

INCH-POUND
MIL-S-23008D(SH)
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SUPERSEDING
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10 April 1981
(See 6.6)

MILITARY SPECIFICATION

STEEL CASTINGS, ALLOY, HIGH YIELD STRENGTH (HY-80 AND HY-100)

This specification is approved for use within 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 grade HY-80 and grade HY-100 steel castings intended for critical structural applications where a weldable, notch-tough, high-strength material is required.

1.2 Classification. Steel castings shall be of the following grades, as specified (see 6.2.1):

- Grade HY-80 - 80,000 pounds per square inch (lb/in²) (552 megapascals (MPa)) tensile yield strength, minimum
- Grade HY-100 - 100,000 lb/in² tensile yield strength, (690 MPa) minimum

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.

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.

AMSC N/A

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SPECIFICATIONS

FEDERAL

- QQ-S-781 - Strapping, Steel, and Seals.
- PPP-B-621 - Boxes, Wood, Nailed and Lock-Corner.

MILITARY

- MIL-C-3774 - Crates, Wood; Open 12,000- and 16,000-Pound Capacity.
- MIL-H-6875 - Heat Treatment of Steel, Process for.
- MIL-C-16173 - Corrosion Preventive Compound, Solvent Cutback, Cold-Application.
- MIL-L-19140 - Lumber and Plywood; Fire-Retardant Treated.
- MIL-C-52950 - Crate, Wood, Open and Covered.

STANDARDS

MILITARY

- MIL-STD-129 - Marking for Shipment and Storage.
- MIL-STD-2149 - Standard Procedures for Explosion Testing Ferrous and Non-Ferrous Metallic Materials and Weldments.
- MIL-STD-1684 - Control of Heat Treatment.
- MIL-STD-1688 - Fabrication, Welding, and Inspection of HY-80/100 Submarine Applications.

(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 370 - Standard Methods and Definitions for Mechanical Testing of Steel Products. (DoD adopted)
- A 700 - Standard Practices for Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment. (DoD adopted)
- A 703 - Standard Specification for Steel Castings, General Requirements, For Pressure-Containing Parts.
- E 23 - Standard Methods for Notched Bar Impact Testing of Metallic Materials. (DoD adopted)
- E 604 - Standard Test Method for Dynamic Tear Testing of Metallic Materials. (DoD adopted)

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

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(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.)

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 First article. When specified in the contract or order, a sample shall be subjected to first article inspection (see 4.3 and 6.3).

3.2 Material. Castings shall be produced from electric furnace or open hearth quality steel which has been made by the procedures and techniques used for production of the first article castings. The steel shall be fully killed and produced to a fine grain practice. Additional refining practices by argon-oxygen decarburization (AOD), are acceptable.

3.2.1 When either chaplets or internal chills are used, they shall be composed of material as specified in table I or of equivalent wrought material.

TABLE I. Chemical composition.^{1/}

Element	Percent ^{2/}	
	Grade HY-80	Grade HY-100
Carbon	0.20	0.22
Manganese	.55-0.75	.55-0.75
Phosphorus	.014	.014
Sulfur	.008	.008
Silicon	.50	.50
Nickel	2.75-3.25	3.00-3.50
Chromium	1.35-1.65	1.35-1.65
Molybdenum	0.30-0.60	0.30-0.60
Vanadium ^{3/}	0.03	0.03
Titanium ^{3/}	.02	.02
Copper ^{3/}	0.25	0.25
Arsenic ^{3/}	.025	.025
Tin ^{3/}	.030	.030
Antimony ^{3/}	.025	.025

^{1/} For definition of lot for heat analysis see 4.4.1.

^{2/} Maximum unless a range is shown.

^{3/} Element shall not be intentionally added.

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3.2.2 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.

3.3 Chemical composition. The chemical composition heat analysis shall be in accordance with table I. Unless otherwise specified (see 6.2.1), product analysis shall conform to table I as modified by the product analysis tolerance as specified in ASTM A 703.

3.4 Mechanical properties. After all heat treatments including stress relief, the material shall meet the mechanical properties specified in tables II and III.

TABLE II. Mechanical properties.

