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400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 2269C
Superseding AMS 2269B
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CHEMICAL CHECK ANALYSIS LIMITS
Wrought Nickel Alloys and Cobalt Alloys

1. SCOPE: This specification covers chemical check analysis limits for wrought nickel alloys and cobalt alloys having nominal compositions made up of elements, other than iron, that comprise more than 50% of the total. 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 specified in the applicable material specification or 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, PA 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, PA 19103.

ASTM E38 - Chemical Analysis of Nickel-Chromium and Nickel-Chromium-Iron Alloys
ASTM E39 - Chemical Analysis of Nickel
ASTM E55 - Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition
ASTM E76 - Chemical Analysis of Nickel-Copper Alloys
ASTM E354 - Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys

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

2.3.1 Federal Standards:

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

3. TECHNICAL REQUIREMENTS:

3.1 Analytical Procedures: Referee methods of analysis shall be in accordance with ASTM E38, ASTM E39, ASTM E76, or ASTM E354, as applicable, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by methods developed by the National Bureau of Standards. Procedures for elements not covered by the above test procedures shall be as agreed upon by purchaser and vendor.

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 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 analysis.

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 in a heat, using the same analytical procedure, vary both above and below the specified range. These variations are not permitted for ladle, ingot, or product 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. It need not be analyzed 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 specified 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 3.1.4) 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 Limits:

Element	Limit or Maximum of Specified Element, %	Variation Under Min or Over Max
Carbon	Up to 0.02, incl	0.005
	Over 0.02 to 0.20, incl	0.01
	Over 0.20 to 0.60, incl	0.02
	Over 0.60 to 1.00, incl	0.03
Manganese	Up to 1.00, incl	0.03
	Over 1.00 to 3.00, incl	0.04
	Over 3.00 to 6.00, incl	0.07
	Over 6.00 to 10.00, incl	0.10
Silicon	Up to 0.05, incl	0.01
	Over 0.05 to 0.25, incl	0.02
	Over 0.25 to 0.50, incl	0.03
	Over 0.50 to 1.00, incl	0.05
	Over 1.00 to 4.50, incl	0.10
Phosphorus	Up to 0.04, incl	0.005
Sulfur	Up to 0.02, incl	0.003
	Over 0.02 to 0.06, incl	0.005

3.3 (Continued)

Element	Limit or Maximum of Specified Element, %	Variation Under Min or Over Max
Chromium	Up to 5.00, incl	0.10
	Over 5.00 to 15.00, incl	0.15
	Over 15.00 to 25.00, incl	0.25
	Over 25.00 to 35.00, incl	0.30
	Over 35.00 to 45.00, incl	0.40
	Over 45.00 to 50.00, incl	0.50
Nickel	Up to 1.00, incl	0.05
	Over 1.00 to 5.00, incl	0.10
	Over 5.00 to 10.00, incl	0.15
	Over 10.00 to 20.00, incl	0.20
	Over 20.00 to 30.00, incl	0.25
	Over 30.00 to 40.00, incl	0.30
	Over 40.00 to 60.00, incl	0.35
	Over 60.00 to 80.00, incl	0.45
	Over 80.00 to 99.00, incl	0.60
Cobalt	Up to 0.10, incl	0.01
	Over 0.10 to 0.20, incl	0.02
	Over 0.20 to 1.00, incl	0.03
	Over 1.00 to 5.00, incl	0.05
	Over 5.00 to 10.00, incl	0.10
	Over 10.00 to 15.00, incl	0.15
	Over 15.00 to 20.00, incl	0.20
	Over 20.00 to 25.00, incl	0.25
	Over 25.00 to 30.00, incl	0.30
	Over 30.00 to 35.00, incl	0.35
	Over 35.00 to 50.00, incl	0.50
Molybdenum	Up to 1.00, incl	0.03
	Over 1.00 to 3.00, incl	0.05
	Over 3.00 to 5.00, incl	0.10
	Over 5.00 to 20.00, incl	0.15
	Over 20.00 to 30.00, incl	0.25
Tungsten ø	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
	Over 10.00 to 20.00, incl	0.25
Columbium + Tantalum	Up to 1.50, incl	0.05
	Over 1.50 to 3.00, incl	0.10
	Over 3.00 to 5.00, incl	0.15
	Over 5.00 to 7.00, incl	0.20
	Over 7.00 to 10.00, incl	0.25

3.3 (Continued)

Element	Limit or Maximum of Specified Element, %	Variation Under Min or Over Max
Titanium	Up to 0.10, incl	0.02
	Over 0.10 to 0.50, incl	0.03
	Over 0.50 to 1.00, incl	0.04
	Over 1.00 to 2.00, incl	0.05
	Over 2.00 to 3.50, incl	0.07
	Over 3.50 to 5.00, incl	0.10
	Over 5.00 to 10.00, incl	0.20
Aluminum	Up to 0.10, incl	0.02
	Over 0.10 to 0.50, incl	0.05
	Over 0.50 to 2.00, incl	0.10
	Over 2.00 to 5.00, incl	0.20
	Over 5.00 to 10.00, incl	0.25
	Over 10.00 to 15.00, incl	0.30
Boron	Up to 0.01, incl	0.002
	Over 0.01 to 0.05, incl	0.005 (See 3.3.1)
	Over 0.05 to 0.15, incl	0.01
Iron	Up to 0.20, incl	0.02
	Over 0.20 to 0.75, incl	0.03
	Over 0.75 to 2.50, incl	0.05
	Over 2.50 to 5.00, incl	0.07
	Over 5.00 to 10.00, incl	0.10
	Over 10.00 to 15.00, incl	0.15
	Over 15.00 to 30.00, incl	0.30
	Over 30.00 to 50.00, incl	0.45
Copper	Up to 0.20, incl	0.02
	Over 0.20 to 0.50, incl	0.03
	Over 0.50 to 5.00, incl	0.04
	Over 5.00 to 10.00, incl	0.05
	Over 10.00 to 20.00, incl	0.10
	Over 20.00 to 30.00, incl	0.15
	Over 30.00 to 40.00, incl	0.20
	Over 40.00 to 50.00, incl	0.25
	Over 50.00 to 60.00, incl	0.30
	Over 60.00 to 70.00, incl	0.35
	Over 70.00 to 80.00, incl	0.40
Vanadium	Up to 0.50, incl	0.04 (See 3.3.2)
	Over 0.50 to 1.50, incl	0.05
Zirconium	Up to 0.10, incl	0.01
	Over 0.10 to 0.20, incl	0.02
Ø Lanthanum	Up to 0.20, incl	0.01

3.3.1 Variation under min is 0.002.

3.3.2 Over max only.