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INCH-POUND
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(See 6.6)

MILITARY SPECIFICATION

STEEL GEAR AND PINION FORGINGS, CARBON AND ALLOY, HEAT TREATED, NAVAL SHIPBOARD PROPULSION UNIT AND AUXILIARY TURBINE

This specification is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers forging rims and blanks for gears and pinions to be used in gear assemblies for Naval shipboard propulsion units and auxiliary turbines.

1.2 Classification. Forgings shall be of the following classes as specified (see 6.2).

Class 1
Class 2
Class 3
Class 4
Class 5
Class 6

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.

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2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

PPP-F-320 - Fiberboard; Corrugated and Solid, Sheet Stock (Container Grade), and Cut Shapes.

MILITARY

MIL-H-6875 - Heat Treatment of Steel, Process for.
MIL-L-19140 - Lumber and Plywood, Fire-Retardant Treated.

STANDARDS

FEDERAL

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

MILITARY

MIL-STD-163 - Steel Mill Products Preparation for Shipment and Storage.
MIL-STD-248 - Welding and Brazing Procedure and Performance Qualification.
MIL-STD-271 - Requirements for Nondestructive Testing Methods.
MIL-STD-278 - Welding and Casting Standard.
MIL-STD-792 - Identification Marking Requirements for Special Purpose Components.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, BLDG. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A 370 - Standard Test Methods and Definitions for Mechanical Testing of Steel Products. (DoD adopted)
A 751 - Standard Methods, Practices, and Definitions for Chemical Analysis of Steel Products.
D 3951 - Standard Practice for Commercial Packaging. (DoD adopted)

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ASTM (Continued)

E 10 - Standard Test Method for Brinell Hardness of Metallic Materials. (DoD adopted)

E 23 - Standard Methods for Notched Bar Impact Testing of Metallic Materials. (DoD adopted)

E 45 - Standard Practice for Determining the Inclusion Content of Steel. (DoD adopted)

E 112 - Standard Methods for Determining the 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.)

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

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Melting. Unless otherwise specified in the contract or order (see 6.2), the material from which the forgings are made shall be continuous cast or cast in metal molds, and shall be manufactured as follows:

(a) Classes 1, 2, and 3. Open hearth, basic oxygen, electric furnace, or vacuum induction melted (VIM).

(b) Classes 4, 5, and 6. Electric furnace or VIM.

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) (see 6.2).

3.1.1 Degassing. Classes 1, 2, and 3 may be vacuum degassed prior to or during pouring of the material. Unless otherwise specified (see 6.2), classes 4, 5, and 6 shall be vacuum degassed prior to or during pouring of the material to remove objectionable gases, particularly hydrogen.

3.1.2 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 heat treatment of the cast material 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.

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3.1.3 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 (see 6.2). None of the above shall be interpreted to mean that the use of used products is allowed under this specification unless otherwise specifically specified.

3.1.4 Discard. Sufficient discard shall be made to ensure freedom from piping and undue segregation.

3.2 Forging process. The original cross-sectional area of the casting shall be at least three times the area of the finished forging. The total reduction of the cross-sectional area shall also be sufficient so that material conforms to the requirements of this specification. Flanges and other enlargements on forgings need not be reduced to the ratio of 3 to 1, but shall be reduced in a ratio of not less than 1.7 to 1. If bored castings are used, the wall of the castings shall be reduced to at least one-half of its original thickness, or the reduction of area shall be at least 2 to 1. Except for forgings expanded on a mandrel or forgings made from castings of less than 16 inches in minimum cross-sectional dimension, the reduction of cross-sectional area from the original casting to the finished forging shall in no case exceed a ratio of 5 to 1. Where an upsetting operation is employed, or the forging expanded on a mandrel, the material shall be worked to an extent not less than that indicated above, but no fixed ratio between the cross-sectional areas of the casting and of the forging is required.

3.2.1 Centerline. Where forgings require a bored center hole, the centerline of the bored hole shall be at the centerline of the casting and forging.

3.2.2 Forgings. Forgings shall conform to the dimensions, tolerances, and finish specified on the applicable drawing. Layout points, when required (see 6.2), shall be as shown on the drawings and shall be marked on the forgings.

3.3 Heat treatment. Heat treatment of forgings shall be as specified in 3.3.1 through 3.3.1.7.

3.3.1 Normalizing and quenching. The forgings shall be given a uniform heat treatment at temperatures necessary to produce material that will conform to the requirements of this specification. The forgings shall be heat-treated as follows:

Classes 1, 2, 3, and 4	Normalize and temper or quench and temper before final machining.
Classes 5 and 6	Quench and temper before final machining.

