

METRIC

DOD-F-24669/5

7 July 1986

SUPERSEDING

MIL-S-17759B(SHIPS)

17 October 1959

MILITARY SPECIFICATION

FORGINGS AND FORGING STOCK, STEEL BARS, BILLETS
AND WIRE (CHROMIUM-NICKEL-PHOSPHOROUS AND CHROMIUM-
NICKEL-MANGANESE-PHOSPHOROUS) LOW MAGNETIC PERMEABILITY (METRIC)

This specification is approved for use by all Departments and Agencies of the Department of the Defense.

1. SCOPE

1.1 Scope. This specification covers precipitation hardening chromium-nickel-phosphorous and chromium-nickel-manganese-phosphorous steel bars, billets forgings and wire for use in applications requiring low magnetic permeability.

1.2 Classification. The material covered by this specification shall be of the following compositions, conditions and finishes, as specified (see 6.2).

Compositions

Composition I - Chromium-nickel-phosphorous steel

Composition II - Chromium-nickel-manganese-phosphorous steel

Conditions

Condition A - Solution annealed (bars, forgings and wire)

Condition B - Solution annealed and aged (bars, wire, and forgings)

Condition C - Solution annealed and cold drawn (bars and wire)

Condition H - Hot rolled or forged only (bars, billets and forgings)

Finishes

Finish (a) - As rolled, as forged, as drawn or as annealed

Finish (b) - Pickled

Finish (c) - Turned

Finish (d) - Cold drawn

Finish (e) - Centerless ground

Finish (f) - Polished

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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DISTRIBUTION STATEMENT A Approved for public release; distribution unlimited

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2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specification and standard. The following specification and standard forms a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

SPECIFICATION

MILITARY

DOD-F-24669 - Forgings and Forging Stock, Steel Bars, Billets and Blooms, General Specification for. (Metric)

STANDARD

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection By Attributes.

(Copies of specifications and standards required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Other publication. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issue of the documents which are DoD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- A 342 - Standard Test Methods for Permeability of Feebly Magnetic Materials.
- E 10 - Standard Test Method for Brinell Hardness of Metallic Materials. (DoD adopted)
- E 18 - Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials. (DoD adopted)
- E 110 - Standard Test Method for Indentation Hardness of Metallic Materials by Portable Hardness Testers.

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

(Nongovernment standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

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2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 General. The material furnished under this specification shall be in accordance with the requirements of DOD-F-24669 and as specified herein.

3.2 Chemical composition. Bars, billets, forgings and wire shall comply with the composition requirements shown in table I.

TABLE I. Chemical composition.

Composition	Carbon (max)	Manganese (max)	Phosphorus	Sulphur (max)	Silicon (max)	Nickel	Chromium
	Percent	Percent	Percent	Percent	Percent	Percent	Percent
I(Cr-Ni-P)	0.15	1.00	0.20-0.40	0.040	1.00	9.5-12.0	16.0-18.0
II(Cr-Ni-Mn-P)	0.26-0.33	3.00-4.00	0.18-0.33	.035	1.00	8.0-10.0	17.0-19.0

3.3 Mechanical properties.

3.3.1 Condition A material shall have a Brinell hardness of HB 225 (Rockwell B98) or less.

3.3.2 Condition C material shall have a Brinell hardness of HB 250 (Rockwell C20) or less.

3.3.3 Condition B material shall comply with the mechanical property requirements shown in table II.

TABLE II. Mechanical properties - age-hardened (condition B).

Aging treatment	Tensile strength (min)		Yield strength (0.2 percent offset) (min)		Elongation in 2 inches (min)	Reduction in area (min)	Hardness (min)	
	MPa	lb/in ²	MPa	lb/in ²	Percent	Percent	Brinell	Rockwell
1	830	120,000	550	80,000	18	30	269	C27
2	830	120,000	620	90,000	15	25	269	C27

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3.4 Capability tests.

3.4.1 Material ordered in conditions A and C (solution annealed) shall meet the mechanical property requirements of table II after aging (see 3.6.2.2 and 3.6.2.3).

3.4.2 Material ordered in condition H shall meet the mechanical property requirements of table II after solution annealing and aging (see 3.6.2).

3.5 Magnetic permeability. The magnetic permeability shall not exceed 1.2. An increase in permeability up to and including 2.0 resulting from the cold shearing of stock to size will not be cause for rejection.

3.6 Heat treatment.

3.6.1 As furnished condition.

3.6.1.1 Bars, wire and forgings. Unless otherwise specified (see 6.2), bars, wire and forgings shall be submitted in the solution annealed and aged condition (condition B).

