

AEROSPACE MATERIAL SPECIFICATION

SAE AMS5223

REV. F

Issued	1952-11
Revised	2002-01
Reaffirmed	2012-02
Superseding AMS5223E	

Iron-Nickel Alloy, Strip
49Fe - 5.3Cr - 42Ni - 2.5Ti - 0.55Al
Solution Heat Treated, Cold Rolled, 10% Reduction
(Composition similar to UNS N09902)

RATIONALE

AMS5223F has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE:

1.1 Form:

This specification covers an iron-nickel alloy in the form of strip.

1.2 Application:

This strip has been used typically for diaphragms, leaf springs, and helical springs, requiring a precipitation-hardenable alloy with a coefficient of modulus of elasticity of -20 to $+20 \times 10^{-6}$ per degree Fahrenheit from -50 to $+150$ °F (-36 to $+36 \times 10^{-6}$ per degree Celsius from -46 to $+66$ °C) after suitable heat treatment, but usage is not limited to such applications.

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 canceled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

AMS 2242	Tolerances, Corrosion and Heat-Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Sheet, Strip, and Plate
MAM 2242	Tolerances, Metric, Corrosion and Heat-Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Sheet, Strip, and Plate
AMS 2248	Chemical Check Analysis Limits, Corrosion and Heat-Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys

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on this Technical Report, please visit
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SAE WEB ADDRESS:

2.1 (Continued):

AMS 2371	Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steels and Alloys, Wrought Products and Forging Stock
AMS 2750	Pyrometry
AMS 2807	Identification, Carbon and Low-Alloy Steels, Corrosion and Heat-Resistant Steels and Alloys, Sheet, Strip, Plate, and Aircraft Tubing
AS4194	Sheet and Strip Surface Finish Nomenclature

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or www.astm.org.

ASTM A 480/A 480M	Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM E 8	Tension Testing of Metallic Materials
ASTM E 8M	Tension Testing of Metallic Materials (Metric)
ASTM E 18	Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E 112	Determining Average Grain Size
ASTM E 354	Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys
ASTM E 384	Microindentation Hardness of Materials

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 354, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

Element	min	max
Carbon	—	0.06
Manganese	—	0.80
Silicon	—	1.00
Phosphorus	—	0.04
Sulfur	—	0.04
Chromium	4.90	5.75
Nickel	41.00	43.50
Titanium	2.20	2.75
Aluminum	0.30	0.80
Chromium + (Titanium - 4x Carbon)	7.10	8.10
Cobalt	—	1.00
Iron	remainder	

3.1.1 Check Analysis: Composition variations shall meet the applicable requirements of AMS 2248.

3.2 Condition:

Solution heat treated, descaled, cold rolled with approximately 10% reduction in thickness, and having a surface appearance comparable to No. 1 strip finish in accordance with ASTM A 480/A 480M and AS4194.

3.3 Heat Treatment:

Strip shall be solution heat treated by heating to $1750^{\circ}\text{F} \pm 25$ ($954^{\circ}\text{C} \pm 14$), holding at heat for a time commensurate with thickness, and cooling as required. Pyrometry shall be in accordance with AMS 2750.

3.4 Properties:

Strip shall conform to the following requirements:

3.4.1 As Solution Heat Treated:

3.4.1.1 Average Grain Size: Shall be ASTM No. 5 or finer, determined in accordance with ASTM E 112.

3.4.2 As Solution Heat Treated and Cold Rolled:

3.4.2.1 Tensile Properties: Shall be as shown in Table 2, determined in accordance with ASTM E 8 or ASTM E 8M; these requirements apply to strip 0.020 to 0.1874 inch (0.51 to 4.760 mm), inclusive, in nominal thickness:

TABLE 2 - Tensile Properties

Properties	Value
Tensile Strength	90 to 110 ksi (621 to 758 MPa)
Elongation in 2 inches (50.8 mm), min	15%

3.4.2.2 Hardness: Shall be 83 to 98 HRB, or equivalent (See 8.2), determined in accordance with ASTM E 18. For thin gages where superficial hardness testing is impractical, microhardness testing in accordance with ASTM E 384 may be used. Strip shall not be rejected on the basis of hardness if the tensile properties of 3.4.2.1 are acceptable, determined on specimens taken from the same sample as that with nonconforming hardness or from another sample with similar nonconforming hardness.

3.4.3 After Precipitation Heat Treatment: Strip 0.020 to 0.1874 inch (0.51 to 4.760 mm), inclusive, in nominal thickness shall conform to the following requirements after being precipitation heat treated by heating to $1300^{\circ}\text{F} \pm 15$ ($704^{\circ}\text{C} \pm 8$), holding at heat for 180 minutes ± 5 , and cooling at a rate equivalent to cooling in air:

3.4.3.1 Tensile Properties: Shall be as shown in Table 3, determined in accordance with ASTM E 8 or ASTM E 8M:

TABLE 3 - Minimum Tensile Properties

Property	Value
Tensile Strength	165 ksi (1138 MPa)
Yield Strength at 0.2% Offset	120 ksi (827 MPa)
Elongation in 2 Inches (50.8 mm)	10%

- 3.4.3.2 Hardness: Shall be 34 to 41 HRC, or equivalent (See 8.2), determined in accordance with ASTM E 18. For thin gages where superficial hardness testing is impractical, microhardness testing in accordance with ASTM E 384 may be used. Strip shall not be rejected on the basis of hardness if the tensile properties of 3.4.3.1 are acceptable, determined on specimens taken from the same sample as that with nonconforming hardness or from another sample with similar nonconforming hardness.

3.5 Quality:

Strip, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the strip.

3.6 Tolerances:

Shall conform to all applicable requirements of AMS 2242 or MAM 2242.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of the product shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the strip conforms to specified requirements.

4.2 Classification of Tests:

All technical requirements are acceptance tests and shall be performed on each heat or lot as applicable.

4.3 Sampling and Testing:

Shall be in accordance with AMS 2371.