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**SAE J409 JUN84**

**Product Analysis —  
Permissible  
Variations from  
Specified Chemical  
Analysis of a Heat or  
Cast of Steel**

SAE Standard  
Revised June 1984

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**φ PRODUCT ANALYSIS—PERMISSIBLE VARIATIONS  
FROM SPECIFIED CHEMICAL ANALYSIS OF A HEAT  
OR CAST OF STEEL—SAE J409 JUN84**

**SAE Standard**

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Report of the Iron and Steel Division, approved January 1942, fourth revision by the Iron and Steel Technical Committee, Division 1, June 1984.

Supplementary to the heat or cast analysis, a product analysis may be made on steel in the semi-finished or finished form. For definitions and methods of sampling steel for product chemical analysis, refer to SAE J408.

A product analysis is a chemical analysis on the semi-finished or finished

steel to determine conformance to the specification requirements. The range of the specified chemical composition is normally expanded to take into account deviations associated with analytical reproducibility and the heterogeneity of the steel. Individual determinations may vary from the specified heat or cast analysis ranges or limits to the extent shown in

Tables 1 through 5; but, the several determinations of any element in a heat or cast may not vary both above and below the specified range except for lead, which may vary both above and below the specified range.

Rimmed or capped steels are not subject to product analysis limits because they are characterized by an inherently large variation in chemical

composition. Also, for rephosphorized and resulfurized steels, the product analysis tolerance limits are not applicable for phosphorus and sulfur because of the degree to which these elements segregate.

Boron is not subject to product analysis tolerances.

**TABLE 1—PERMISSIBLE VARIATIONS FROM SPECIFIED CHEMICAL RANGES AND LIMITS FOR CARBON STEEL IN HOT ROLLED AND COLD FINISHED BARS AND SEMIFINISHED FOR FORGING, WIRE ROD, AND SEAMLESS TUBING**

Element	Limit or Max of Specified Range, %	Variation, %, Over Max Limit or Under Min Limit			
		Bars, Wire Rod, Seamless Tubing and Semifinished for Forging to 100 in <sup>2</sup> (0.065 m <sup>2</sup> ) Incl	Semifinished Products for Forging		
			Over 100 to 200 in <sup>2</sup> (0.065 to 0.129 m <sup>2</sup> ) Incl	Over 200 to 400 in <sup>2</sup> (0.129 to 0.258 m <sup>2</sup> ) Incl	Over 400 to 800 in <sup>2</sup> (0.258 to 0.516 m <sup>2</sup> ) Incl
Carbon	To 0.25 incl Over 0.25 to 0.55 incl Over 0.55	0.02 0.03 0.04	0.03 0.04 0.05	0.04 0.05 0.06	0.05 0.06 0.07
Manganese	To 0.90 incl Over 0.90 to 1.65 incl	0.03 0.06	0.04 0.06	0.06 0.07	0.07 0.08
Phosphorus	Over max only to 0.040 incl	0.008	0.008	0.010	0.015
Sulfur	Over max only to 0.050 incl	0.008	0.010	0.010	0.015
Silicon	To 0.35 incl Over 0.35 to 0.60	0.02 0.05	0.02 —	0.03 —	0.04 —
Copper	Under min only for copper bearing steels	0.02	0.03	—	—
Lead <sup>a</sup>	0.15 to 0.35 incl	0.03	0.03	—	—

<sup>a</sup> Product analysis tolerance for lead applies, both over and under, to a range of 0.15–0.35% lead.

**TABLE 2—PERMISSIBLE VARIATIONS FROM SPECIFIED CHEMICAL RANGES AND LIMITS FOR CARBON STEEL SHEETS, STRIP, AND WELDED TUBING**

Element	Limit or Max of Specified Range, %	Variation, %, over Max Limit or under Min Limit	
		Under Min Limit	Over Max Limit
Carbon	To 0.15 incl Over 0.15 to 0.40 incl Over 0.40 to 0.80 incl Over 0.80	0.02 0.03 0.03 0.03	0.03 0.04 0.05 0.06
Manganese	To 0.60 incl Over 0.60 to 1.15 incl Over 1.15 to 1.65 incl	0.03 0.04 0.05	0.03 0.04 0.05
Phosphorus	—	—	0.01
Sulfur	—	—	0.01
Silicon	To 0.30 incl Over 0.30 to 0.60	0.02 0.05	0.03 0.05
Copper	Under min only for Copper bearing steels	0.02	—
Lead <sup>a</sup>	0.15 to 0.35 incl	0.03	0.03

<sup>a</sup> Product analysis tolerance for lead applies both over and under a range of 0.15–0.35% lead.