3.6.1.2 Billets. Unless otherwise specified (see 6.2), billets shall be submitted in the hot rolled or forged condition (condition H).

3.6.2 Heat treat procedures.

3.6.2.1 Solution annealing. Solution annealing of composition I and composition II material shall be accomplished by heating to 1095-1175 degrees Celsius ($^{\circ}\text{C}$) (2000-2150 degrees Fahrenheit ($^{\circ}\text{F}$)) holding at temperature for 30 minutes and water quenching.

3.6.2.2 Age-hardening (composition I). Composition I material shall be age-hardened by one of the following treatments. Unless otherwise specified (see 6.2), age-hardening treatment number 1 shall be used:

- (a) Age-hardening treatment number 1. Heat to $700 \pm 15^{\circ}\text{C}$ ($1300 \pm 25^{\circ}\text{F}$), hold at temperature for 24 hours, air cool or water quench.
- (b) Age-hardening treatment number 2. Heat to $700 \pm 15^{\circ}\text{C}$ ($1300 \pm 25^{\circ}\text{F}$), hold at temperature for 12 hours, air cool or water quench. Reheat to $650 \pm 15^{\circ}\text{C}$ ($1200 \pm 25^{\circ}\text{F}$), hold at temperature for 24 hours, air cool or water quench.

3.6.2.3 Age-hardening (composition II). Composition II material shall be age-hardened as follows:

- (a) Heat to $690 \pm 15^{\circ}\text{C}$ ($1275 \pm 25^{\circ}\text{F}$), hold at temperature for 16 hours, air cool.

4. QUALITY ASSURANCE PROVISIONS

4.1 The quality assurance provisions shall be in accordance with DOD-F-24669 and as specified herein.

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4.2 Sampling.

4.2.1 Sampling for mechanical property tests.

4.2.1.1 Material as furnished.

4.2.1.1.1 Billets, all conditions and condition H, all forms. No mechanical property tests are required.

4.2.1.1.2 Conditions A, B, and C material (all forms except billets). Two hardness tests shall be performed on each lot (see DOD-F-24669). For sections larger than 38 millimeters (1-1/2 inches) in diameter or least thickness, hardness tests shall be taken at a point midway between center and surface.

4.2.1.1.3 Condition B material (all forms). Two tension tests and one hardness test specimens shall be taken from each lot (see DOD-F-24669).

4.2.1.2 For demonstration of response to heat treatment. For material ordered in conditions A, C, or H, two test specimens shall be taken from each lot (see DOD-F-24669) for test of conformance with the requirements of table II after being aged.

4.2.2 Magnetic permeability. Sampling shall be in accordance with MIL-STD-105, general inspection level I, acceptance quality level 1.5.

4.2.3 Dimensional examination. Sampling shall be in accordance with MIL-STD-105, general inspection level III, acceptance quality level 1.5.

4.3 Examination and test procedures.

4.3.1 Hardness tests. Hardness tests shall be performed as specified by ASTM E 10, ASTM E 18 or ASTM E 110.

4.3.2 Magnetic permeability. Each of the items selected in accordance with 4.2.2 shall be tested in accordance with ASTM A 342, method 6.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition.)

5.1 Preservation, packing, packaging, and marking shall be in accordance with DOD-F-24669.

6. NOTES

6.1 Intended use. The material furnished under this specification is intended for applications requiring high strength together with low magnetic permeability.

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6.2 Ordering data. In addition to the ordering data of DOD-F-24669, acquisition documents should specify the following:

- (a) Composition, condition and finish required (see 1.2).
- (b) Size, shape, quantity of bars, reforging stock and forgings required.
- (c) For bars, billets and forgings in excess of 645 square centimeters (100 square inches) in cross sectional area the acceptance criteria for macrostructure examination (see DOD-F-24669).
- (d) The applicable drawing, piece number and location of markings (for forgings only).
- (e) If bars, wire and forgings shall be submitted in other than the age hardened condition (see 3.6.1.1).
- (f) If billets shall be submitted in other than the hot rolled condition (see 3.6.1.2).
- (g) If age hardening treatment number 2 is required for composition (see 3.6.2.2).

Custodians:

Army - MR
Navy - SH
Air Force - 99

Preparing activity:

Navy - SH
(Project FORG-0128-05)

Review activities:

Army - AR, MI, GL
Navy - AS, OS
Air Force - 84

User activity:

Navy - MC

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