



AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AMS 7701A
Superseding AMS 7701

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MAGNETIC ALLOY SHEET AND STRIP Nickel-Iron Alloy Annealed

1. SCOPE:

- 1.1 Form: This specification covers two types of magnetic nickel-iron alloy in the form of sheet and strip.
- 1.2 Application: Primarily for parts used in magnetic circuits requiring high magnetic permeability at low flux densities after high temperature annealing in hydrogen.
- 1.3 Classification: The magnetic alloys covered by this specification are classified as follows:
- Type 1 - Nickel plus iron and other alloying elements, usually copper and chromium. Type 1 may be required for applications involving severe forming.
- Type 2 - Nickel plus iron and other alloying elements, usually copper and molybdenum.
- 1.3.1 Unless a specific type is specified, either type may be supplied.

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 2232 - Tolerances, Carbon Steel Sheet, Strip, and Plate
- AMS 2350 - Standards and Test Methods
- AMS 2371 - Quality Assurance Sampling of Corrosion and Heat Resistant Alloys, Wrought Products Except Forgings
- 2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.
- ASTM A596 - Direct Current Magnetic Properties of Materials Using Ring Test Procedures and the Ballistic Methods
- ASTM E18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
- 2.3 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.
- 2.3.1 Military Standards:
- MIL-STD-163 - Steel Mill Products, Preparation for Shipment and Storage

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3. TECHNICAL REQUIREMENTS:

- 3.1 Composition: Shall be an alloy containing approximately 80% nickel plus iron and other alloying elements (See 1.3) in such proportions as required to provide a product meeting the requirements of 3.3.
- 3.2 Condition: Hot rolled with or without subsequent cold reduction, annealed, and descaled, having a surface appearance comparable to a commercial corrosion-resistant steel No. 2D finish; standards for acceptance shall be as agreed upon by purchaser and vendor.
- 3.3 Properties: The product shall conform to the following requirements:
- 3.3.1 Hardness: Shall be not higher than 75 HRB or equivalent, determined in accordance with ASTM E18.
- 3.3.2 Magnetic Properties: Shall be as follows, determined in accordance with ASTM A596 on specimens annealed by heating to $2150^{\circ}\text{F} \pm 25$ ($1175^{\circ}\text{C} \pm 15$) in a dry hydrogen atmosphere having a dew point of -60°F (-50°C) or lower, holding at heat for $4 \text{ hr} \pm 0.25$, and cooling in a non-oxidizing atmosphere at a rate not greater than $100 \text{ F (56 C) deg per hr}$ to 1100°F (595°C) or lower or at a cooling rate recommended by the alloy producer.
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| 3.3.2.1 | Maximum permeability, min | 250,000 |
| 3.3.2.2 | Permeability at 100 gaussess, min | 70,000 |
| 3.3.2.3 | Induction at 100 oersteds, gaussess, min | 7,500 |
- 3.4 Quality: The product, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to usage of the product.
- 3.5 Tolerances: Unless otherwise specified, tolerances shall conform to all applicable requirements of AMS 2232.

4. QUALITY ASSURANCE PROVISIONS:

- 4.1 Responsibility for Inspection: The vendor of the product shall supply all samples and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to ensure that the product conforms to the requirements of this specification.
- 4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and shall be performed on each lot.
- 4.3 Sampling: Shall be in accordance with AMS 2371 and the following; a lot shall be all product of the same nominal thickness from the same heat of alloy:
- 4.3.1 Samples for magnetic properties testing shall, unless otherwise specified, be selected in accordance with one of the following methods; the sampling method used shall be reported with the test results:
- 4.3.1.1 A pilot sample nominally 0.014 in. (0.35 mm) thick from each heat of alloy.
- 4.3.1.2 A sample taken at random from finished product of the same nominal thickness from the same heat of alloy.
- 4.4 Reports:

- 4.4.1 The vendor of the product shall furnish with each shipment three copies of a report showing the method of sampling for magnetic tests, and the results of test for hardness of each lot and the magnetic properties of each heat. This report shall include the purchase order number, heat number, material specification number and its revision letter, cooling rate if other than 100 F (55 C) deg per hr, size, and quantity from each heat.
 - 4.4.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number and its revision letter, contractor or other direct supplier of material, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification, and shall include in the report a statement that the material conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.
 - 4.5 Resampling and Retesting: Shall be in accordance with AMS 2371.
 5. PREPARATION FOR DELIVERY:
 - 5.1 Identification: The product shall be identified as in 5.1.1 unless purchaser permits a method from 5.1.2.
 - 5.1.1 Each sheet and strip shall be marked on one face, in the respective location indicated below, with AMS 7701A, heat number, manufacturer's identification, and nominal thickness. The characters shall be of such size as to be clearly legible, shall be applied using a suitable marking fluid, and shall be removable in hot alkaline cleaning solution without rubbing. The markings shall have no deleterious effect on the product or its performance and shall be sufficiently stable to withstand normal handling.
 - 5.1.1.1 Flat Strip 6 In. (152 mm) and Under in Width: Shall be marked in one or more lengthwise rows of characters recurring at intervals not greater than 3 ft (914 mm).
 - 5.1.1.2 Flat Sheet and Flat Strip Over 6 In. (152 mm) in Width: Shall be marked in lengthwise rows of characters recurring at intervals not greater than 3 ft (914 mm), the rows being spaced not more than 6 in. (152 mm) apart and alternately staggered.
 - 5.1.1.3 Coiled Sheet and Strip: Shall be marked near both the outside and inside ends of the coil; the markings shall be applied as in 5.1.1 or shall appear on a durable tag or label attached to the coil and marked with the information of 5.1.1. When the inside end of the coil is inaccessible, as when the product is wound on cores, the tag or label may be attached to the core.
 - 5.1.2 When purchaser permits, each sheet and strip may be marked near one end, coils being marked near the outside end, with AMS 7701A, heat number, manufacturer's identification, and nominal thickness, using any suitable marking fluid. As an alternate method, individual pieces and bundles shall have attached a durable tag marked with the above information or shall be boxed and the box marked with the same information.
 - 5.2 Packaging:
 - 5.2.1 The product shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the product to ensure carrier acceptance and safe delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.
 - 5.2.2 For direct U. S. Military procurement, packaging shall be in accordance with MIL-STD-163, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.2.1 will be acceptable if it meets the requirements of Level C.