3.3.1.1 Cooling prior to heat treatment. After forging and before reheating for heat treatment, the forgings shall be allowed to cool in a manner to prevent damage to the forging and to accomplish transformation of the austenite.

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3.3.1.2 Normalizing. The forgings shall be reheated to and held at the proper temperature for a sufficient time to austenitize and then be withdrawn from the furnace and allowed to cool in air.

3.3.1.3 Quenching. The forgings shall be reheated to and held at the proper temperature for a sufficient time to austenitize and then quenched in a suitable medium to meet specification requirements.

3.3.1.4 Tempering procedure for gear rims, gears, and pinions. Gear rims, gears, and pinions shall be reheated to and held at the proper temperature for final tempering treatment, which shall be below the lower critical austenitizing temperature but not below 1050 degrees Fahrenheit (°F).

3.3.1.5 Stress relieving procedure for gear rims, gears, and pinions. The gear rims, gears, and pinions shall be stress relieved in the same manner as they are tempered except that the temperature shall be not less than 1000°F and at least 50°F below the tempering temperature applied to the forging.

3.3.1.6 Cooling rate. Following stress relief, forgings shall be furnace cooled to 600°F under uniform conditions at a rate not to exceed 500°F per hour divided by the maximum thickness of the part in inches, but in no case greater than 500°F per hour.

3.3.1.7 Heat treatment equipment and controls. Continuous or automatic heat treating equipment may be employed, provided it produces heat-treated material meeting the requirements of this specification. Equipment shall comply with MIL-H-6875 (see 6.3). The temperature of the furnace charge shall be recorded during the heating, holding, and, when applicable, the cooling cycles of the heat treatment (see 6.3 and appendix).

3.4 Surface conditioning before final forging. Material before final forging may be conditioned to remove injurious surface defects provided the depth of conditioning does not exceed 1/16 inch (1.6 millimeters (mm)) for each 1 inch (25.4 mm) of local forging thickness up to a maximum depth of 3/4 inch (19.1 mm), 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 3/4 inch. 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 Macrostructure. Unless otherwise specified (see 6.2), the macrostructure of the starting stock for forging (in the form of blooms, billets, or continuously cast strands after initial reduction) shall be determined for all classes of material. Macrostructure for sizes up to and including 36 square inches shall not exceed S-3, R-2, and C-3 of ASTM E 381. Sizes over 36 square inches and including 100 square inches shall not exceed S-3, R-3 and C-3 of ASTM E 381. For sizes in excess of 100 square inches, macrostructure requirements shall be as specified (see 6.2).

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3.6 Microscopic requirements. Specimens from all forgings, when examined at a magnification of 100 diameters, shall show a homogeneous structure, that is, one in which the normal constituents are evenly distributed, free from decided segregation of any constituents. The grain size for classes 2, 3, 4, 5, and 6, when examined at a magnification of 100 diameters, shall have a grain size number of 5 or finer as specified in the grain size chart in ASTM E 112. The area under examination shall show at least 95 percent of the structure with a grain size of number 5 or finer.

3.7 Nonmetallic inclusion content. The inclusion rating for each heat shall be the average of the worst field for each inclusion type in each specimen. The inclusion rating shall not exceed the following (reference ASTM E 45, plates I and III; plate I is to be used for ratings exceeding 2-1/2):

A: 3.0t/2.0h B: 3.0t/2.5h* C: 2.5t/1.5h D: 2.0t/1.5h*

* Maximum allowable diameter of heavy oxide inclusions shall be 0.005 inch.

3.8 Repair of defects. Defects shall be repaired as specified in 3.8.1 and 3.8.1.1.

3.8.1 Repair welding. Repair welding is not permitted unless specifically approved by the Command or agency concerned or its authorized representative (see 6.2).

3.8.1.1 Weld repair. When approved, 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.

3.9 Chemical composition. The chemical composition of the forging material, gear rims, gears, and pinions shall be in accordance with the specified class as shown in table I.

TABLE I. Chemical composition, weight percent.1/

Class	Carbon	Manganese	Phosphorus	Sulphur	Silicon 3/	Nickel minimum	Chromium	Molybdenum	Vanadium
1	0.45	0.55 - 0.90	0.040	.040	0.15 - 0.35	2/	2/	2/	0.10
2	.45	.55 - .90	.040	.040	0.15 - 0.35	2.25	1.25 (max)	0.50 (max)	0.10
3	0.35 - 0.45	.70 - 1.05	.040	.040	0.15 - 0.35	----	.75 - 1.15	.13 - 0.27	0.10
4 and 5	.50	.60 - .90	.015	.015	0.15 - 0.35	1.65	.50 (min)	.20 (min)	0.10
6	.55	.60 - .90	.015	.015	0.15 - 0.35	1.65	.50 (min)	.13 - 0.50	0.10

1/ Maximum, unless otherwise indicated as a range or minimum. The percent titanium, tin, arsenic, antimony, and copper shall be reported.
2/ Elements shall be held as low as possible for weldability.
3/ When vacuum carbon deoxidation is used, silicon maximum shall be 0.10 percent.

