A

UNS Designation ^B	Type ^C	Carbon ^D	Manganese	Phosphorus	Sulfur	Silicon	Chromium	Nickel	Molybdenum	Nitrogen	Copper	Other Elements ^{E,F}
Austenitic (Chromium-Nickel) (Chromium-Manganese-Nickel)												
N08020	...	0.07	2.00	0.045	0.035	1.00	19.0-21.0	32.0-38.0	2.00-3.00	...	3.0-4.0	Cb 8×C min, 1.00 max
N08367	...	0.030	2.00	0.040	0.030	1.00	20.0-22.0	23.5-25.5	6.0-7.0	0.18-0.25	0.75	Fe ^H 39.5 min
N08800	800 ^G	0.10	1.50	0.045	0.015	1.00	19.0-23.0	30.0-35.0	...	...	0.75	Al 0.15-0.60 Ti 0.15-0.60
N08810	800H ^G	0.05-0.10	1.50	0.045	0.015	1.00	19.0-23.0	30.0-35.0	...	...	0.75	Al 0.15-0.60 Ti 0.15-0.60
N08811	...	0.06-0.10	1.50	0.040	0.015	1.00	19.0-23.0	30.0-35.0	...	...	0.75	Al 0.15-0.60 Ti 0.15-0.60
N08904	904L ^G	0.020	2.00	0.045	0.035	1.00	19.0-23.0	23.0-28.0	4.0-5.0	0.10	1.0-2.0	...
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	0.5-1.5	...
S20100	201	0.15	5.5-7.5	0.060	0.030	1.00	16.0-18.0	3.5-5.5	...	0.25	...	...
S20103	...	0.03	5.5-7.5	0.045	0.030	0.75	16.0-18.0	3.5-5.5	...	0.25	...	...
S20153	...	0.03	6.4-7.5	0.045	0.015	0.75	16.0-17.5	4.0-5.0	...	0.10-0.25	1.00	...
S20161	...	0.15	4.0-6.0	0.040	0.040	3.0-4.0	15.0-18.0	4.0-6.0	...	0.08-0.20	...	...
S20200	202	0.15	7.5-10.0	0.060	0.030	1.00	17.0-19.0	4.0-6.0	...	0.25	...	...
S20400	...	0.030	7.0-9.0	0.040	0.030	1.00	15.0-17.0	1.50-3.00	...	0.15-0.30	...	...
S20910	XM-19 ^J	0.06	4.0-6.0	0.040	0.030	0.75	20.5-23.5	11.5-13.5	1.50-3.00	0.20-0.40	...	Cb 0.10-0.30 V 0.10-0.30
S21400	XM-31 ^J	0.12	14.0-16.0	0.045	0.030	0.30-1.00	17.0-18.5	1.00	...	0.35 min	...	...
S21600	XM-17 ^J	0.08	7.5-9.0	0.045	0.030	0.75	17.5-22.0	5.0-7.0	2.00-3.00	0.25-0.50	...	...
S21603	XM-18 ^J	0.03	7.5-9.0	0.045	0.030	0.75	17.5-22.0	5.0-7.0	2.00-3.00	0.25-0.50	...	...
S21800	...	0.10	7.0-9.0	0.060	0.030	3.5-4.5	16.0-18.0	8.0-9.0	...	0.08-0.18	...	...
S24000	XM-29 ^J	0.08	11.5-14.5	0.060	0.030	0.75	17.0-19.0	2.3-3.7	...	0.20-0.40	...	...
