SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 2249F

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Superseding AMS 2249E

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 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, 100 Barr Harbor Drive, P. O. Box C700, West Conshohocken, PA 19428-2959 or www.astm.org.

ASTM E 59	Sampling Steel and Iron for Determination of Chenical Composition
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
ASTM E 1937	Standard Test Method for Determination of Nitrogen in Titanium and Titanium Alloys by the Inert Gas Fusion Technique
ASTM E 1941	Standard Test Method for Determination of Carbon in Refractory and Reactive Metals and Their Alloys
ASTM E 2371	Standard Test Method for Analysis of Titanium and Titanium Alloys by Atomic Emission Plasma Spectrometry

TO PLACE A DOCUMENT ORDER:
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3. TECHNICAL REQUIREMENTS:

3.1 Composition:

Referee methods of analysis shall be ASTM E 1409 for oxygen, ASTM E 1447 for hydrogen, ASTM E 1941 for carbon, and ASTM E 1937 for nitrogen. Other elements shall be determined by ASTM E 2371.

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.

5. PREPARATION FOR DELIVERY:

Not applicable.