	Grade HY-80	Grade HY-100
Yield strength, at 0.2 percent offset lb/in ² (MPa)	80,000-99,500 (552 to 686)	100,000-120,000 (690 to 793)
Tensile strength, minimum	Information only	Information only
Elongation, percent, minimum in 2 inches (51 mm)	20.0	18.0
Reduction of area, percent, minimum	35.0	30.0

TABLE III. Minimum impact test requirements.^{1/}

Nominal casting thickness		Test temperature ±3°F/±2°C °F (°C)	Charpy test requirements ^{2/} ft-lb(J)	Dynamic tear test requirements
Inches	Milli-meters			
1/2 and over <u>3/</u>	13 and over	minus 100 (minus 73) 0 (minus 18)	50(68) 70(95)	
5/8 and over <u>4/</u>	16 and over	minus 40 (minus 40)		Information only

- ^{1/} Sampling and location of test specimens shall be as specified in 4.3.2.6 for first article and 4.4.3.4 for quality conformance inspection.
- ^{2/} Average of three specimens. No single test value shall be below the minimum average by more than 5 foot-pounds (6.8 joules).
- ^{3/} Unless otherwise specified (see 6.2.1), Charpy impact testing is not required for material less than 1/2 inch (13 millimeters (mm)) in maximum cross-section.
- ^{4/} Unless otherwise specified (see 6.2.1), dynamic tear testing is not required for material less than 5/8 inch (16 mm) in maximum cross-section.

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3.5 Heat treatment. The contractor shall determine the detailed procedure that will produce castings that will meet the mechanical requirements specified herein, with the following restrictions:

- (a) The castings shall be quenched and tempered. The quench and temper shall be preceded by a homogenize or normalize, or anneal heat treatment. When necessary to achieve mechanical properties, double tempering is permitted and the restrictions for single tempering shall apply to double tempering. The final tempering temperature shall be not less than 1190 degrees Fahrenheit ($^{\circ}\text{F}$) (643 degrees Celsius ($^{\circ}\text{C}$)) for grade HY-80 and 1150 $^{\circ}\text{F}$ (621 $^{\circ}\text{C}$) for grade HY-100. After tempering or stress relief, the castings shall be removed from the furnace and rapidly cooled by water quenching.
- (b) When necessary for distortion control, grade HY-80 castings may be stress relieved after final tempering. The stress relief temperature shall be $1125 \pm 25^{\circ}\text{F}$ ($607 \pm 14^{\circ}\text{C}$). Stress relief of grade HY-100 is not permitted unless approved by the Naval Sea Systems Command (NAVSEA) on a case basis.
- (c) The holding time at the stress relief temperature shall be based on the thickness (t) of the maximum weld repair depth. The holding time shall be 1 hour per inch (25 mm) of t up to a thickness of 3 inches (76 mm) or 3 hours plus 15 minutes per inch (25 mm) of t greater than 3 inches (76 mm).
- (d) The contractor shall maintain a complete record of the heat treatments given each casting, including stress relief, and shall prepare a record of the final heat treatment in the certified report (see 4.1.2). The final heat treatment record shall include the time and temperature for the final tempering cycle and the stress relief cycle, if any, and the cooling method used.

3.5.1 Simulated stress relief. When a simulated stress relief is specified in the contract or order (see 6.2.1), a test block as specified in 4.3.1.2 shall be subjected to the stress relief thermal cycle based on the final tempering temperature of the material (see 3.5), and shall be tested for mechanical and impact properties in accordance with 4.4 and shall meet the requirements specified in 3.4. The fabricator (contracting activity) shall specify the stress relief thermal cycles (including cooling rates) to the contractor. Stress relief shall be specified only when necessary to meet machining tolerances.

3.5.1.1 When specified in the contract or order (see 6.2.1), a representative sample as specified in 3.5.1 shall be forwarded with the material to verify properties after the proposed stress relief as specified in the applicable fabrication document.

3.6 Heat treatment equipment and controls. Continuous or automatic heat treating equipment may be employed provided such equipment produces heat-treated castings that meet the requirements specified herein. The furnaces and temperature recording equipment shall be shown to correlate with the actual temperature of the castings and shall be satisfactorily maintained and calibrated on a

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regular scheduled basis in accordance with MIL-H-6875 or MIL-STD-1684. The temperature of the castings shall be recorded during the heating and stress relieving cycles of the heat treatment. After the charge reaches the selected temperature control setting, furnaces for heat treatment of grade HY-80 and grade HY-100 castings shall maintain the temperature of the castings at any point in the working zone within plus or minus 25°F.