S30100	301	0.15	2.00	0.045	0.030	1.00	16.0-18.0	6.0-8.0	...	0.10	...	...
S30103	301L ^G	0.03	2.00	0.045	0.030	1.00	16.0-18.0	6.0-8.0	...	0.10	...	...
S30153	301LN ^G	0.03	2.00	0.045	0.030	1.00	16.0-18.0	6.0-8.0	...	0.07-0.20	...	...
S30200	302	0.15	2.00	0.045	0.030	0.75	17.0-19.0	8.0-10.0	...	0.10	...	...
S30400	304	0.08	2.00	0.045	0.030	0.75	18.0-20.0	8.0-10.5	...	0.10	...	...
S30403	304L	0.030	2.00	0.045	0.030	0.75	18.0-20.0	8.0-12.0	...	0.10	...	...
S30409	304H	0.04-0.10	2.00	0.045	0.030	0.75	18.0-20.0	8.0-10.5	...	...	...	...
S30415	...	0.04-0.06	0.80	0.045	0.030	1.00-2.00	18.0-19.0	9.0-10.0	...	0.12-0.18	...	Ce 0.03-0.08
S30451	304N	0.08	2.00	0.045	0.030	0.75	18.0-20.0	8.0-10.5	...	0.10-0.16	...	...
S30452	XM-21 ^J	0.08	2.00	0.045	0.030	0.75	18.0-20.0	8.0-10.5	...	0.16-0.30	...	...
S30453	304LN	0.030	2.00	0.045	0.030	0.75	18.0-20.0	8.0-12.0	...	0.10-0.16	...	...
S30500	305	0.12	2.00	0.045	0.030	0.75	17.0-19.0	10.5-13.0	...	...	...	...
S30600	...	0.018	2.00	0.020	0.020	3.7-4.3	17.0-18.5	14.0-15.5	0.20	...	0.50	...
S30601	...	0.015	0.50-0.80	0.030	0.013	5.0-5.6	17.0-18.0	17.0-18.0	0.20	0.05	0.35	...
S30615	...	0.16-0.24	2.00	0.030	0.030	3.2-4.0	17.0-19.5	13.5-16.0	...	...	...	Al 0.80-1.50
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
S30908	309S	0.08	2.00	0.045	0.030	0.75	22.0-24.0	12.0-15.0	...	...	...	...
S30909	309H ^G	0.04-0.10	2.00	0.045	0.030	0.75	22.0-24.0	12.0-15.0	...	...	...	Cb 10×C min, 1.10 max
S30940	309Cb ^G	0.08	2.00	0.045	0.030	0.75	22.0-24.0	12.0-16.0	...	...	...	Cb 10×C min, 1.10 max
S30941	309HCb ^G	0.04-0.10	2.00	0.045	0.030	0.75	22.0-24.0	12.0-16.0	...	...	...	Cb 10×C min, 1.10 max
S31008	310S	0.08	2.00	0.045	0.030	1.50	24.0-26.0	19.0-22.0	...	...	...	...
S31009	310H ^G	0.04-0.10	2.00	0.045	0.030	0.75	24.0-26.0	19.0-22.0	...	...	...	...
S31040	310Cb ^G	0.08	2.00	0.045	0.030	1.50	24.0-26.0	19.0-22.0	...	...	...	Cb 10×C min, 1.10 max

