LAND SEA AIR SPACE

AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AMS 2259A
Superseding AMS 2259

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CHEMICAL CHECK ANALYSIS LIMITS
Wrought Low-Alloy and Carbon Steels

1. SCOPE: This specification covers standard chemical check analysis limits as established by AMS or AISI usage. The chemical check analysis limits shown herein shall apply when this specification is referenced in the material specification. Check analysis limits for elements or for ranges of elements not listed herein shall be as agreed upon by purchaser and vendor.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, Pennsylvania 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

ASTM E59 - Sampling Steel, Cast Iron, Open Hearth Iron, and Wrought Iron for Determination of Chemical Composition
ASTM E350 - Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

2.3 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

3. TECHNICAL REQUIREMENTS:

3.1 Analytical Procedures: Reference methods of analysis shall be in accordance with ASTM E350, by spectrographic methods in accordance with Federal Test Method Standard No. 151, or by methods ø approved by The National Bureau of Standards. Procedures for elements not covered shall be as agreed upon by purchaser and vendor.

3.2 Definitions:

3.2.1 Check Analysis: An analysis made by purchaser after the steel has been worked into semi-finished or finished forms or fabricated into parts, and is either for the purpose of verifying the composition of a heat or lot or to determine variations in the composition within a heat. Acceptance or rejection of a heat or lot of material or batch of parts may be made by the purchaser on the basis of this check analysis. In the analysis of finished parts, these values do not apply to elements whose percentage can be varied by fabricating techniques employed (for example carbon in steel) unless the sample is taken in such a manner as to exclude such changes.

3.2.2 Variation Limit, Under Min or Over Max: Given in 3.3 is the amount an individual determination for a specified element may vary under or over the specified composition limit. In no case shall the several determinations of any element (except lead) in a heat, using the same analytical procedure, vary both ø and below the specified range. Lead may vary both above and below the specified range. These variations are not permitted for ladle or ingot analyses made by the producer. Dimensional sizes shown in paragraph titles or text or in column headings refer to the cross-sectional area of the product being analyzed.

3.2.3 Remainder: Shows the basic element from which the alloy is made and is assumed to be present in an amount approximately equal to the difference between 100% and the sum percentage of the alloying elements and listed impurities. Analysis for this element need not be made nor need a percentage figure be reported.

3.2.4 Other Impurities (Elements), Each, Max: The maximum amount of an individual element not mentioned specifically in the tabulated composition that may be present. Producer normally will analyze only for impurities which are possible to be present because of raw materials or manufacturing processes and which may affect the product significantly. Others will analyze for impurities as they deem necessary.

3.2.5 Other Impurities (Elements), Total, Max: The sum percentage of the impurities (elements) (See 3.2.4) found. It is not inferred by this statement that an analysis need be made for each element of the periodic table not mentioned specifically in the composition section.

3.3 Check Analysis Limits: Shall be as follows:

3.3.1 Carbon Steels: Variations for carbon, phosphorus, and sulfur do not apply to rimmed or capped steels; ø variations for phosphorus and sulfur do not apply to rephosphorized or resulfurized steels; boron is not subject to check analysis.

3.3.1.1 Bars, Forgings, Wire, Seamless Tubing, and Stock for Forging or Heading: Applicable to product ø up to 100 sq in. (645 cm^2), incl, in section area:

Element	Limit or Maximum of Specified Range, %	Variation, % Under Min or Over Max
Carbon	Up to 0.25, incl	0.02
	Over 0.25 to 0.55, incl	0.03
	Over 0.55	0.04
Manganese	Up to 0.90, incl	0.03
	Over 0.90 to 1.65, incl	0.06
Silicon	Up to 0.35, incl	0.02
	Over 0.35 to 0.60, incl	0.05
Phosphorus	Up to 0.040, incl	0.008 (3.3.1.1.1)
Sulfur	Up to 0.050, incl	0.008 (3.3.1.1.1)
Copper	All	0.02 (3.3.1.1.2)
Lead	0.15 to 0.35, incl	0.03 (3.2.2)

3.3.1.1.1 Variation applicable only to over maximum.

3.3.1.1.2 Variation applicable only to under minimum for copper bearing steels.

3.3.1.2 Forging Stock Over 100 Sq In. (645 cm^2) in Section Area:

Ø Element	Limit or Maximum of Specified Range, %	Variation, % Under Min or Over Max: Over 100 to 200 sq in., incl (Over 645 to 1290 cm^2, incl)	Over 200 to 400 sq in., incl (Over 1290 to 2580 cm^2, incl)	Over 400 to 800 sq in., incl (Over 2580 to 5160 cm^2, incl)
Carbon	Up to 0.25, incl	0.03	0.04	0.05
	Over 0.25 to 0.55, incl	0.04	0.05	0.06
	Over 0.55	0.05	0.06	0.07
Manganese	Up to 0.90, incl	0.04	0.06	0.07
	Over 0.90 to 1.65, incl	0.06	0.07	0.08
Silicon (3.3.1.2.1)	Up to 0.35, incl	0.02	0.03	0.04
	Over 0.35 to 0.60, incl	--	--	--
Phosphorus (3.3.1.1.1)	Up to 0.040, incl	0.008	0.010	0.015
Sulfur (3.3.1.1.1)	Up to 0.050, incl	0.010	0.010	0.015
Copper (3.3.1.1.2, 3.3.1.2.1)	All	0.03	--	--
Lead (3.2.2, 3.3.1.2.1)	0.15 to 0.35, incl	0.03	--	--

3.3.1.2.1 Where no tolerance is shown, limits have not been established, and shall be subject to agreement between purchaser and vendor.