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3.9.1 Heat and product analysis. The heat and product analysis shall conform to the specified chemical analysis.

3.10 Mechanical properties. The mechanical properties of the final forged material shall be in accordance with the specified class as shown in table II and as specified in 3.10.1.

TABLE II. Mechanical properties.

Class	Size, solid diameter or thickness (inches)		Tensile strength (minimum) (lb/in^2)	Yield strength (0.2 percent offset) (minimum) (lb/in^2)	Elongation in 2 inches, (minimum) (percent)		Reduction in area (minimum) (percent)		Brinell hardness number
	Over	Not over			Longitudinal	Tangential 2/	Longitudinal	Tangential 2/	Hardness range
1 1/	All	sizes							163 - 193
	--	10	95,000	70,000	20	18	45	30	201 - 241
2	10	20	95,000	70,000	20	18	45	30	201 - 241
	20	--	95,000	70,000	18	16	35	28	201 - 241
	--	10	110,000	80,000	19	16	45	30	229 - 277
3	10	20	110,000	80,000	19	16	45	30	229 - 277
	20	--	110,000	80,000	17	14	35	28	229 - 277
	--	10	125,000	100,000	16	12	40	30	248 - 293
4	10	20	125,000	100,000	14	12	35	30	248 - 293
	20	--	125,000	100,000	12	10	30	25	248 - 293
	--	10	145,000	120,000	15	12	40	30	302 - 352
5	10	20	145,000	120,000	14	12	35	30	302 - 352
	20	--	145,000	120,000	12	10	30	25	302 - 352
6	--	10	165,000	135,000	12	10	35	25	341 - 388

1/ Tension tests will not be required for gear rim forgings.
2/ Unless otherwise specified (see 6.2), tangential test is not required for forgings less than 8 inches thick.

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3.10.1 Impact properties. The average impact energy of a set of three Charpy V-notch test specimens shall be greater than or equal to 35 foot-pounds for class 4, and greater than or equal to 20 foot-pounds for classes 5 and 6, when tested at 10 ± 3°F. No single test result shall be more than 5 foot-pounds below the required average value. Retests shall be as specified (see 4.6.3).

3.11 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.

3.11.1 Marking method. Bars and reforging stock shall be continuously marked in accordance with FED-STD-183. When required (see 6.2), forgings shall be marked with a permanent method in accordance with MIL-STD-792.

3.11.2 Individual forgings. All forging blanks shall be marked by die stamping in accordance with MIL-STD-792. Die stamping shall not be performed in the vicinity of teeth or journals.

3.11.3 Grouped forgings. 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 shall be wired together or otherwise segregated, and a metal tag containing the required information shall be attached.

3.12 Workmanship. The material shall be of uniform quality and condition, free from seams, pipes, flaws, cracks, scale, fins, porosity, hard spots, excessive nonmetallic inclusions (see 3.7) and segregation that may detrimentally affect its suitability for the service intended.

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 (examinations and tests) 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 this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall 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 ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract (see 6.3). Sampling inspection, as part of the manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

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

4.3 Sampling. Sampling for examination and tests shall be as specified in 4.3.1 through 4.3.8.

4.3.1 Chemical analysis. One sample from a forging in each lot shall be taken for chemical analysis. The chemical analysis specimens may be taken from broken tension test specimens. When drillings are used, sample shall consist of not less than 2 ounces and be clean of all foreign matter such as oil, dirt, or grit.

4.3.2 Tension test specimens. Tension test specimens shall be as specified in 4.3.2.1 through 4.3.2.2.3.

4.3.2.1 Number of specimens. When the end of the forging nearest the uppermost part of the ingot as cast is known, two tension test specimens shall be taken from that end of each pinion forging. When the end of the forging nearest the uppermost part of the ingot as cast is unknown, two tension test specimens shall be taken from each end of each pinion forging. When two or more pieces are forged and heat treated in multiple, they shall be sampled as a single forging. One specimen shall be longitudinal and the other tangential, except as specified in 4.3.2.2.3. For gear rim forgings of material other than class 1, two tangential test specimens shall be taken from each forging, approximately 180 degrees apart.

