SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS5221 | REV. E

Issued 1955-08
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Reaffirmed 2012-02

Superseding AMS5221D

Iron-Nickel Alloy Strip
49Fe - 5.3Cr - 42Ni - 2.5Ti - 0.55Al
Solution Heat Treated

UNS N09902

RATIONALE

AMS5221E 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 thermoelastic coefficient of -20 to +20 x 10^{-6} per degree Fahrenheit from -50 to +150 °F (-36 to +36 x 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.

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, Wrought Corrosion and Heat Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys
AMS 2371	Quality Assurance Sampling and Testing, Corrosion and Heat Resistant Steels and Alloys, Wrought Products and Forging Stock

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

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AMS5221E

2.1 (Continued):

AMS 2750	Pyrometry
AMS 2807	Identification, Carbon and Low-Alloy Steels, Corrosion and Heat Resistant Steels and Alloys, 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.

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
ASTM A 480/A 480M	General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

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

	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 - 4 x Carbon)	7.10	8.10
Iron	remainder	

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

3.2 Condition:

Solution heat treated and, unless solution heat treatment is performed in an atmosphere yielding a bright finish, descaled, and having a surface appearance comparable to a commercial corrosion resistant steel No. 1 strip finish in accordance with ASTM A 480/A 480M and AS4194.

3.3 Solution Heat Treatment:

Strip shall be solution heat treated by heating to 1750 °F ± 25 (954 °C ± 14), holding at heat for a time commensurate with section thickness but not more than 30 minutes, 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 Tensile Properties: Shall be as shown in Table 2, determined in accordance with ASTM E 8 or ASTM E 8M, on specimens as in 4.3.1 from strip 0.020 to 0.250 inch (0.51 to 6.35 mm), incl, in nominal thickness:

TABLE 2 - Tensile Properties as Solution Heat Treated

Properties	Value
Tensile Strength, maximum	95 ksi (655 MPa)
Elongation in 2 inches (50.8 mm), minimum	35%

3.4.1.2 Hardness: Shall be not higher than 80 HRB, or equivalent (See 8.2), determined in accordance with ASTM E 18. For thin gauges 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 requirement of 3.4.1.1 are acceptable, determined on specimens taken from the same sample as that with the nonconforming hardness or from another sample with similar nonconforming hardness.

3.4.1.3 Average Grain Size: Shall be ASTM No. 5 or finer, determined in accordance with ASTM E 112 (See 8.3).

3.4.2 After Precipitation Heat Treatment: Specimens as in 4.3.1 from strip 0.020 to 0.250 inch (0.51 to 6.35 mm), inclusive, in nominal thickness shall conform to the following requirements after being precipitation heat treated by heating to 1300 °F ± 15 (704 °C ± 8) (See 8.4), holding at heat for 180 minutes ± 5, and cooling at a rate equivalent to cooling in air.

3.4.2.1 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 After Precipitation Heat Treatment

Property	Value
Tensile Strength	150 ksi (1034 MPa)
Yield Strength at 0.2% Offset	90 ksi (621 MPa)
Elongation in 2 Inches (50.8 mm)	5%

3.4.2.2 Hardness: Shall be 27 to 35 HRC, or equivalent (See 8.2), determined in accordance with ASTM E 18. For thin gauges 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 property requirements of 3.4.2.1 are acceptable, determined on specimens taken from the same sample as that with the 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 strip shall supply all samples for vendor's tests and 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.