3.3.1.3 Sheet, Strip, Plate, and Welded Tubing:

Ø Element	Limit or Maximum of Specified Range, %	Variation, % Under Min	Over Max
Carbon	Up to 0.15, incl	0.02	0.03
	Over 0.15 to 0.40, incl	0.03	0.04
	Over 0.40 to 0.80, incl	0.03	0.05
	Over 0.80	0.03	0.06
Manganese	Up to 0.60, incl	0.03	0.03
	Over 0.60 to 1.15, incl	0.04	0.04
	Over 1.15 to 1.65, incl	0.05	0.05
Silicon	Up to 0.30, incl	0.02	0.03
	Over 0.30 to 0.60, incl	0.05	0.05
Phosphorus	All	--	0.01
Sulfur	All	--	0.01
Copper	All	0.02	--

3.3.2 Low-Alloy Steels:

3.3.2.1 Product Up to 100 Sq In. (645 cm^2), Incl, in Section Area, Except Plate:

	Element	Limit or Maximum of Specified Range, %	Variation, % Under Min or Over Max
	Carbon	Up to 0.30, incl	0.01
		Over 0.30 to 0.75, incl	0.02
		Over 0.75	0.03
	Manganese	Up to 0.90, incl	0.03
		Over 0.90 to 2.10, incl	0.04
Ø	Silicon	Up to 0.40, incl	0.02
		Over 0.40 to 2.20, incl	0.05
	Phosphorus	All	0.005 (3.3.2.1.1)
	Sulfur	Up to 0.060, incl	0.005 (3.3.2.1.1)
	Chromium	Up to 0.90, incl	0.03
		Over 0.90 to 2.10, incl	0.05
		Over 2.10 to 10.00, incl	0.10
Ø	Nickel	Up to 1.00, incl	0.03
		Over 1.00 to 2.00, incl	0.05
		Over 2.00 to 5.30, incl	0.07
		Over 5.30 to 10.00, incl	0.10
		Over 10.00 to 20.00, incl	0.15
Ø	Cobalt	Up to 1.00, incl	0.03
		Over 1.00 to 5.00, incl	0.05
		Over 5.00 to 10.00, incl	0.10
Ø	Molybdenum	Up to 0.20, incl	0.01
		Over 0.20 to 0.40, incl	0.02
		Over 0.40 to 1.15, incl	0.03
		Over 1.15 to 2.50, incl	0.05
		Over 2.50 to 5.00, incl	0.10
	Tungsten	Up to 1.00, incl	0.04
		Over 1.00 to 4.00, incl	0.08
	Aluminum	Up to 0.10, incl	0.03
		Over 0.10 to 0.20, incl	0.04
		Over 0.20 to 0.30, incl	0.05
		Over 0.30 to 0.80, incl	0.07
		Over 0.80 to 1.80, incl	0.10
	Vanadium (3.3.2.1.2)	Up to 0.10, incl	0.01
		Over 0.10 to 0.25, incl	0.02
		Over 0.25 to 0.50, incl	0.03
		Over 0.50 to 1.10, incl	0.04

Element	Limit or Maximum of Specified Range, %	Variation, % Under Min or Over Max
Ø Copper	Up to 1.00, incl	0.03
	Over 1.00 to 2.00, incl	0.05
Zirconium	Up to 0.50, incl	0.02
Ø Lead	0.15 to 0.35, incl	0.03 (3.2.2)

3.3.2.1.1 Variation applies only to over maximum.

3.3.2.1.2 If a minimum value is specified, check analysis limit is 0.01 under min for all ranges in all sizes and the tabulated limit applies only over maximum.

Ø 3.3.2.1.3 Boron is not subject to check analysis tolerances.

3.3.2.2 Semifinished Product Over 100 Sq In. (645 cm^2) in Section Area, and Plate:

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Element	Limit or Maximum of Specified Range, %	Variation, % Under Min or Over Max		
		Over 100 to 200 sq in., incl (Over 645 to 1290 cm^2, incl) and All Plate	Over 200 to 400 sq in., incl (Over 1290 to 2580 cm^2, incl)	Over 400 to 800 sq in., incl (Over 2580 to 5160 cm^2, incl)
Carbon	Up to 0.30, incl	0.02	0.03	0.04
	Over 0.30 to 0.75, incl	0.03	0.04	0.05
	Over 0.75	0.04	0.05	0.06
Manganese	Up to 0.90, incl	0.04	0.05	0.06
	Over 0.90 to 2.10, incl	0.05	0.06	0.07
Silicon	Up to 0.40, incl	0.02	0.03	0.04
	Over 0.40 to 2.20, incl	0.06	0.06	0.07
Phosphorus	All	0.010	0.010	0.010
Sulfur	Up to 0.040, incl	0.010	0.010	0.010
Chromium	Up to 0.90, incl	0.04	0.04	0.05
	Over 0.90 to 2.10, incl	0.06	0.06	0.07
	Over 2.10 to 10.00, incl	0.10	0.12	0.14
Nickel	Up to 1.00, incl	0.03	0.03	0.03
	Over 1.00 to 2.00, incl	0.05	0.05	0.05
	Over 2.00 to 5.30, incl	0.07	0.07	0.07
	Over 5.30 to 10.00, incl	0.10	0.10	0.10
	Over 10.00 to 20.00, incl	0.15	0.15	0.15
Cobalt	Up to 1.00, incl	0.03	0.03	0.03
	Over 1.00 to 5.00, incl	0.05	0.05	0.05
	Over 5.00 to 10.00, incl	0.10	0.10	0.10