4.3.2.2 Location of specimens. Specimens shall be taken from the locations specified in 4.3.2.2.1 through 4.3.2.2.3.

4.3.2.2.1 Method of locating test specimens. Test specimens shall be taken from an extension of the main body of the forging, or from a full size prolongation left on one end of each individual forging or both ends of the multiple forging if the forgings are made in multiple. The nominal or specified outside rough machined diameter or thickness of the forgings, disregarding large ends, collars and flanges, shall determine the size of prolongation for test specimens. The method of locating test specimens shall be as shown on figures 1 and 2, and specimens shall be taken at least 1 inch below all adjacent surfaces.

4.3.2.2.2 Longitudinal test specimens. Longitudinal test specimens shall, when possible, be taken from a full size prolongation of the forging in the direction in which the metal is most drawn.

4.3.2.2.3 Tangential test specimens. When size limitations of the forgings prohibit obtaining both tangential and longitudinal test specimens, the tangential test specimens shall be preferred. When it is considered impractical to obtain tangential test specimens, longitudinal test specimens shall be taken from the appropriate locations.

4.3.3 Hardness test specimens. Brinell hardness shall be determined after final heat treatment. For pinions, the hardness reading shall be taken at four points on the outside diameter of each helix, approximately 90 degrees apart, after rough machining and final heat treatment but before cutting teeth. For gear

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rims, hardness readings shall be taken after final heat treatment at four points on the end of each helix, approximately 90 degrees apart and slightly below the root diameter of the teeth, but before the teeth are cut. The method of locating hardness tests shall be as shown on figure 3.

4.3.4 Impact test specimens. One set of three impact test specimens shall be taken from each forging of classes 4, 5, and 6. Test material shall be provided on forgings in accordance with 4.3.2.2.1.

4.3.4.1 Location of test specimens. Specimens shall be taken at least 1 inch below all adjacent surfaces. The length of the specimen shall be taken in the direction in which the steel is most drawn. The axis of the notch shall be normal to the nearest forged surface.

4.3.5 Microscopic specimens. One microscopic specimen shall be taken from each forging of classes 2, 3, 4, 5 and 6. The location of microscopic specimens shall be as shown on figures 1 and 2. The microscopic test specimen shall be taken form unstrained material from the tension test specimen after tension testing (see 4.5.1) or from the innermost end of the core.

4.3.6 Macroscopic etch specimens. The macroscopic etch specimens shall be full transverse cross sections, approximately 1/2 inch thick, taken from each end of the starting stock. When several stocks are cut from one mill length, one sample shall be cut from each end of the mill length. The original cross sectional area of the casting (ingot or strand) shall be reduced in a ratio of not less than 1.7 to 1 prior to taking macroscopic etch specimens.

4.3.7 Nonmetallic inclusion content test specimens. The nonmetallic inclusion content test specimens shall be taken from each end of the starting stock. The specimen configuration and orientation shall be as specified in ASTM E 45 and shall be taken from the mid-radius position. When several stocks are cut from one mill length, one sample shall be cut from each end of the mill length. The original cross sectional area of the casting (ingot or strand) shall be reduced in a ratio of not less than 1.7 to 1 prior to taking test specimens.

4.3.8 Nondestructive test sampling. Visual, magnetic particle, and ultrasonic inspection tests shall be conducted on all forgings as specified in 4.5.7.

4.3.9 Marking of specimens. Test bars shall be die stamped to ensure traceability to the material or forgings they represent.

4.4 Examination. All material shall meet the requirements of this specification and the dimensions specified in the contract or order and the drawings. Forgings containing defective material shall be rejected.

4.5 Tests and inspections. Tests and inspections shall be performed as specified in 4.5.1 through 4.5.8. Mechanical tests shall be performed after the final heat treating operation (including stress relieving treatment).

4.5.1 Tension test. The tensile test shall be conducted in accordance with ASTM A 370 to meet the requirements specified in 3.10.

4.5.2 Hardness test. The Brinell hardness test shall be conducted in accordance with ASTM E 10 to meet the requirements specified in 3.10.

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4.5.3 Charpy V-notch impact tests. The Charpy V-notch impact test shall be conducted in accordance with ASTM E 23 to meet the requirements specified in 3.10.1.

4.5.4 Microscopic test. The grain size of the specimens selected in accordance with 4.3.5 shall be determined in accordance with ASTM E 112 to meet the requirements specified in 3.6. The microscopic test is not required for class 1 material.

4.5.5 Macroscopic etch test. Etching test shall be conducted in accordance with ASTM E 381 to meet the requirements specified in 3.5. The etching solution shall be 1 to 1 hydrochloric acid and water.