3.6.1 Explosion bulge. When specified (see 6.2.1), and for first article testing, the castings shall meet the following requirements when tested in accordance with 4.5.5.

(a) Crack starter.

(1) First shot:

Crack starter bead shall crack.

Percent reduction in thickness shall be obtained for information only.

No piece shall be thrown out of material being tested.

No through-thickness cracks shall be present.

No cracks shall extend into hold-down area.

(2) Second shot:

Percent reduction in thickness shall be obtained for information only.

No piece shall be thrown out of material being tested.

Through-thickness cracks are acceptable.

No cracks shall extend into hold-down area.

(b) Bulge.

(1) First shot:

Percent reduction thickness shall be obtained for information only.

No piece shall be thrown out of material being tested.

No through-thickness cracks shall be present.

No cracks shall extend into hold-down area.

(2) Second shot:

Percent reduction in thickness shall be obtained for information; 3 percent reduction per shot is expected.

No piece shall be thrown out of material being tested.

No through-thickness cracks shall be present.

No cracks shall extend into hold-down area.

(c) Additional shots.

Shots shall continue until both a minimum of four shots and a minimum of 10 percent reduction in thickness is obtained on one or both sides. The performance is considered satisfactory provided the following conditions are met:

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- (1) No piece shall be thrown out of material being tested.
- (2) Through-thickness cracks are acceptable.
- (3) No cracks shall extend into the hold-down area.

Shots shall be discontinued when cracks go into the hold-down area, a through-thickness crack occurs, or if the reduction in thickness and minimum number of shots requirement is met.

NOTE:

The bulge area is defined as that plate over the diehole (9-inch radius) plus the rounded outside corners (3-inch radius) plus 1/2 inch, for a total circle diameter of 25 inches. The hold-down area is defined as the area outside of this circle.

3.7 Cleaning. Prior to final inspection, the castings shall have the heads and gates removed and shall have all sand, scale, fins, and rough spots removed by mechanical means to ACI - surface indicator scale (SIS-3) or better. Any padding added by the foundry to provide directional solidification shall be removed unless provision is made in the contract or purchase order (see 6.2.1) to permit such padding to remain for removal by subsequent machining operations. When heads, gates, and padding are removed by gas cutting or scarfing, the removal shall be performed before the final heat treatment, and in such a manner as to not impair the casting. Gas cutting or scarfing shall be followed by cutting, chipping, or grinding operations, as necessary, to provide the required contour. Flame or arc cutting and beveling of edges is permitted. Gouges on flame or arc cut surfaces shall be repaired in accordance with the specified fabrication document (see 6.2.1), and shall not exceed 1/8 inch (3 mm) in depth or exceed the minimum design dimensions of the material.

3.7.1 Unless otherwise specified (see 6.2.1), chills and chaplets shall not remain with the casting.

3.8 Internal and external soundness. Castings and test blocks shall be of uniform quality and condition, free of defects harmful to their intended use, as determined by visual examination and applicable nondestructive tests, including radiographic examination, ultrasonic testing, and magnetic particle inspection. The degree of inspection and acceptability of discontinuities shall be in accordance with the applicable fabrication document and the contract or purchase order (see 6.2.1).

3.9 Repair of defects. Welding may be used to repair defects in accordance with the applicable fabrication document. The applicable fabrication document shall be as specified (see 6.2.1). Defects not requiring welding may be ground or chipped out provided the width of the defective area is 3 times its depth and gradually tapered into the defect, and the design thickness is not violated. When specified (see 6.2.1), the locations of weld repairs shall be provided with the casting. Repair methods and inspection requirements shall be in accordance with the applicable fabrication document.

3.10 Dimensions and tolerances. The contractor shall provide heat treated castings that can be machined to the finished dimensions within the specified tolerances without further straightening. When required, layout

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points shall be incorporated in the castings and shall be shown on the applicable drawings. Castings shall not be provided excessively oversize or overweight.

3.11 Marking. The castings shall be identified with the contractor's name or trademark and a serial number which will positively identify the casting to pattern, part number, and melt from which they were poured and the lot with which they were heat treated. Markings shall be placed in areas which are least stressed in service and will not be machined off in finishing. The locations of the markings shall be as shown on the drawings (see 6.2.1).