TABLE 1 Continued

UNS Designation ^a	Type ^c	Carbon ^d	Manganese	Phosphorus	Sulfur	Silicon	Chromium	Nickel	Molybdenum	Nitrogen	Copper	Other Elements ^{e,f}
S31041	310HCb ^g	0.04–0.10	2.00	0.045	0.030	0.75	24.0–26.0	19.0–22.0	...	...	...	Cb 10×C min, 1.10 max
S31050	310 MoLN ^g	0.020	2.00	0.030	0.010	0.50	24.0–26.0	20.5–23.5	1.60–2.60	0.09–0.15	...	...
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	0.50–1.00	...
S31266	...	0.030	2.0–4.0	0.035	0.020	1.00	23.0–25.0	21.0–24.0	5.2–6.2	0.35–0.60	1.00–2.50	W 1.50–2.50
S31600	316	0.08	2.00	0.045	0.030	0.75	16.0–18.0	10.0–14.0	2.00–3.00	0.10	...	...
S31603	316L	0.030	2.00	0.045	0.030	0.75	16.0–18.0	10.0–14.0	2.00–3.00	0.10	...	...
S31609	316H	0.04–0.10	2.00	0.045	0.030	0.75	16.0–18.0	10.0–14.0	2.00–3.00	...	...	...
S31635	316Ti ^g	0.08	2.00	0.045	0.030	0.75	16.0–18.0	10.0–14.0	2.00–3.00	0.10	...	Ti 5 × (C + N) min, 0.70 max
S31640	316Cb ^g	0.08	2.00	0.045	0.030	0.75	16.0–18.0	10.0–14.0	2.00–3.00	0.10	...	Cb 10 × C min, 1.10 max
S31651	316N	0.08	2.00	0.045	0.030	0.75	16.0–18.0	10.0–14.0	2.00–3.00	0.10–0.16	...	...
S31653	316LN	0.030	2.00	0.045	0.030	0.75	16.0–18.0	10.0–14.0	2.00–3.00	0.10–0.16	...	...
S31700	317	0.08	2.00	0.045	0.030	0.75	18.0–20.0	11.0–15.0	3.0–4.0	0.10	...	...
S31703	317L	0.030	2.00	0.045	0.030	0.75	18.0–20.0	11.0–15.0	3.0–4.0	0.10	...	...
S31725	317LM ^g	0.030	2.00	0.045	0.030	0.75	18.0–20.0	13.5–17.5	4.0–5.0	0.20	...	...
S31726	317LMN ^g	0.030	2.00	0.045	0.030	0.75	17.0–20.0	13.5–17.5	4.0–5.0	0.10–0.20	...	...
S31753	317LN ^g	0.030	2.00	0.045	0.030	0.75	18.0–20.0	11.0–15.0	3.0–4.0	0.10–0.22	...	...
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	0.40	...
S32100	321	0.08	2.00	0.045	0.030	0.75	17.0–19.0	9.0–12.0	...	0.10	...	Ti 5 × (C + N) min, 0.70 max
S32109	321H	0.04–0.10	2.00	0.045	0.030	0.75	17.0–19.0	9.0–12.0	...	...	...	Ti 4 × (C + N) min, 0.70 max
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	...	1.50–2.50	...
S32654	...	0.020	2.0–4.0	0.030	0.005	0.50	24.0–25.0	21.0–23.0	7.0–8.0	0.45–0.55	0.30–0.60	...
S33228	...	0.04–0.08	1.00	0.020	0.015	0.30	26.0–28.0	31.0–33.0	...	...	...	Ce 0.05–0.10
S33400	334 ^g	0.08	1.00	0.030	0.015	1.00	18.0–20.0	19.0–21.0	...	...	...	Cb 0.6–1.0
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	...	Al 0.025
S34700	347	0.08	2.00	0.045	0.030	0.75	17.0–19.0	9.0–13.0	...	...	...	Al 0.15–0.60
S34709	347H	0.04–0.10	2.00	0.045	0.030	0.75	17.0–19.0	9.0–13.0	...	...	...	Ti 0.15–0.60
S34800	348	0.08	2.00	0.045	0.030	0.75	17.0–19.0	9.0–13.0	...	...	...	Cb 10 × C min, 1.00 max
S34809	348H	0.04–0.10	2.00	0.045	0.030	0.75	17.0–19.0	9.0–13.0	...	...	...	Cb 8 × C min, 1.00 max
S35045	...	0.06–0.10	1.50	0.045	0.015	1.00	25.0–29.0	32.0–37.0	...	...	...	1.00 max (Cb + Ta) 10×C min, 1.00 max
S35135	...	0.08	1.00	0.045	0.015	0.60–1.00	20.0–25.0	30.0–38.0	4.0–4.8	...	0.75	Co 0.20
S35315	...	0.04–0.08	2.00	0.040	0.030	1.20–2.00	24.0–26.0	34.0–36.0	...	0.12–0.18	0.75	Ta 0.10
S38100	XM-15/ ^h	0.08	2.00	0.030	0.030	1.50–2.50	17.0–19.0	17.5–18.5	...	...	...	Co 0.20
S31200	...	0.030	2.00	0.045	0.030	1.00	24.0–26.0	5.5–6.5	1.20–2.00	0.14–0.20	...	Ta 0.10
S31260	...	0.03	1.00	0.030	0.030	0.75	24.0–26.0	5.5–7.5	2.5–3.5	0.10–0.30	0.20–0.80	Co 0.20
S31803	...	0.030	2.00	0.030	0.020	1.00	21.0–23.0	4.5–6.5	2.5–3.5	0.08–0.20	...	Al 0.15–0.60
S32001	...	0.030	4.0–6.0	0.040	0.030	1.00	19.5–21.5	1.00–3.00	0.60	0.05–0.17	1.00	Ti 0.40–1.00
S32205	2205 ^g	0.030	2.00	0.030	0.020	1.00	22.0–23.0	4.5–6.5	3.0–3.5	0.14–0.20	...	Ce 0.03–0.08

Duplex (Austenitic-Ferritic)

