

METRIC

DOD-F-24669

7 July 1986

SUPERSEDING

(See 6.3)

MILITARY SPECIFICATION

FORGINGS AND FORGING STOCK, STEEL BARS, BILLETS AND
BLOOMS, GENERAL SPECIFICATION FOR (METRIC)

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 general requirements for carbon steel, alloy steel and stainless steel bars, forgings and reforging stock.

1.2 Classification. Bars, forgings and forging stock shall be furnished in the type, class, grade, condition, alloy or finish specified in the detailed specification (see 3.1 and 6.2.1).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form 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.

SPECIFICATIONS

(See supplement 1 for list of associated specifications)

STANDARDS

FEDERAL

FED-STD-183 - Continuous Identification Marking of Iron and Steel Products.

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 55Z3, 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.

AMSC N3875

AREA FORG

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MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection By Attributes.
- MIL-STD-163 - Steel Mill Products Preparation for Shipment and Storage.
- MIL-STD-248 - Welding and Brazing Procedure and Performance Qualification.
- MIL-STD-271 - Nondestructive Testing Requirements for Metals.
- MIL-STD-278 - Fabrication Welding and Inspection; and Casting Inspection and Repair for Machinery, Piping and Pressure Vessels in Ships of the United States Navy.
- MIL-STD-792 - Identification Marking Requirements for Special Purpose Components.

(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 publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues 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 29 - Standard Specifications for Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished, General Requirements for. (DoD adopted)
- A 370 - Standard Methods and Definitions for Mechanical Testing of Steel Products. (DoD adopted)
- A 751 - Standard Methods, Practices, and Definitions for Chemical Analysis of Steel Products, Methods, Practice and Definitions for.
- A 788 - Standard Specification for Steel Forgings, General Requirements. (DoD adopted)
- E 112 - Standard Methods for Determining Average Grain Size. (DoD adopted)
- E 381 - Standard Method of Macroetch Testing, Inspection, and Rating Steel Products, Comprising Bars, Billets, Blooms, and Forgings. (DoD adopted)

(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 Detail specifications. The individual item requirements shall be as specified herein and in accordance with the applicable detail specification. In the event of any conflict between the requirements of this specification and the detail specifications, the latter shall govern.

3.2 Material. Unless otherwise specified in the detail specification, the steel shall be produced by any of the following primary processes: open hearth, basic oxygen, electric furnace or vacuum induction (VIM). Stainless steel grades shall be produced by electric furnace or VIM only. The primary melting may incorporate separate degassing or refining and may be followed by secondary melting using electroslag remelting (ESR) or vacuum arc remelting (VAR). The material shall be made using fine grain practice. The molten steel may be vacuum treated prior to or during pouring. Steel may be cast into ingots or continuous cast into billets.

3.2.1 Reduction from cast structure. Cast billets or ingots shall be processed by hot working so that the cross section of the finished forgings is reduced to at least one-third the cross section of the as-cast material. Flanges and other enlargements on forgings need not be reduced to this ratio, but shall be reduced in a ratio of not less than 1.7 to 1. Where an upsetting operation is employed or expanding on a mandrel, no fixed ratio between the as-cast cross-sectional area and that of the forging is required. All material supplied shall be wrought.

3.2.2 Discard. Sufficient discard shall be made to secure freedom from piping and undue segregation.

3.2.3 Stability. Material shall be furnished in a condition to withstand, for an indefinite time, exposure to all climatic conditions without developing any external or internal cracks. The method of cooling or of treatment before shipment shall be optional with the manufacturer, but he shall be responsible (in the same manner as for defects disclosed after delivery) for cracks that may develop before material is subjected to reheating.

3.2.4 Recovered materials. Unless otherwise specified herein, all material incorporated in the products covered by this specification shall be new and may be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specifically specified.

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3.3 Grain size. The grain size shall be considered fine when the structure falls within photograph numbers 5 to 8, inclusive, of ASTM E 112. The grain structure shall be considered satisfactory if 70 percent is within the specified grain size limits. The grain size requirements also apply to material over 645 square centimeters (100 square inches) in cross-sectional area.

3.4 Heat treatment. Unless otherwise specified (see 6.2.1), heat treatment shall be as specified in the detail specification.

3.4.1 Heat treat equipment and controls. Continuous or automatic heat treating equipment may be employed, provided it produces heat treated material to meet the requirements of this specification. For the particular loading and size range of the pieces being heat treated, the temperature recording equipment shall be proven to correlate with actual temperature of the material and shall be maintained and calibrated on a regular basis. The temperature of the furnace charge shall be recorded during the heating, holding and when applicable the cooling cycles of the heat treatment. Recording is not applicable to cooling cycles involving air or liquid cooling. After the charge reaches the selected temperature control setting, furnaces shall maintain the temperature of the heating medium and any point in the furnace charge within plus or minus 14 degrees Celsius (C°) (25 degrees Fahrenheit (°F)).