4.5.6 Nonmetallic inclusion content. The inclusion content shall be determined in accordance with ASTM E 45, method A and D, to meet the requirements specified in 3.7.

4.5.7 Nondestructive inspection. Visual, magnetic particle and ultrasonic inspection shall be conducted in accordance with MIL-STD-271 to meet the requirements of 3.12. When specified (see 6.2), other additional nondestructive test methods may be required.

4.5.7.1 Visual inspection. Each forging shall be visually examined after all final heat treatment, stress relief, and machining covered by this specification. The entire forging surface shall be visually examined in accordance with the requirements of MIL-STD-271. The surface of the forging shall be free of seams, pipe, cracks, fins, scale, nicks, gouges, and porosity (see 6.3).

4.5.7.2 Magnetic particle inspection. Magnetic particle inspection shall be performed in accordance with MIL-STD-271 after all final heat treatment, stress relief, and machining covered by this specification. The entire surface of each forging shall be inspected. Any linear indication greater than 1/16 inch long shall be cause for rejection (see 6.3).

4.5.7.3 Ultrasonic inspection. Ultrasonic inspection shall be performed after final heat treatment, but not necessarily after stress relief heat treatment when used (see 6.3).

4.5.7.3.1 Hollow forgings. Each forging shall be ultrasonically inspected in accordance with the requirements for ring forgings in MIL-STD-271. Inspection shall include two opposing shear wave scans, a radial longitudinal wave scan, and two opposing axial longitudinal wave scans. Ultrasonic acceptance criteria shall be as follows:

(a) Shear wave inspection - Any indication equal to or exceeding the amplitude reject level (ARL) or distance amplitude correction (DAC) curve (see MIL-STD-271), as applicable, shall be cause for rejection.
(b) Longitudinal wave inspection - Any indication equal to or exceeding the response from the calibration reflector shall be cause for rejection.

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4.5.7.3.2 Solid forgings. Each forging shall be ultrasonically inspected in accordance with the requirements for round wrought bar in MIL-STD-271. Inspection shall include a radial and two opposing axial longitudinal wave scans. Any indication equal to or exceeding the response from the calibration reflector shall be cause for rejection.

4.5.8 Chemical analysis. Chemical analysis shall be performed in accordance with ASTM A 751 to meet the requirements of 3.9.

4.6 Retests. When a rejected lot consists of more than one piece, each remaining piece in the lot may be retested for the nonconforming characteristic and each piece that conforms to requirements may be offered for acceptance.

4.6.1 Reheat treatment. The contractor is permitted to reheat treat forgings which fail to meet the requirements of this specification. All inspection tests originally performed on the failed forgings, except the chemical analysis test, shall be repeated when the material is reinspected.

4.6.2 Retests (tension tests). If the percentage of elongation of any tension test specimen is less than that specified in table II, and any part of the fracture is more than 3/4 inch from the center of the gauge length, as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed.

4.6.3 Retests (impact tests). One retest of three new specimens shall be permitted if the average value of the three initial specimens equals or exceeds 30 foot-pounds for class 4, or equals or exceeds 15 foot-pounds for classes 5 and 6, or if the value of a single initial specimen falls below 30 foot-pounds for class 4, or below 15 foot-pounds for classes 5 and 6. The value for each of the retest specimens shall equal or exceed the required average values in 3.10.1.

4.6.4 Retests (defective material). If the results of the mechanical tests do not conform to the specified requirements because a flaw is found in the specimen during testing, a retest shall be allowed if the defect is not caused by ruptures, cracks, or flakes in the steel.

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

5. PACKAGING

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

5.1 General.

5.1.1 Navy fire-retardant requirements.

5.1.1.1 Lumber and plywood. When specified (see 6.2), all lumber and plywood including laminated veneer material used in shipping container and pallet construction members, blocking, bracing and reinforcing shall be fire-retardant treated material conforming to MIL-L-19140 as follows:

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Level A and B - Type II - weather resistant
Category 1 - general use
Level C - Type I - non-weather resistant
Category 1 - general use.

5.1.1.2 Fiberboard. When specified (see 6.2), fiberboard used in the construction of class domestic, non-weather resistant fiberboard, and cleated fiberboard boxes, including interior packaging forms, shall meet the requirements of PPP-F-320.

5.2 Preservation. Preservation shall be level A or commercial, as specified (see 6.2).

5.2.1 Level A. Level A preservation shall be as specified in 5.2.1.1 through 5.2.1.2.

5.2.1.1 Small polished forgings. Small polished forgings weighing less than 150 pounds each shall be individually wrapped with a minimum of two thicknesses of 40-pound minimum weight kraft paper.