TABLE 1 Continued

UNS Designation ^B	Type ^C	Carbon ^D	Manganese	Phosphorus	Sulfur	Silicon	Chromium	Nickel	Molybdenum	Nitrogen	Copper	Other Elements ^{E,F}
S32304	3204 ^G	0.030	2.50	0.040	0.030	1.00	21.5–24.5	3.0–5.5	0.05–0.60	0.05–0.20	0.05–0.60	...
S32520	...	0.030	1.50	0.035	0.020	0.80	24.0–26.0	5.5–8.0	3.0–4.0	0.20–0.35	0.50–2.00	...
S32550	255 ^G	0.04	1.50	0.040	0.030	1.00	24.0–27.0	4.5–6.5	2.9–3.9	0.10–0.25	1.50–2.50	...
S32750	2507 ^G	0.030	1.20	0.035	0.020	0.80	24.0–26.0	6.0–8.0	3.0–5.0	0.24–0.32	0.50	...
S32760 ^K	...	0.030	1.00	0.030	0.010	1.00	24.0–26.0	6.0–8.0	3.0–4.0	0.20–0.30	0.50–1.00	W 0.50–1.00
S32900	329	0.08	1.00	0.040	0.030	0.75	23.0–28.0	2.0–5.00	1.00–2.00	...	...	...
S32950	...	0.030	2.00	0.035	0.010	0.60	26.0–29.0	3.5–5.2	1.00–2.50	0.15–0.35	...	...
Ferritic or Martensitic (Chromium)												
S32803	...	0.015	0.50	0.020	0.0035	0.55	28.0–29.0	3.0–4.0	1.80–2.50	0.020	...	Cb 12×(C+N) min, 0.15–0.50 Al 0.10–0.30
S40500	405	0.08	1.00	0.040	0.030	1.00	11.5–14.5	0.60	...	...	...	...
S40900 ^L	409 ^L	0.030	1.00	0.040	0.020	1.00	10.5–11.7	0.50	...	0.030	...	Ti 6×(C+N) min, 0.50 max; Cb 0.17
S40910	...	0.030	1.00	0.040	0.020	1.00	10.5–11.7	0.50	...	0.030	...	Ti 8×(C+N) min, Ti 0.15–0.50; Cb 0.10
S40920	...	0.030	1.00	0.040	0.020	1.00	10.5–11.7	0.50	...	0.030	...	Ti 8×(C+N) min, Ti 0.15–0.50; Cb 0.10
S40930	...	0.030	1.00	0.040	0.020	1.00	10.5–11.7	0.50	...	0.030	...	×(C+N) min, 0.75 max; Ti 0.05 min Cb 0.18–0.40 Ti 0.05–0.20
S40945	...	0.030	1.00	0.040	0.030	1.00	10.5–11.7	0.50	...	0.030	...	Ti 6×(C+N) min, 0.75 max
S40975	...	0.030	1.00	0.040	0.030	1.00	10.5–11.7	0.50–1.00	...	0.030	...	...
S40977	...	0.030	1.50	0.040	0.015	1.00	10.5–12.5	0.30–1.00	...	0.030	...	...
S41000	410	0.15	1.00	0.040	0.030	1.00	11.5–13.5	0.75	...	0.030	...	...
S41003	...	0.03	1.50	0.040	0.030	1.00	10.5–12.5	1.50	...	0.030	...	...
S41008	410S	0.08	1.00	0.040	0.030	1.00	11.5–13.5	0.60	...	0.030	...	...
S41045	...	0.030	1.00	0.040	0.030	1.00	12.0–13.0	0.50	...	0.030	...	...
S41050	...	0.04	1.00	0.045	0.030	1.00	10.5–12.5	0.60–1.10	...	0.10	...	Cb 9×(C+N) min, 0.60 max
S41500 ^M	...	0.05	0.50–1.00	0.030	0.030	0.60	11.5–14.0	3.5–5.5	0.50–1.00	...	...	...
S42035	...	0.08	1.00	0.045	0.030	1.00	13.5–15.5	1.0–2.5	0.2–1.2	...	...	...
S42900	429 ^G	0.12	1.00	0.040	0.030	1.00	14.0–16.0	...	...	...	...	Ti 0.30–0.50
S43000	430	0.12	1.00	0.040	0.030	1.00	16.0–18.0	0.75	...	...	...	...
S43035	439	0.07	1.00	0.040	0.030	1.00	17.0–19.0	0.50	...	0.04	...	...
S43400	434	0.12	1.00	0.040	0.030	1.00	16.0–18.0	...	0.75–1.25	...	...	...
S43600	436	0.12	1.00	0.040	0.030	1.00	16.0–18.0	...	0.75–1.25	...	...	...
S43932	...	0.030	1.00	0.040	0.030	1.00	17.0–19.0	0.50	...	0.030	...	...
S43940	...	0.030	1.00	0.040	0.015	1.00	17.5–18.5	...	...	...	...	...
S44400	444	0.025	1.00	0.040	0.030	1.00	17.5–19.5	1.00	1.75–2.50	0.035	...	...