3.5 Soundness. Material shall be of uniform quality and condition, free of defects harmful to its intended use, such as seams, pipe, cracks, excessive scale, fins, porosity, and segregation as determined by visual examination and the non-destructive tests, such as ultrasonic, magnetic particle, or dye penetrant inspection.

3.5.1 Nondestructive requirement method and acceptance criteria shall be as specified (see 6.2.1).

3.5.2 Surface conditioning of billets, blooms and slabs. Material may be conditioned to remove injurious surface defects provided the depth of conditioning does not exceed 1.6 millimeters (mm) (1/16 inch) for each 2 centimeters (inch) of dimension concerned up to a maximum depth of 19 mm (3/4 inch), and provided that the width of the conditioning is at least four times its greatest depth; except that in the case of slabs where the width is at least twice the thickness, the depth of conditioning on the wide surfaces may exceed this allowance by 50 percent up to a maximum depth of 19 mm. The maximum depth of conditioning on two parallel sides at opposite locations shall not exceed one and one-half times the maximum allowed for one side. Conditioned areas shall be flared to result in a uniform blending.

3.5.3 Macrostructure. The macrostructure shall be determined on all billets, slabs, bars and forgings. Deep acid etched blooms, billets and forgings up to and including 232 square centimeters (36 square inches) shall be equal to or better than S-3, R-2, and C-3 plates of ASTM E 381. Sizes over 232 square centimeters and including 645 square centimeters (100 square inches) shall be equal to or better than S-3, R-3 and C-3. For sizes in excess of 645 square centimeters, macrostructure requirements shall be as specified (see 6.2.1).

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3.6 Repair of defects.

3.6.1 Repair welding is not permitted unless specifically approved by the Command or agency concerned or its authorized representative.

3.6.1.1 Weld repair shall be performed in accordance with MIL-STD-278. Welding procedure qualification, prior to production welding, shall be in accordance with MIL-STD-248.

3.6.2 Defects may be ground or chipped out provided the defective area is faired into the surrounding area and dimensional tolerances are not violated.

3.7 Dimensions and tolerances.

3.7.1 Bars. Dimensions shall be as specified in the detail specification. Tolerance requirements shall be as required by ASTM A 29.

3.7.2 Forgings. Forgings shall conform to the dimensions, tolerances and finish specified on the applicable drawing. Forgings shall be furnished that can be machined to the finished dimensions within the tolerances given on the applicable drawing. Layout points, when required, shall be as shown on the applicable drawings and shall be marked on the forgings.

3.7.3 Reforging stock. Billets, bars, blooms, and slabs shall conform to the form and dimensions as specified (see 6.2.1).

3.7.3.1 Weight tolerances. The permissible variation from the specified or theoretical weight of blooms, billets and slabs shall be plus or minus 5 percent for individual pieces, or lots less than a carload. For carload lots the permissible variation shall be plus or minus 2.5 percent of the total weight of the lot.

3.8 Forging drawing. When specified (see 6.2.1), a drawing shall be prepared in accordance with the data ordering document included in the contract or order (see 6.2.2) for approval by the Command or agency concerned, showing the shape of the as-forged forging and the principle steps in the forging process in sufficient detail to determine the direction of metal flow. The drawing shall also show the locations from which the test specimens are to be taken, the location of any marking specified, the dimension of the forging at time of ultrasonic inspection and a superimposed outline of the finished part.

3.9 Identification marking. Each item shall be marked with the following information:

- (a) Manufacturer's name or symbol.
- (b) Material specification number.
- (c) The class, grade, alloy, finish, condition, type, as appropriate.
- (d) Manufacturer's identification or heat number.

3.9.1 Marking method. Bars and reforging stock shall be continuously marked in accordance with FED-STD-183. Forgings shall be marked with a permanent method in accordance with MIL-STD-792.

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3.9.2 When forgings are of a size that individual marking is not required in accordance with FED-STD-183, forgings of the same heat number, size and configuration may be wired together or otherwise segregated, and a metal tag attached containing the information required by 3.8.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor 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.

4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.1.2 Certificate of quality conformance. A certificate of quality conformance shall be prepared for each lot of material offered for acceptance (see 6.2.2). The certificate shall include actual data of specified chemical and mechanical tests. Qualitative results of nondestructive tests and other inspections and tests shall be recorded on the certificate. The certificate shall also state that each lot has been sampled, tested, and inspected in accordance with the specification and meets all specification requirements. The certificate shall be signed by a responsible representative of the contractor.

