SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS2259 | REV. E

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Superseding AMS2259D

Chemical Check Analysis Limits Wrought Low-Alloy and Carbon Steels

RATIONALE

AMS2259E has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE

1.1 Purpose

This specification defines limits of variation for determining acceptability of the composition of wrought low-alloy and carbon steel parts and material acquired from a producer.

1.1.1 Check analysis limits for elements or for ranges of elements not listed herein shall be as specified in the applicable material specification or as agreed upon by purchaser and vendor.

1.2 Application

When specifically referenced in the material specification, the purchaser may apply check analysis limits to determine the acceptability of parts and materials at purchaser's final acceptance test or verification test operation. Use of check analysis limits is not permitted for ladle or ingot analyses, or for other acceptance testing by the producer.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM E 1806 Sampling Steel and Iron for Determination of Chemical Composition

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

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http://www.sae.org/technical/standards/AMS2259E

3. TECHNICAL REQUIREMENTS

3.1 Analytical Procedures

Referee analysis shall be by any method acceptable to purchaser and vendor.

3.2 Definitions

3.2.1 Check (Product or Verification) Analysis

Analysis made by purchaser of parts or materials to verify the composition of a heat or lot or to determine variations in the composition within a heat or lot. Acceptance or rejection of a heat or lot of material or batch of parts may be made by applying variation limits as described in 3.2.2. In the analysis of finished parts, limits 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 variations.

3.2.2 Variation Limit, Under Minimum or Over Maximum

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 reported determinations of any element (except lead) in a heat, using the same analytical procedure, vary both above and below the specified range. Lead may vary both above and below the specified range. 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 basis 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 and reporting of the basis element are not required.

3.2.4 Residual Elements, Each, Maximum

The maximum amount of an individual element not mentioned specifically in the specified composition that may be present. Producer normally will analyze only for elements 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 Residual Elements, Total, Maximum

The sum percentage of the residual 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 Variation Limits

3.3.1 Carbon Steels

Variations for carbon, phosphorus, and sulfur do not apply to rimmed or capped steels. Variations for phosphorous and sulfur do not apply to rephosphorized or resulfurized steels. Boron is not subject to check analysis variation limits.

3.3.1.1 Bars, Forgings, Wire, Seamless Tubing, and Stock for Forging or Heading

For product up to 100 square inches (645 cm^2), inclusive in section area, check analysis variation limits shall be as shown in Table 1.

TABLE 1 - CHECK ANALYSIS VARIATION LIMITS FOR CARBON STEEL BARS, FORGINGS, WIRE, SEAMLESS TUBING, AND STOCK UP TO 100 SQUARE INCH SECTION AREA

Element	Limit or Maximum of Specified Range, %	Variation Limit, % 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 Square Inches (645 cm^2) in Section Area

Check analysis variation limits shall be as shown in Table 2.

TABLE 2 - CHECK ANALYSIS VARIATION LIMITS FOR CARBON STEEL FORGING STOCK OVER 100 SQUARE INCH SECTION AREA

Element	Limit or Maximum of Specified Range, %	Variation, % Section Over 100 to 200 Square Inches (over 645 to 1290 cm^2), Incl	Variation, % Section Over 200 to 400 Square Inches (over 1290 to 2581 cm^2), Incl	Variation, % Section Over 400 to 800 Square Inches (over 2581 to 5161 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 variation limit 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

Check analysis variation limits shall be as shown in Table 3.

TABLE 3 - CHECK ANALYSIS VARIATION LIMITS FOR CARBON STEEL SHEET, STRIP, PLATE, AND WELDED TUBING

Element	Limit or Maximum of Specified Range, %	Variation, % Under Min	Variation, % 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 0.65, 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 Square Inches (645 cm^2), Inclusive, in Section Area, Except Plate

Check analysis variation limits shall be as shown in Table 4.

TABLE 4 - CHECK ANALYSIS VARIATION LIMITS FOR LOW-ALLOY STEEL PRODUCT UP TO 100 SQUARE INCHES (645 cm^2) SECTION AREA

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
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
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
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
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

TABLE 4 - CHECK ANALYSIS VARIATION LIMITS FOR LOW-ALLOY STEEL PRODUCT UP TO 100 SQUARE INCHES (645 cm^2) SECTION AREA (CON'T.)

Element	Limit or Maximum of Specified Range, %	Variation, % Under Min or Over Max
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
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
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 variation limit is 0.01 under minimum for all ranges in all sizes and the tabulated limit applies only over maximum.

3.3.2.1.3 Boron is not subject to check analysis variation limits.

3.3.2.2 Semifinished Product Over 100 Square Inches (645 cm^2) in Section Area, and Plate

Check analysis variation limits shall be as shown in Table 5.

TABLE 5 - CHECK ANALYSIS VARIATION LIMITS FOR LOW-ALLOY STEEL SEMIFINISHED PRODUCT OVER 100 SQUARE INCH (645 cm^2) SECTION AREA, AND PLATE

Element	Limit or Maximum of Specified Range, %	Variation, % Section Over 100 to 200 Square Inches (over 645 to 1290 cm^2), Incl and All Plate	Variation, % Section Over 200 to 400 Square Inches (over 1290 to 2581 cm^2), Incl	Variation, % Section Over 400 to 800 Square Inches (over 2581 to 5161 cm^2), Incl
Carbon	Up to 0.30, incl	0.03	0.04	0.05
	Over 0.30 to 0.75, incl	0.04	0.05	0.06
	Over 0.75	0.05	0.06	0.07
Manganese	Up to 0.90, incl	0.04	0.06	0.07
	Over 0.90 to 2.10, incl	0.06	0.07	0.08
Silicon	Up to 0.40, incl	0.02	0.03	0.04
	Over 0.40 to 2.20, incl	--	--	--
Phosphorus	All	0.008	0.010	0.015
Sulfur	Up to 0.040, incl	0.010	0.010	0.015
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
Molybdenum	Up to 0.20, incl	0.01	0.02	0.03
	Over 0.20 to 0.40, incl	0.03	0.03	0.04
	Over 0.40 to 1.15, incl	0.04	0.05	0.06
	Over 1.15 to 2.50, incl	0.06	0.07	0.08
	Over 2.50 to 5.00, incl	0.11	0.12	0.13