TABLE 1 Continued

UNS Designation ^B	Type ^C	Carbon ^D	Manganese	Phosphorus	Sulfur	Silicon	Chromium	Nickel	Molybdenum	Nitrogen	Copper	Other Elements ^{E,F}
S44500	...	0.020	1.00	0.040	0.012	1.00	19.0–21.0	0.60	...	0.03	0.30–0.60	Cb 10×(C+N) min, 0.80 max Ti 0.20–1.00; Ti 7(C+N) min
S44626	XM-33 ^G	0.06	0.75	0.040	0.020	0.75	25.0–27.0	0.50	0.75–1.50	0.04	0.20	Cb 0.05–0.20 (Ni + Cu) 0.50
S44627	XM-27 ^G	0.010 ^H	0.40	0.020	0.020	0.40	25.0–27.5	0.50	0.75–1.50	0.015 ^N	0.20	(Ti+Cb) [0.20+4(C+N)] min, 0.80 max
S44635	...	0.025	1.00	0.040	0.030	0.75	24.5–26.0	3.5–4.5	3.5–4.5	0.035	...	(Ti+Cb) 0.20 – 1.00, Ti + Cb 6×(C+N) min (C+N) 0.025 (Ti+Cb) 0.20–1.00, (Ti+Cb) 6× (C+N) min (C+N) 0.025 Ti 0.07–0.30 Cb 0.10–0.60 (Ti+Cb) [0.20+4(C+N)] min, 0.80 max
S44660	...	0.030	1.00	0.040	0.030	1.00	25.0–28.0	1.0–3.5	3.0–4.0	0.040	...	
S44700	...	0.010	0.30	0.025	0.020	0.20	28.0–30.0	0.15	3.5–4.2	0.020	0.15	
S44735	...	0.030	1.00	0.040	0.030	1.00	28.0–30.0	1.00	3.6–4.2	0.045	...	
S44800	...	0.010	0.30	0.025	0.020	0.20	28.0–30.0	2.00–2.50	3.5–4.2	0.020	0.15	
S46800	...	0.030	1.00	0.040	0.030	1.00	18.0–20.0	0.50	...	0.030	...	

^A Maximum, unless range or minimum is indicated.

^B Designation established in accordance with Practice E 527 and SAE J 1086.

^C Unless otherwise indicated, a grade designation originally assigned by the American Iron and Steel Institute (AISI).

^D Carbon analysis shall be reported to nearest 0.01 % except for the low-carbon types, which shall be reported to nearest 0.001 %.

^E The terms Columbium (Cb) and Niobium (Nb) both relate to the same element.

^F When two minimums or two maximums are listed for a single type, as in the case of both a value from a formula and an absolute value, the higher minimum or lower maximum shall apply.

^G Common name, not a trademark, widely used, not associated with any one producer.

^H Iron shall be determined arithmetically by difference of 100 minus the sum of the other specified elements.

^I (Al + Ti) 0.85–1.20.

^J Naming system developed and applied by ASTM.

^K Cr + 3.3 Mo + 16 N = 40 min.

^L S40900 (Type 409) has been replaced by S40910, S40920, and S40930. Unless otherwise specified in the ordering information, an order specifying S40900 or Type 409 shall be satisfied by any one of S40910, S40920, or S40930 at the option of the seller. Material meeting the requirements of S40910, S40920, or S40930, may at the option of the manufacturer be certified as S40900.

^M Plate version of CA-6NM.

^N Product (check or verification) analysis tolerance over the maximum limit for C and N in XM-27 shall be 0.002 %.