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MILITARY SPECIFICATION

NICKEL ALLOY, HIGH PERMEABILITY, SHIELDING GRADE

This specification is approved for use by all departments and agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the requirements for a soft magnetic nickel alloy, shielding grade, that can be cold formed and heat treated to develop high permeabilities at low magnetizing forces. The alloy shall be composed of approximately 80 percent nickel, 16 percent iron and 4 percent molybdenum.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

STANDARDS

Federal

FED-STD-48	Tolerances for Steel Wrought Products, and for Centrifugally Cast Steel
FED-STD-151	Metals, Test Methods

Military

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-163	Steel Mill Products Preparation for Shipment and Storage

FSC 9535

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or reuest for proposals shall apply.

American Society for Testing Material

ASTM A 341	Direct Current Magnetic Properties of Materials Using D-C Permeameters and the Ballistic Test Methods, Test For

(Application for copies should be addressed to the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pennsylvania 19103.)

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.

3. REQUIREMENTS

3.1 Preproduction sample. Unless otherwise specified (see 6.2), a preproduction sample (see 4.2) of material shall meet the requirements of this specification.

3.2 Material. The alloy shall be uniform in quality and shall be free from foreign materials and contamination. The surface shall be free from all oxide, dirt, foreign material, tool and roll marks or other imperfections that will be injurious to the intended use.

3.3 Chemical properties. The material shall meet the requirements specified in Table I.

Table I. Chemical Properties

Property	Value (% by wt.)	Applicable test
Nickel	78.0 - 81.0	4.6.2
Molybdenum	4.0 - 5.0	4.6.2
Manganese	1.00 max.	4.6.2
Silicon	0.50 max.	4.6.2

Table I. (Continued)

Property	Value (% by wt.)	Applicable test
Carbon	0.07 max.	4.6.2
Phosphorus	0.015 max.	4.6.2
Sulfur	0.015 max.	4.6.2
Iron	balance	by difference

3.4 Magnetic property.

3.4.1 Permeability. The permeability at 40 plus or minus one gauss shall be 25,000 minimum.

3.5 Physical properties.

3.5.1 Hardness. The Rockwell B hardness of the material, as received, shall be 75 maximum.

3.5.2 Condition. The condition of the material, as received, shall be bright annealed.

3.5.3 Form and size. The form and size shall be as specified in the procuring document (see 6.2). The dimensional tolerances of FED-STD-48 and its applicable paragraphs as shown in Table II shall apply for the material size.

Table II. Tolerances

Dimension	Paragraph
Thickness	12 a 2
Width	12 a 3
Length	12 a 4
Out of square	12 a 6
Camber	12 a 9
Flatness	12 a 10

3.6 Workmanship. The workmanship shall be such as to insure a product which is uniform and in conformance with this specification.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Preproduction sample. The preproduction sample shall be prepared using the same methods proposed for the preparation of subsequent production lots of material. The preproduction sample shall be subjected to all examinations and tests specified herein. Unless otherwise specified (see 6.2), the Government will perform the examinations and tests for preproduction sample acceptance at the contractor's plant. Preproduction samples which do not meet all the requirements of this specification shall be rejected and returned to the contractor. Subsequent quantities will not be considered for acceptance until approval of the preproduction sample has been obtained.

4.3 Classification of examinations and tests. The examination and testing of material shall be classified as follows:

a. Preproduction tests (see 4.4).

b. Quality conformance tests (see 4.5).

4.4 Preproduction tests. Preproduction tests shall be conducted only on the preproduction sample and shall consist of all the examinations and tests specified herein.

4.5 Quality conformance tests. Quality conformance tests for acceptance of material shall consist of all examinations, tests, and inspection requirements of this specification and shall be performed by the supplier on a sample of alloy representative of the shipment. A certified test report shall be furnished by the supplier and shall include the results of all examinations, tests, and inspections. The procuring agency reserves the right to conduct any or all of the examinations, tests and inspections prescribed herein on each lot material (see 4.5.1) submitted by the supplier.

4.5.1 Lot size. Lot size shall consist of all the nickel alloy submitted for acceptance at the same time, which has been prepared by the same company from the same heat of metal in one continuous period of operation.

4.6 Test methods.

4.6.1 Test specimen preparation. Specimens for testing shall be prepared according to 4.6.1.1 and 4.6.1.2. Samples shall be selected so as to be representative of the heat undergoing test.

4.6.1.1 Chemical analysis samples. Samples shall be taken in accordance with FED-STD-151, Method 111.1.

4.6.1.2 Magnetic specimens. Ring samples 1-1/4 inches inside diameter by 1-1/2 inches outside diameter at the required thickness, 1 inch stack, shall be prepared for each melt of the alloy. The supplier is permitted to deviate from the specified ring size. The deviation shall be stated in the test report (see 4.5). The number of ring samples required shall be specified in the purchase order (see 6.2).

4.6.1.2.1 Heat treatment. Prior to testing, the ring samples shall be annealed for four hours in dry hydrogen at 1150 plus or minus 25 degrees Celsius (C) (2102 plus or minus 45 degrees Fahrenheit (F)) and cooled to room temperature with the cooling rate between 300 and 600 degrees C (572 and 1112 degrees F) controlled to 3 to 5 degrees C (5.4 to 9 degrees F) per minute.

4.6.2 Chemical property test. The chemical properties specified in Table I shall be determined in accordance with FED-STD-151, Method 111.1.

4.6.3 Magnetic property test.

4.6.3.1 Permeability. The permeability of heat treated rings in the thickness range of 0.010 to 0.032 inch as specified in 3.4.1 shall be determined at 40 plus or minus 1 gauss using a modified Hay Bridge test circuit and 60 hertz. The permeability of heat treated rings over 0.032 inch thickness, shall be determined in accordance with ASTM A 341, Permeameter Method.

4.6.4 Physical Property tests.

4.6.4.1 Hardness. The Rockwell B hardness specified in 3.5.1 shall be determined in accordance with FED-STD-151, Method 2431.

4.6.4.2 Condition. The condition specified in 3.5.2 shall be determined visually.

4.6.4.3 Form and size. The form and size of the material shall be determined by measurement with instruments capable of determining accuracy within the specified tolerances (see 3.5.3).

5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, and packing. Material shall be prepared for shipment in accordance with methods prescribed by MIL-STD-163. A suitable preservative shall be applied for protection against corrosion.

5.2 Marking. Individual pieces of material or shipping containers shall be legibly and durably marked in accordance with MIL-STD-129. Marking information shall include, but shall not necessarily be limited to, the following:

a. Manufacturer's stock identification number.

b. Manufacturer's heat number.

c. Manufacturer's name and address.

d. Strip length, width, and thickness.

6. NOTES

6.1 Intended use. This material is intended for use as a shield for electronic components. It may be used for magnetic amplifiers, saturable reactors, audio transformers or instrument transformers.

6.2 Ordering data. Procurement documents should specify the following:

a. Title, number, and date of this specification.

b. Whether a preproduction sample is required (see 3.1).

c. Where preproduction sample test shall be performed (see 4.2).

d. Form and size requirements (see 3.5.3).

e. Request for supplier inspection certification (see 4.5).

f. Number of ring samples required for permeability test (see 4.6.1.2).

g. Stock identification number (see 5.2).

6.3 Supersession data. This specification includes the requirements of Missile Interim Specification, MIS-14205, dated 1 March 1965.

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