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. When specified in the contract or order, a certificate of quality conformance shall be prepared (see 6.2.2).

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

- (a) First article inspection (see 4.3).
- (b) Quality conformance inspection (see 4.4).

4.3 First article inspection. First article inspection shall consist of the samples specified in 4.3.1.

4.3.1 First article samples. First article samples shall be as specified in 4.3.1 through 4.3.1.3.

4.3.1.1 Castings. The first article sample shall be a casting representative of the largest size to be cast at the facility. One casting of sufficient thickness and complexity to demonstrate the capability to provide

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homogenous castings with uniform chemistry and mechanical properties throughout the volume of the casting shall be cast for first article inspection. Unless otherwise specified (see 6.2.1), HY-80 and HY-100 shall be tested separately.

4.3.1.2 Test block. Test blocks sufficient to meet the testing requirements specified herein shall be provided. Test blocks shall be of the same heat, having the same heat treatment, and heat treated at the same time as the castings. Test block soundness shall be in accordance with 3.8.

4.3.1.2.1 Test block size. The size of the test block shall be in proportion to the diameter (T) of the largest circle that can be inscribed in any cross section of the casting. Two sizes of test blocks shall be heat treated with each lot. One shall represent the maximum T of the largest casting in a lot and one shall represent the maximum T of the smallest casting in a lot. The terms large and small castings are defined by the respective T of each. Where castings representing a lot are identical with regard to minimum or maximum T, one test block will suffice. The minimum dimensions of the test block shall be as specified in table IV.

TABLE IV. Dimensions of test blocks.

Test block sizes	
T, inches (mm)	Test block dimension ^{1/} , inches (mm)
Under 1 (25)	1 by 7 by 7 (25 X 178 X 178)
1 to 2, exclusive (25 to 51)	T by 4.5T by 4.5T
2 to 4, exclusive (51-102)	T by 3T by 3T
4 and over (102)	T by T by $6\sqrt{T}$

^{1/} Dimensions specified are minimum. The dimensions may be increased in order to secure a practical test block for heat treating and cutting tests.

4.3.1.2.2 Test block heat treatment. Test blocks shall accompany the casting through all the heat treatment cycles. The test blocks shall receive the same thermal treatment as the parent castings.

4.3.1.3 Explosion bulge test specimens. A minimum of 12 plates, 2 by 16 by 55 inches (51 by 406 by 1397 mm) shall be cast to evaluate the explosion bulge properties.

4.3.2 First article inspection. First article inspection shall consist of the examination and tests of 4.3.2.1 through 4.3.2.8.

4.3.2.1 Examination. The castings shall be inspected to ensure soundness and freedom from defects by the same method specified for the production castings (see 3.9). If no method is specified, radiography to the applicable category of MIL-STD-1688 shall be used.

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4.3.2.2 Test specimen location. Test specimens for first article inspection shall be taken from the samples poured with the heat or from prototype castings cast for first article samples. Samples shall be taken from the prototype castings at the center and from the opposite extremes (the locations between which the longest straight line can be drawn). Test specimens shall be taken at a depth of $T/2$ from the heat-treated surface for T up to 4 inches where T is defined as the as-quenched thickness (minimum dimension) of the heaviest cross-section of the casting or as defined in 4.3.1.2.1 for test blocks. For T greater than 4 inches and less than or equal to 12 inches, test specimens shall be taken at a depth of $T/4$ or 2 inches, whichever is greater. For T greater than 12 inches, test specimen location shall be approved.

4.3.2.3 Chemical analysis. Samples sufficient to perform chemical analysis shall be taken from each of the locations specified in 4.3.2.2 and a prepared heat analysis sample. Specimens shall meet the requirements specified in 3.3 when tested in accordance with 4.5.1. The range over which the chemical analysis method that is used can be shown to be accurate for the particular element reported shall be provided (see 6.3).

4.3.2.4 Tensile test. One tensile test specimen shall be taken at each location specified in 4.3.2.2. Specimens shall meet the requirements specified in table II when tested in accordance with 4.5.2.

4.3.2.5 Charpy V-notch. A set of three Charpy impact specimens from each of the locations specified in 4.3.2.2 shall be tested at 0°F (minus 18°C), minus 40°F (minus 40°C), and minus 100°F (minus 73°C). The specimens shall meet the requirements specified in table III when tested in accordance with 4.5.3.