4.2 Lot size.

4.2.1 Lot size for chemical analysis, macroscopic etch, grain size. Each melt or heat of steel shall constitute a lot. For remelted, vacuum arc remelt or electroslag remelt products, a lot for heat analysis is defined as the products of one remelted ingot of each melt. In the case of secondary melting or ladle refining, each charged vessel is considered a lot for heat analysis.

4.2.2 Lot size for mechanical tests (includes impact and hardness tests) and examinations.

- (a) Forgings with an as-heat treated weight of less than 455 kilograms (kg) (1,000 pounds). All forging of one design, produced from the same heat, or melt, and heat treated in the same furnace charges, shall constitute a lot.
- (b) Forgings with an as-heat treated weight of 455 kg (1,000 pounds) or more. Each forging shall constitute a lot.

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- (c) Bars and reforcing stock. A lot shall consist of all bars, billets or blooms submitted for inspection at the same time of the same heat, condition, finish, size and shape.

4.3 Sampling.

4.3.1 Chemical analysis.

4.3.1.1 Bars and reforcing stock. Sampling for heat analysis and product analysis shall be in accordance with ASTM A 29.

4.3.1.2 Forgings. Sampling for heat analysis and product analysis shall be in accordance with ASTM A 788.

4.3.2 Grain size. When specified by the detail specification, one sample per lot shall be tested.

4.3.3 Sampling for grain size. Test specimens shall be selected in accordance with the detail specification.

4.3.4 Sampling for macroscopic etch test. From each lot four samples shall be selected representing the top and bottom of the first and last ingot poured. If strand casting is used two samples representing the first and last material poured shall be selected. For bottom poured ingots one sample per heat shall be selected. Provided the identity of the material is maintained, in the case of mill purchases, the results of the manufacturer's tests on the heat from which the bar, billets, slabs, and so forth are formed may be substituted. When forgings are made from bars, billets, and so forth the specimens for macroetch examination shall be taken from the bars or billets before forging. If the material cannot be identified by its relative position in the heat at the time of pouring a test shall be made on each of a sample of bars or billets selected in accordance with MIL-STD-105, general acceptance level II, normal inspection, acceptance quality level 1.0.

4.3.5 Examination.

4.3.5.1 Visual and dimensional examination. Each item shall be visually examined. Sampling for dimensional examination shall be as specified in the detail specification.

4.3.5.2 Nondestructive inspection. When required, each piece shall be inspected or sampling shall be as specified (see 6.2.1).

4.4 Examination and test procedures.

4.4.1 Chemical analysis. Chemical analysis shall be performed in accordance with ASTM A 751.

4.4.2 Mechanical property tests.

4.4.2.1 Method. Tests shall be conducted in accordance with ASTM A 370. Unless otherwise specified in the detail specification yield strength shall be determined by the 0.2 percent offset method.

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4.4.2.2 Test specimen location. Unless otherwise specified in the detail specification, the test specimens shall be located, when size permits, at any point at mid-radius of solid forgings, bars and billets, and mid-wall thickness of hollow forgings. Prolongations shall be provided on forgings from which test specimens are to be taken. The cross-sectional area of each prolongation shall be the same as the average cross-sectional area of rough forgings excluding any flanges. Test specimens may be taken from finish forgings in lieu of prolongations at the option of the manufacturer.

4.4.3 Visual examination. Each item shall be visually examined in accordance with MIL-STD-271 for the requirements of 3.5 and 3.9.

4.4.4 Dimensional examination. Items shall be examined for dimensions in accordance with the detail specification or as specified (see 6.2.1).

4.4.5 Nondestructive test. Items shall be nondestructively tested in accordance with MIL-STD-271.

4.4.6 Grain size. The austenitic grain size shall be determined in accordance with ASTM E 112, McQuaid-Ehn test.

4.4.7 Macroetch test. The macroetch test shall be performed in accordance with ASTM E 381.

4.5 Retests.

4.5.1 Chemical analysis. If the results of heat or product analysis do not conform to the specified requirements, an analysis of each piece from the nonconforming heat may be performed, and all pieces conforming to the product specification shall be accepted.

4.5.2 Mechanical property tests.

4.5.2.1 If the results of the initial mechanical property tests do not conform to the specified requirements, the items may be heat treated (if initially tested in the as-forged or rolled condition) or reheat treated (if heat treated prior to initial testing).

4.5.2.2 If any test specimen exhibits a localized flaw which is not indicative of inferior metal quality, the specimen may be discarded and a replacement specimen tested. Also, if the specimen is mismachined or the test instrument malfunctions during testing, a replacement specimen is allowed.

