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INTERNATIONAL
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 2249E

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Superseding AMS 2249D

Submitted for recognition as an American National Standard

(R)

Chemical Check Analysis Limits Titanium and Titanium Alloys

1. SCOPE:

This specification covers standard chemical check analysis limits as established by AMS usage. The chemical check analysis limits shown herein shall apply when this specification is referenced in material specifications for titanium and titanium alloys. 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 applicable issue of referenced publications shall be the issue in effect on the date of the purchase order.

2.1 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 59	Sampling Steel and Iron for Determination of Chemical Composition
ASTM E 120	Chemical Analysis of Titanium and Titanium Alloys
ASTM E 1409	Determination of Oxygen in Titanium and Titanium Alloys by the Inert Gas Fusion Technique
ASTM E 1447	Determination of Hydrogen in Titanium and Titanium Alloys by the Inert Gas Fusion Thermal Conductivity Method

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3. TECHNICAL REQUIREMENTS:

3.1 Composition:

Referee methods of analysis shall be by wet chemical methods in accordance with ASTM E 120, ASTM E 1409 for oxygen and ASTM E 1447, for hydrogen, and other elements by spectrochemical methods, or by other analytical methods acceptable to purchaser.

3.2 Definitions:

3.2.1 Check Analysis: An analysis made by purchaser or vendor of the metal after it 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 the 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 oxygen, nitrogen, hydrogen) unless the sample is sufficiently large to produce a reliable result.

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 several determinations of any element in a heat, using the same analytical procedure, vary both above and below the specified range. These variations are not permitted for ingot analyses made by the producer.

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 this element need not be made nor need a percentage figure be reported.

3.2.4 Residual Elements, Each, Maximum: 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 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 tabulated composition.

3.2.6 Heat: All metal which, during the final melting operation, is melted in the same furnace crucible and solidified in the same ingot mold.

3.2.7 Lot: All product of the same size processed at the same time from the same heat.

3.3 Check Analysis Limits:

Shall be as shown in Table 1.

TABLE 1 - Check Analysis Limits

Element	Limits or Maximum of Specified Range, %	Variation Under Min or Over Max
Carbon	Up to 0.20, incl	0.02
	Over 0.20 to 0.50, incl	0.04
	Over 0.50	0.06
Manganese	Up to 0.30, incl	0.10
	Over 0.30 to 6.00, incl	0.20
	Over 6.00 to 9.00, incl	0.25
Chromium	Up to 1.00, incl	0.05
	Over 1.00 to 4.00, incl	0.20
	Over 4.00	0.25
Molybdenum	Up to 0.50, incl	0.04
	Over 0.50 to 1.00, incl	0.10
	Over 1.00 to 10.00, incl	0.20
	Over 10.00 to 30.00, incl	0.25
Aluminum	Up to 1.00, incl	0.12
	Over 1.00 to 10.00, incl	0.40
	Over 10.00 to 30.00, incl	0.50
Hydrogen	Up to 0.020 (200 ppm), incl	0.0020 (20 ppm)
	Over 0.020 to 0.050 (200 to 500 ppm), incl	0.005 (50 ppm)
	Over 0.050 (500 ppm)	0.010 (100 ppm)
Nitrogen	Up to 0.10 (1000 ppm), incl	0.02 (200 ppm)
Oxygen	Up to 0.20 (2000 ppm), incl	0.02 (200 ppm)
	Over 0.20 (2000 ppm)	0.03 (300 ppm)
Iron	Up to 0.25, incl	0.10
	Over 0.25 to 0.50, incl	0.15
	Over 0.50 to 5.00, incl	0.20
	Over 5.00	0.25
Vanadium	Up to 0.50, incl	0.05
	Over 0.50 to 5.00, incl	0.15
	Over 5.00 to 6.00, incl	0.20
	Over 6.00 to 10.00, incl	0.30
	Over 10.00 to 20.00, incl	0.40
Tin	Up to 3.00, incl	0.15
	Over 3.00 to 6.00, incl	0.25
	Over 6.00 to 12.00, incl	0.40
Copper	Up to 1.00, incl	0.05
	Over 1.00 to 3.00, incl	0.10

TABLE 1 - Check Analysis Limits (Continued)

Element	Limits or Maximum of Specified Range, %	Variation Under Min or Over Max
Zirconium	Up to 4.00, incl	0.10
	Over 4.00 to 6.00, incl	0.20
	Over 6.00 to 10.00, incl	0.30
	Over 10.00	0.40
Columbium	Up to 1.00, incl	0.10
	Over 1.00 to 5.00, incl	0.15
	Over 5.00 to 7.00, incl	0.20
	Over 7.00 to 10.00, incl	0.25
	Over 10.00 to 15.00, incl	0.30
	Over 15.00 to 20.00, incl	0.35
	Over 20.00 to 30.00, incl	0.40
Tantalum	Up to 0.50, incl	0.10
	Over 0.50 to 2.00, incl	0.15
Silicon	Up to 0.10, incl	0.02
	Over 0.10 to 0.50, incl	0.05
Bismuth	Up to 0.50, incl	0.05
Yttrium	Up to 0.005, incl	0.0006
	Over 0.005 to 0.020, incl	0.001
Boron	Up to 0.005, incl	0.0006
Palladium	Up to 0.250, incl	0.02
Nickel	Up to 1.00, incl	0.03
Tungsten	Up to 1.00, incl	0.04
	Over 1.00 to 3.00, incl	0.10
	Over 3.00 to 5.00, incl	0.15
	Over 5.00 to 10.00, incl	0.20

4. QUALITY ASSURANCE PROVISIONS:

4.1 Sampling and Testing:

For the purpose of determining conformance to the material specification composition requirement, each heat or lot, whichever is applicable, in the shipment shall be considered separately. All samples shall be taken from material in the condition in which it is received, except that all protective surface treatments shall be removed before sampling finished parts. Drillings, chips, and other samples shall be taken without the application of water, oil, or other lubricants and shall be free from scale, grease, dirt, and other foreign materials. Samples shall be taken to prevent alteration of the chemical composition of the sample. Sampling shall be in accordance with ASTM E 59, insofar as practicable.