4.3.2.6 Dynamic tear. Two dynamic tear test specimens shall be taken from both the casting and the test blocks. The test specimens shall be taken a maximum distance of $T/4$ from the centerline of the casting and no surface of the test specimen shall be closer than $T/4$ from any surface of the test block. The specimens shall meet the requirements specified in table III when tested in accordance with 4.5.4.

4.3.2.7 Transition test curve. Charpy V-notch and dynamic tear transition curves shall be formed from impact specimens taken from the thickest sections of the castings and tested at minus 100°F (minus 73°C), minus 80°F (minus 62°C), minus 40°F (minus 40°C), 0°F (minus 18°C), and 30°F (minus 1°C). A minimum of three specimens shall be tested at each temperature.

4.3.2.8 Explosion bulge. The explosion bulge specimens specified in 4.3.1.3 shall meet the requirements specified in 3.6.1 when tested in accordance with 4.5.5.

4.3.2.9 First article inspection report. When specified in the contract or order, a first article inspection procedure and report shall be prepared (see 6.2.2).

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4.4 Quality conformance inspection.

4.4.1 Lot size. For purposes of inspections and tests, lot sizes shall be defined as follows:

- (a) Chemical or spectrographic analysis. Each melt of steel shall be a lot. Also, a ladle consisting of a number of smaller melts when properly stirred shall be a lot. For remelted vacuum arc remelt (VAR) or electroslag remelt (ESR) products, a lot for heat analysis shall be defined as a chemical analysis obtained from the products of one remelted ingot of each melt. In the case of AOD, each charge of AOD vessel is considered a lot for heat analysis.
- (b) Mechanical tests. Castings produced from one heat or melt, heat treated under similar conditions in the same heat treating charge, shall constitute a lot.
- (c) Examination and inspection. Each casting shall constitute a lot.

4.4.2 Sampling for chemical analysis. The test sample shall be taken during the pouring of the heat at a time which, in the contractor's judgement, best represents the composition of the cast. In case the heat analysis samples are lost or inadequate, or when it is evident that the sample does not truly represent the heat, representative samples may be taken from the castings, in which case such samples may be analyzed. The analysis shall meet the specified limits for heat analysis. Product analysis limits shall apply only when the analysis is performed by the purchaser.

4.4.3 Sampling for mechanical tests. Test blocks in accordance with 4.3.1.2 shall be provided for mechanical tests as specified in the contract or purchase order (see 6.2.1). Test specimen location shall be in accordance with 4.3.2.2.

4.4.3.1 Sampling for mechanical tests following simulated stress relief. When specified (see 6.2.1), sample material shall be subjected to simulated stress relief operations after quenching and tempering, but prior to testing for conformance to the mechanical property requirements of 3.4. The sample material shall not be removed from the material prior to quenching and tempering. The total time at temperature and cooling rate for the simulated stress relief operation shall be as specified (see 6.2.1). The cooling rate and the maximum and minimum time at temperature used on the sample material shall be incorporated in the test certification, if applicable, along with the destructive and nondestructive test results (see 4.1.2).

4.4.3.2 Sampling for tensile test. One specimen shall be taken from the test block representing the lot.

4.4.3.3 Sampling for Charpy V-notch tests. Three Charpy V-notch test samples shall be taken for each test temperature from a test block representing the lot.

4.4.3.4 Sampling for dynamic tear test. Two samples shall be taken from the test block representing the lot.

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4.4.4 Examination.

4.4.4.1 Visual and dimensional examination. Each casting shall be examined for conformance to the specified dimensions and shall be visually examined to determine conformance to the requirements of 3.7, 3.8 and 3.11.

4.4.4.2 Nondestructive testing. Each casting shall be examined for conformance to the requirements of the applicable fabrication documents.

4.5 Test procedures.

4.5.1 Chemical analysis. The sample selected in accordance with 4.4.2 shall be analyzed in accordance with a standard ASTM method or a method that will assure accurate results for conformance to 3.3. The methods shall be correlated with National Bureau of Standards standard reference materials, when available, to ensure the validity of the method that is used as a control in chemical analysis or for the calibration in instrumental methods of analysis. If any analysis fails to conform to 3.3, and product analyses are determined, the product analyses shall be used to determine acceptance or rejection.