5.2.1.2 Other forgings. Unless otherwise specified (see 6.2), forgings other than those specified in 5.2.1.1 will require no preservation.

5.2.2 Commercial. Forgings shall be packaged in accordance with ASTM D 3951.

5.3 Packing. Packing shall be level A or commercial, as specified (see 6.2), in accordance with MIL-STD-163.

5.4 Marking. In addition to any special marking required (see 6.2), marking shall be in accordance with MIL-STD-163.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The rims and blanks for gears and pinions are to be used in gear assemblies for naval shipboard propulsion units and auxiliary turbines.

6.2 Acquisition requirements. Acquisition documents must specify the following:

(a) Title, number, and date of this specification.
(b) Class of forging required (see 1.2).
(c) Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).
(d) Whether continuous casting is prohibited (see 3.1).
(e) Whether special melting practices are required (see 3.1).
(f) Whether vacuum degassing is unnecessary (see 3.1.1).
(g) Whether virgin raw materials are required (see 3.1.3).
(h) Whether layout points are required (see 3.2.2).
(i) Deletion of macrostructure test requirements (see 3.5).

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(j) Macrostructure requirements for forgings with cross-sections in excess of 100 square inches (see 3.5).
(k) When repair welding is to be permitted (see 3.8.1).
(l) If tangential properties are required for forgings less than 8 inches thick (see table II).
(m) When forgings are to be permanently marked in accordance with MIL-STD-792 (see 3.11.1).
(n) Additional nondestructive requirement methods and the acceptance criteria that are to be utilized (see 4.5.7).
(o) When fire-retardant materials are required, or when fiberboard is to be in accordance with PPP-F-320 (see 5.1.1.1 and 5.1.1.2).
(p) Levels of preservation and packing required (see 5.2 and 5.3).
(q) When forgings other than those specified require preservation (see 5.2.1.2).
(r) Whether special marking is required (see 5.4).

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DoD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
3.3.1.7	DI-E-3129	Request for deviation/ waiver	----
3.3.1.7 and appendix	DI-MISC-80652	Technical information reports	----
4.1.1, 4.5.7.1, 4.5.7.2, and 4.5.7.3	DI-MISC-80678	Certification data/ report	----

The above DID's were those cleared as of the date of this specification. The current issue of DoD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.4 Rejection. Individual forgings not meeting the requirements of this specification will be cause for rejection. If a forging representative of a lot fails to meet the requirements of this specification, the lot should be rejected. Retests should be made in accordance with 4.6. Material that shows injurious defects subsequent to this acceptance at the manufacturer's works will be subject to rejection.

6.4.1 Identification and separation of rejected lots. The contractor should keep rejected lots identified and separate from acceptable lots until the rejected lots are withdrawn by the contractor or demonstrated as meeting specification requirements.

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6.5 Subject term (key word) listing.

Blank
Carbon steel
Rim

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing activity:
Navy - SH
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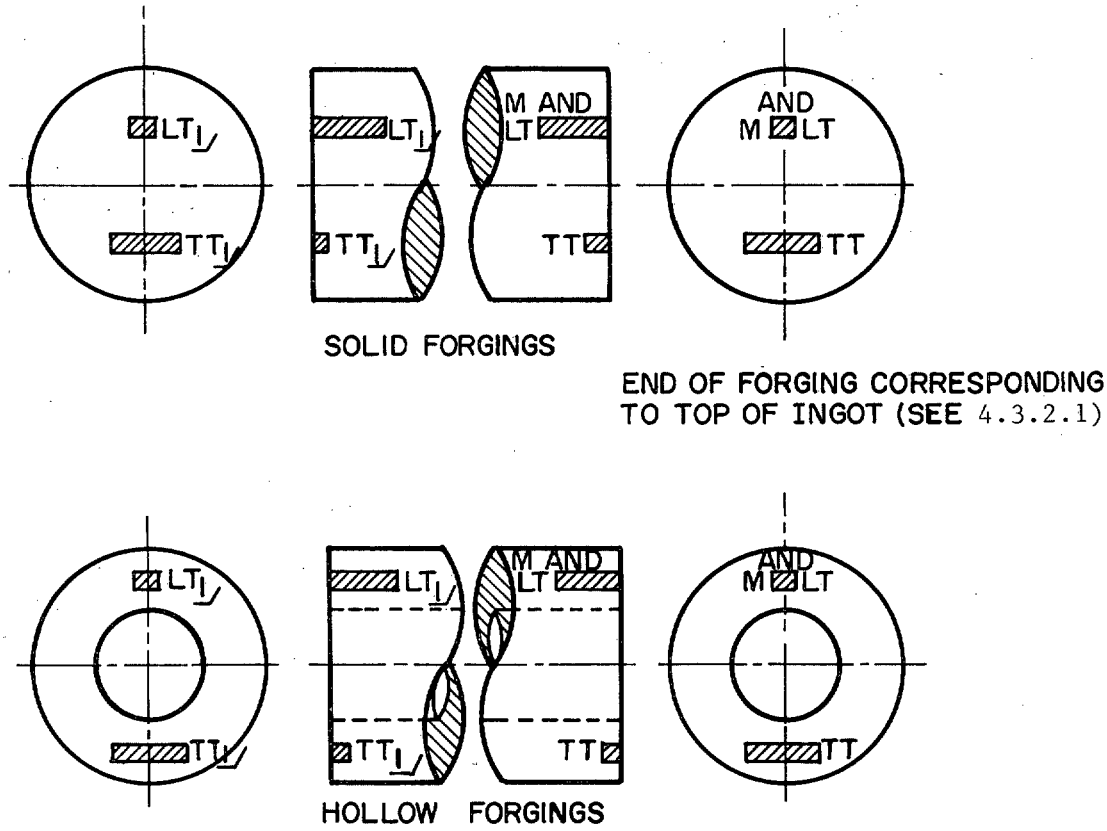

