

Appendix A to Part 178—Specifications for Steel

Table 1

[Open-hearth, basic oxygen, or electric steel of uniform quality. The following chemical composition limits are based on ladle analysis:]

Designation	Chemical composition, percent-ladle analysis		
	Grade 1 ¹	Grade 2 ^{1,2}	Grade 3 ^{2,4,5}
Carbon	0.10/0.20	0.24 maximum	0.22 maximum.
Manganese	1.10/1.60	0.50/1.00	1.25 maximum.
Phosphorus, maximum	0.04	0.04	0.045. ⁶
Sulfur, maximum	0.05	0.05	0.05.
Silicon	0.15/0.30	0.30 maximum	
Copper, maximum	0.40		
Columbium		0.01/0.04	
Heat treatment authorized	(³)	(³)	(³).
Maximum stress (p.s.i.)	35,000	35,000	35,000.

¹Addition of other elements to obtain alloying effect is not authorized.

²Ferritic grain size 6 or finer according to ASTM E 112–96 (IBR, see §171.7 of this subchapter).

³Any suitable heat treatment in excess of 1,100 °F., except that liquid quenching is not permitted.

⁴Other alloying elements may be added and shall be reported.

⁵For compositions with a maximum carbon content of 0.15 percent of ladle analysis, the maximum limit for manganese on ladle analysis may be 1.40 percent.

⁶Rephosphorized Grade 3 steels containing no more than 0.15 percent phosphorus are permitted if carbon content does not exceed 0.15 percent and manganese does not exceed 1 percent.

Check Analysis Tolerances

[A heat of steel made under any of the above grades, the ladle analysis of which is slightly out of the specified range is acceptable if the check analysis is within the following variations:]

Element	Limit or maximum specified (percent)	Tolerance (percent) over the maximum limit or under the minimum limit	
		Under minimum limit	Over maximum limit
Carbon	To 0.15 inclusive	0.02	0.03
	Over 0.15 to 0.40 inclusive	0.03	0.04
Manganese	To 0.60 inclusive	0.03	0.03

	Over 0.60 to 1.15 inclusive	0.04	0.04
	Over 1.15 to 2.50 inclusive	0.05	0.05
Phosphorus ⁷	All ranges		0.01
Sulfur	All ranges		0.01
Silicon	To 0.30 inclusive	0.02	0.03
	Over 0.30 to 1.00 inclusive	0.05	0.05
Copper	To 1.00 inclusive	0.03	0.03
	Over 1.00 to 2.00 inclusive	0.05	0.05
Nickel	To 1.00 inclusive	0.03	0.03
	Over 1.00 to 2.00 inclusive	0.05	0.05
Chromium	To 0.90 inclusive	0.03	0.03
	Over 0.90 to 2.10 inclusive	0.05	0.05
Molybdenum	To 0.20 inclusive	0.01	0.01
	Over 0.20 to 0.40 inclusive	0.02	0.02
Zirconium	All ranges	0.01	0.05
Columbium	To 0.04 inclusive	0.005	0.01
Aluminum	Over 0.10 to 0.20 inclusive	0.04	0.04
	Over 0.20 to 0.30 inclusive	0.05	0.05

⁷Rephosphorized steels not subject to check analysis for phosphorus.

[Amdt. 178-3, 34 FR 12283, July 25, 1969; 34 FR 12593, Aug. 1, 1969, as amended by Amdt. 178-64, 45 FR 81573, Dec. 11, 1980; Amdt. 178-97, 55 FR 52728, Dec. 21, 1990; 68 FR 75758, Dec. 31, 2003]