4.5.2 Tensile tests. Tensile testing shall be in accordance with ASTM A 370. The largest round standard tensile specimens of ASTM A 370 which can be obtained from the test material shall be prepared and tested.

4.5.3 Charpy impact test. The impact strength shall be determined in accordance with ASTM E 23 using the type A, Charpy V-notch specimen and the Charpy (simple beam type) apparatus complying with the construction requirements of ASTM E 23. In addition, the accuracy of the Charpy impact machine shall be verified in accordance with the requirements for standard specimens of ASTM E 23.

4.5.4 Dynamic tear test. The test specimens selected in accordance with 4.4.3.4 shall be tested in accordance with ASTM E 604.

4.5.5 Explosion bulge tests. The explosion bulge specimen shall be fabricated and tests conducted in accordance with MIL-STD-2149. Specimens shall be tested with reinforcement in place.

4.6 Retests. When a test specimen representing a lot of material fails to meet the requirements specified herein, the lot shall be rejected. The contractor may rework or retest the lot as provided herein. The contractor shall keep rejected lots identified and separate from acceptable lots until the rejected lots are withdrawn by the contractor or demonstrated as meeting the requirements specified herein.

4.6.1 Reheat treatment. The contractor will be permitted to reheat castings which fail to meet the tensile or impact requirements of this specification. Required tests originally performed on the failed castings, except chemical analysis, shall be repeated when the material is reinspected.

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4.6.2 Replacement of test specimens. A test specimen may be discarded and replaced with a specimen taken from the same approximate location under the following conditions:

- (a) When the specimen is incorrectly machined.
- (b) When the test procedure is incorrect.
- (c) When there is malfunction of the testing equipment.
- (d) When the test specimen shows an obvious lack of continuity; such as, porosity, slag, sand, and so forth.

4.7 Inspection of packaging. Sample 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 shipboard stowage fire-retardant requirements. Unless otherwise specified (see 6.2.1), 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:

Levels A and B - Type II - weather resistant.
Category 1 - general use.

5.2 Preservation. Preservation shall be level A or commercial, as specified (see 6.2.1).

5.2.1 Level A.

5.2.1.1 Preservative application. Unless otherwise specified (see 6.2.1), machined surfaces of castings shall be protected with an application of preservative conforming to grade 1 or grade 4 of MIL-C-16173.

5.2.1.2 Wrapping. Castings weighing less than 50 pounds each without preservative application shall be individually wrapped with a minimum of two thicknesses of 40-pound basis weight kraft paper. For castings with preservative application, two thicknesses of equal weight grease-proof paper shall be used for wrapping.

5.2.2 Commercial. Commercial preservation shall be as specified in ASTM A 700.

5.3 Packing. Packing shall be level A, B, or commercial, as specified (see 6.2.1).

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5.3.1 Level A.

5.3.1.1 Small castings. Small castings weighing less than 200 pounds each shall be packed individually, or in multiple units with adequate blocking or bracing in nailed wood boxes conforming to PPP-B-621, class 2, with box closure and strapping in accordance with the appendix to the box specification. Small castings may also be bundled utilizing steel strapping conforming to QQ-S-781, class 1, finish A. The gross weight shall not exceed 200 pounds for boxes or 250 pounds for bundles.

5.3.1.2 Large castings. Castings that exceed the boxed gross weight of 200 pounds and have projections which may be damaged in handling or shipping, shall be packed individually or in multiple units with adequate blocking and bracing in an unsheathed crate conforming to MIL-C-3774 or MIL-C-52950. Type, style, and crate selection shall be at the option of the contractor. The gross weight of the crates shall not exceed 500 pounds unless individual castings exceed this weight. Steel strapping shall be applied in accordance with the applicable crate specification.

5.3.1.2.1 Castings weighing more than 200 pounds each and not subject to damage in shipment may be shipped unpacked.

5.3.2 Level B. Small and large castings shall be packed as specified in 5.2.1 except that wood boxes shall be of the domestic class and steel strapping is not required.

5.3.3 Commercial. Commercial packing shall be in accordance with ASTM A 700.

5.4 Marking. In addition to any special marking required (see 6.2.1), levels A and B shipments shall be marked in accordance with MIL-STD-129, commercial in accordance with ASTM A 700.