4.5.3 Reinspection. Lots rejected by dimensional or visual discrepancies may be resubmitted for inspection in accordance with 4.4.3 or 4.4.4 after the manufacturer has reworked and reinspected the lot to remove nonconforming material.

4.6 Inspection of packaging. Sample packages and packs, and the inspection of the preservation-packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

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5. PACKAGING

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

5.1 Preparation for shipment. Items shall be prepared for shipment in accordance with level A or C of MIL-STD-163 (see 6.2.1).

5.2 Marking. In addition to any special marking required by the contract or purchase order (see 6.2.1), shipments shall be marked in accordance with MIL-STD-163.

6. NOTES

6.1 Intended use. Steel bars, forgings and forging stock are intended for machinery, transportation equipment and marine application.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Title, number, and date of applicable detail specification.
- (c) Type, class, condition, composition, alloy and finish required by applicable detail specification (see 1.2).
- (d) If heat treatment is other than specified in the detail specification (see 3.4).
- (e) Nondestructive requirement method and acceptance criteria (see 3.5.1).
- (f) Macrostructure requirements for sizes in excess of 645 square centimeters (see 3.5.3).
- (g) Form and dimensions of billets, bars, blooms and slabs (see 3.7.3).
- (h) If forging drawing is required (see 3.8).
- (i) If sampling for nondestructive inspection is to be other than specified (see 4.3.5.2).
- (j) If dimensional requirements are other than to detail specification (see 4.4.4).
- (k) Level of packing required (see 5.1).
- (l) Special marking required (see 5.2).

6.2.2 Data requirements. When this specification is used in an acquisition and data are required to be delivered, the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (CDRL), incorporated into the contract. When the provisions of DoD FAR Supplement, Part 27, Sub-Part 27.410-6 (DD Form 1423) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification are cited in the following paragraphs.

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<u>Paragraph no.</u>	<u>Data requirement title</u>	<u>Applicable DID no.</u>	<u>Option</u>
3.8	Drawings, engineering and associated lists	DI-E-7031	Level 3 Design activity designation - Contractor
4.1.2	Certification data/ report	UDI-A-23264	----

(Data item descriptions related to this specification, and identified in section 6 will be approved and listed as such in DoD 5010.12-L., Vol. I, AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.2.2.1 The data requirements of 6.2.2 and any task in sections 3, 4, or 5 of this specification required to be performed to meet a data requirement may be waived by the contracting/acquisition activity upon certification by the offeror that identical data were submitted by the offeror and accepted by the Government under a previous contract for identical item acquired to this specification. This does not apply to specific data which may be required for each contract regardless of whether an identical item has been supplied previously (for example, test reports).

6.3 Supersession data. The following detail specifications cover carbon steel, alloy steel and stainless steel bars, forging and reforging stock:

- (a) DOD-F-24669/1 supersedes MIL-S-866 and MIL-S-16974.
- (b) DOD-F-24669/2 supersedes MIL-S-872 and MIL-S-18410.
- (c) DOD-F-24669/3 supersedes MIL-S-869.
- (d) DOD-F-24669/4 supersedes MIL-S-17758.
- (e) DOD-F-24669/5 supersedes MIL-S-17759.
- (f) DOD-F-24669/6 supersedes MIL-S-862.
- (g) DOD-F-24669/7 supersedes MIL-S-861.

6.4 Subject term (key word) listing.

Bars	Naval steam turbine parts
Billets	Nickel
Blooms	Nickel-molybdenum
Chromium-nickel-manganese	Nitriding steel
Chromium-nickel-phosphorus	Reforging stock
Corrosion resisting	Slabs
Forging stock	Steel (carbon and alloy)
Low magnetic permeability	Wire
Modified Hadfield	

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Custodians:

Army - MR

Navy - SH

Air Force - 99

Preparing activity:

Navy - SH

(Project FORG-0128)

Review activities:

Army - AR, MI, GL

Navy - AS, OS

Air Force - 84

User activity:

Navy - MC

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NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

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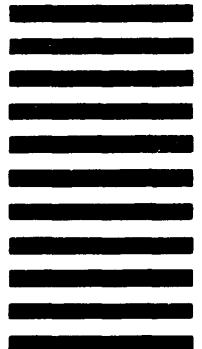
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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER
DOD-F-24669

2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION (Mark one)

☐ VENDOR☐ USER☐ MANUFACTURER☐ OTHER (Specify): _____

b. ADDRESS (Street, City, State, ZIP Code)

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER (Last, First, MI) - Optional

b. WORK TELEPHONE NUMBER (Include Area Code) - Optional

c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional

8. DATE OF SUBMISSION (YYMMDD)

DD FORM 1426
82 MAR

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(TO DETACH THIS FORM, CUT ALONG THIS LINE.)