M – MICROSCOPIC TEST SPECIMEN
LT – LONGITUDINAL TENSION TEST SPECIMEN
TT – TANGENTIAL TENSION TEST SPECIMEN

NOTE: MICROSCOPIC TEST SPECIMEN SHALL BE TAKEN FROM MATERIAL REPRESENTING THE UNSTRAINED PORTION OF THE LONGITUDINAL TENSION TEST SPECIMEN AFTER TENSION TESTING.

IT WILL NOT BE NECESSARY TO TAKE THESE TESTS WHEN THE END OF THE FORGING NEAREST THE UPPERMOST PART OF THE INGOT AS CAST IS KNOWN (SEE 4.3.2.1).

FIGURE 1. Location of tension test and microscopic test specimens for pinion forgings.

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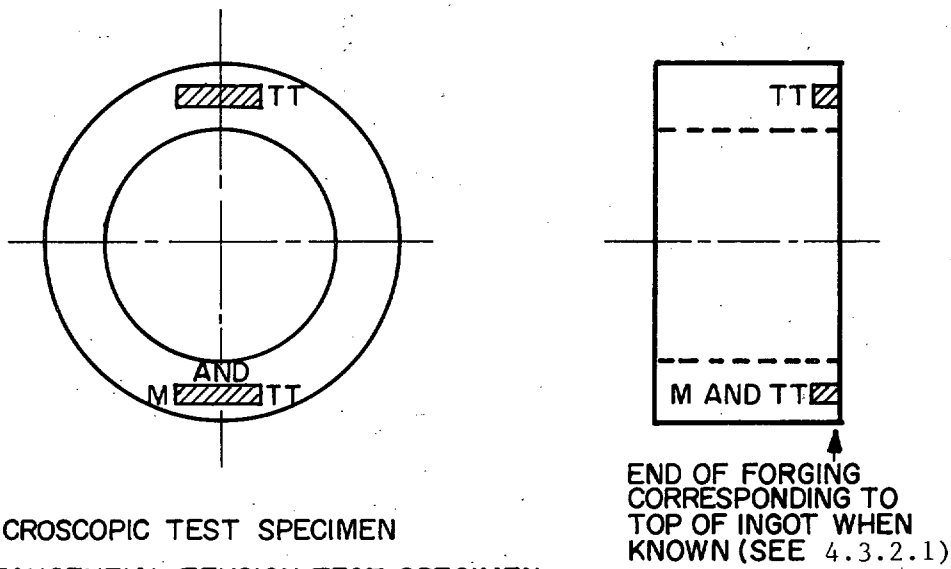

M – MICROSCOPIC TEST SPECIMEN

TT – TANGENTIAL TENSION TEST SPECIMEN

NOTE – MICROSCOPIC TEST SPECIMEN SHALL BE TAKEN FROM MATERIAL REPRESENTING THE UNSTRAINED PORTION OF THE TANGENTIAL TENSION TEST SPECIMEN AFTER TENSION TESTING.

FIGURE 2. Location of tension test and microscopic test specimens for gear rim forgings.