TABLE 3—PERMISSIBLE VARIATIONS FROM SPECIFIED CHEMICAL RANGES AND LIMITS FOR ALLOY STEELS

Element	Limit or Max of Specified Range, %	Variation, %, Over Max Limit or Under Min Limit				Plates
		Bars, Sheets, Strip and Semifinished Products to 100 in <sup>2</sup> (0.065 m <sup>2</sup> ) incl	Semifinished Products			
			Over 100 to 200 in <sup>2</sup> (0.065 to 0.129 m <sup>2</sup> ) incl	Over 200 to 400 in <sup>2</sup> (0.129 to 0.258 m <sup>2</sup> ) incl	Over 400 to 800 in <sup>2</sup> (0.258 to 0.516 m <sup>2</sup> ) incl	
Carbon	To 0.30 incl	0.01	0.02	0.03	0.04	0.02
	Over 0.30 to 0.75 incl	0.02	0.03	0.04	0.05	0.03
	Over 0.75	0.03	0.04	0.05	0.06	0.04
Manganese	To 0.90 incl	0.03	0.04	0.05	0.06	0.04
	Over 0.90 to 2.10 incl	0.04	0.05	0.06	0.07	0.05
Phosphorus	Over max only	0.005	0.010	0.010	0.010	0.010
Sulfur	To 0.060 incl <sup>a</sup>	0.005	0.010	0.010	0.010	0.010
Silicon	To 0.40 incl	0.02	0.02	0.03	0.04	0.02
	Over 0.40 to 2.20 incl	0.05	0.06	0.06	0.07	0.06
Nickel	To 1.00 incl	0.03	0.03	0.03	0.03	0.03
	Over 1.00 to 2.00 incl	0.05	0.05	0.05	0.05	0.05
	Over 2.00 to 5.30 incl	0.07	0.07	0.07	0.07	0.07
	Over 5.30 to 10.00 incl	0.10	0.10	0.10	0.10	0.10
Chromium	To 0.90 incl	0.03	0.04	0.04	0.05	0.04
	Over 0.90 to 2.10 incl	0.05	0.06	0.06	0.07	0.06
	Over 2.10 to 3.99	0.10	0.10	0.12	0.14	0.10
Molybdenum	To 0.20 incl	0.01	0.01	0.02	0.03	0.01
	Over 0.20 to 0.40 incl	0.02	0.03	0.03	0.04	0.03
	Over 0.40 to 1.15 incl	0.03	0.04	0.05	0.06	0.04
Tungsten	To 1.00 incl	0.04	0.05	0.05	0.06	0.05
	Over 1.00 to 4.00 incl	0.08	0.09	0.10	0.12	0.09
Vanadium	To 0.10 incl	0.01	0.01	0.01	0.01	0.01
	Over 0.10 to 0.25 incl	0.02	0.02	0.02	0.02	0.02
	Over 0.25 to 0.50 incl	0.03	0.03	0.03	0.03	0.03
	Min value specified check under min limit	0.01	0.01	0.01	0.01	0.01
Aluminum <sup>b</sup>	Up to 0.10 incl	0.03	—	—	—	0.03
	Over 0.10 to 0.20 incl	0.04	—	—	—	0.04
	Over 0.20 to 0.30 incl	0.05	—	—	—	0.05
	Over 0.30 to 0.80 incl	0.07	—	—	—	0.07
	Over 0.80 to 1.80 incl	0.10	—	—	—	0.10
Lead <sup>b</sup>	0.15 to 0.35 incl	0.03 <sup>c</sup>	—	—	—	0.03 <sup>c</sup>
Copper <sup>b</sup>	To 1.00 incl	0.03	—	—	—	0.03
	Over 1.00 to 2.00 incl	0.05	—	—	—	0.05

<sup>a</sup> Sulfur over 0.060% is not subject to check analysis.

<sup>b</sup> Tolerances shown apply only to 100 in<sup>2</sup> or less and to all plates.

<sup>c</sup> Tolerance is over and under.