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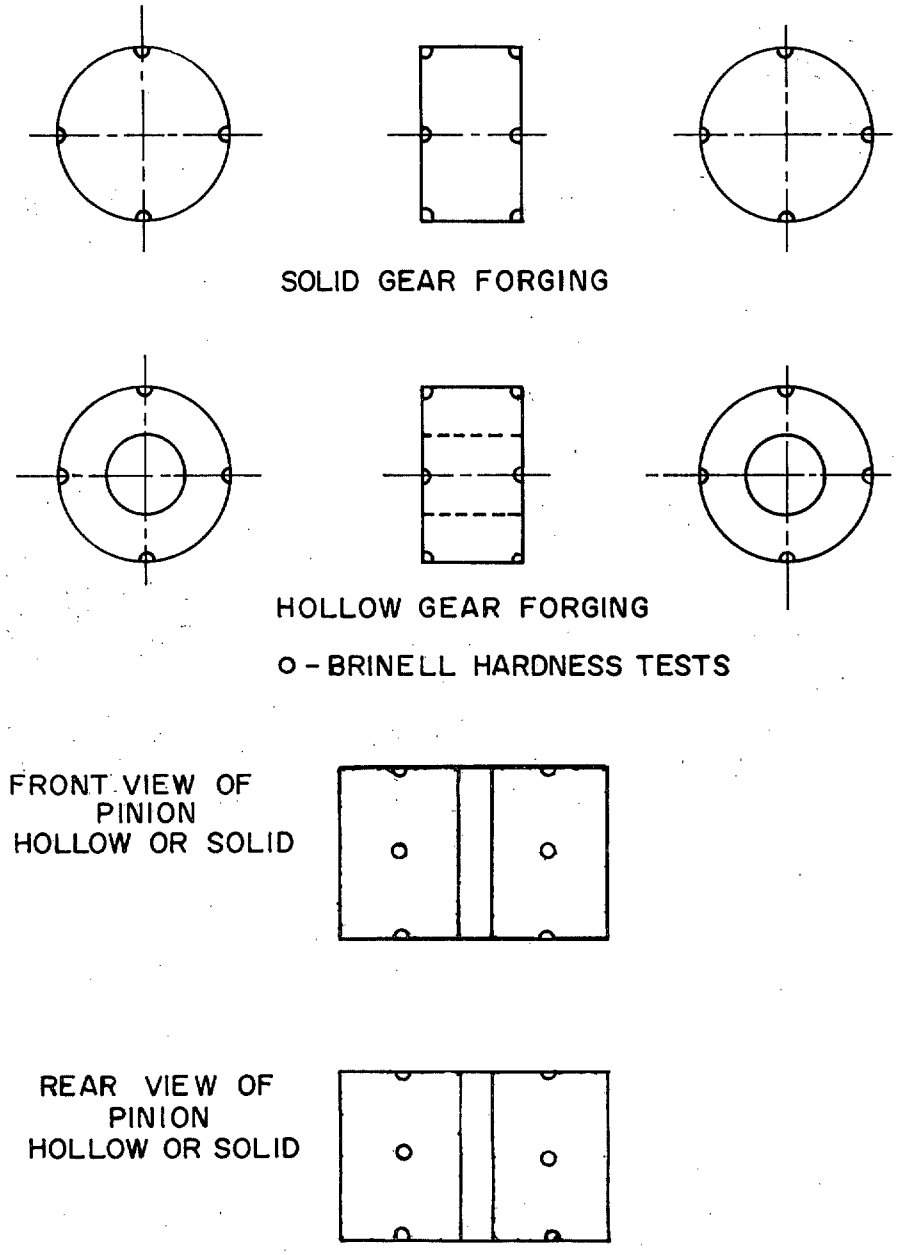

FIGURE 3. Location of hardness tests.

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APPENDIX

TECHNICAL REPORT TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers information that shall be included on technical reports when required by the contract or order. This appendix is applicable only when data item description DI-MISC-80652 is cited on the DD Form 1423.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. TECHNICAL REPORTS

30.1 Heat treatment records. Heat treatment records shall include the time and temperature of all heat treatments.

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

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I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER: MIL-S-19434B(SH)
2. DOCUMENT DATE (YYMMDD): 31 December 1990
3. DOCUMENT TITLE: STEEL GEAR AND PINION FORGINGS, CARBON AND ALLOY, HEAT TREATED, NAVAL SHIPBOARD
4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER
a. NAME *(Last, First, Middle Initial)*
b. ORGANIZATION
c. ADDRESS *(Include Zip Code)*
d. TELEPHONE *(Include Area Code)*
(1) Commercial
(2) AUTOVON *(If applicable)*
7. DATE SUBMITTED *(YYMMDD)*

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(1) Commercial TPOC: 703-602-0143
(2) AUTOVON 8-332-0143
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