6. NOTES

6.1 Intended use. Grade HY-80 and HY-100 alloy steel castings are intended for critical structural applications where a weldable, notch-tough, high-strength material is required. References to the contractor in this application are meant to apply to a specific steel casting foundry facility.

6.1.1 The use of grade HY-80 and HY-100 steel in fabricated structures or equipment entails much more than a material specification and caution is advised in the areas of welding and fabrication. Applicable fabrication documents should be required for any construction with these materials.

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6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Grade required (see 1.2).
- (c) When first article inspection is required (see 3.1).
- (d) If product analysis is to be other than specified (see 3.3).
- (e) When a simulated stress relief sample is required, the number of thermal cycles, the heating and cooling rates, and time at temperature should be specified (see 3.5.1).
- (f) When a representative sample is to be forwarded to verify properties after stress relief (see 3.5.1.1).
- (g) If Charpy V-notch or dynamic tear impact tests are required below the minimum thickness specified (see table III).
- (h) When explosion bulge tests are required (see 3.6.1).
- (i) When padding added by the foundry may be allowed to remain for removal by subsequent machining operations (see 3.7).
- (j) Applicable fabrication document required (see 3.7 and 3.9).
- (k) When chills and chaplets may remain with the casting (see 3.7.1).
- (l) The degree of inspection and the acceptability requirements (see 3.8).
- (m) When the locations of weld repairs are to be provided with the casting (see 3.9).
- (n) Locations of markings shown on drawings (see 3.11).
- (o) If HY-80 and HY-100 castings are to be first article tested together (see 4.3.1.1).
- (p) When test blocks are to be provided (see 4.4.3).
- (q) When sample material is to be subjected to simulated stress relief (see 4.4.3.1).
- (r) Total time at temperature and cooling rate for simulated stress relief (see 4.4.3.1).
- (s) When fire-retardant treatment is not required (see 5.1.1).
- (t) Level of preservation and packing required (see 5.2).
- (u) When preservation application is not required (see 5.2.1.1).
- (v) Special marking required (see 5.4).
- (w) When first article approval for previous revisions are not valid for this revision (see 6.3.1).
- (x) When first article test data for one grade material may not be used for first article approval of the other grade material (see 6.3.2).

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 27.475-1 (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>
4.1.2	Certification data/report	UDI-A-23264	---
4.3.2.9	First article inspection procedure	DI-T-4901	---
4.3.2.9	First article inspection report	DI-T-4902	---

(Data item descriptions related to this specification, and identified in section 6 will be approved and listed as such in DoD 5010.12-L., 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 First article. When a first article inspection is required, the item should be a first article sample. The first article should consist of one unit. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.3.1 First article approval. Unless otherwise specified (see 6.2.1), first article approval for previous specification revisions or amendments are valid for this revision.

6.3.2 Prior to delivery, contractors who have not previously produced castings under this specification of the strength level specified should demonstrate to NAVSEA that their facilities are capable of quality production of castings conforming to the requirements of this specification. Unless otherwise required by the contract or purchase order (see 6.2.1), when grade HY-100 cast material has met first article test requirements, grade HY-80 material may be reviewed for first article approval by submitting the required first article data, exclusive of explosion bulge tests.

6.3.3 Where a contract does not exist, the contractor may submit first article data directly to NAVSEA for verification. The first article inspection report should be verified by the Defense Contract Administration Services Management Area (DCASMA) or American Bureau of Shipping (ABS) representative.

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The report should be forwarded to the Commander, Naval Sea Systems Command, Materials Engineering Division, via DCASMA. Upon review of the report, authorization will be forwarded for preparation of test specimens for the explosion bulge tests as required by MIL-STD-2149, and instructions will be furnished for shipment to a designated Government testing location. Specimen preparation and testing will be verified by DCASMA or ABS.

6.4 Receipt inspection. The castings will be subject to receipt inspection by the contracting activity to verify conformance to all requirements specified herein. Castings not conforming to the requirements specified herein may be rejected by the contracting activity. The contractor may verify the results of the contracting activity's receipt inspection. It is the responsibility of the contracting activity to determine the acceptability of the castings for the intended application.

6.5 Subject term (key word) listing.

Charpy V-notch
Explosion bulge
Nondestructive testing

6.6 Changes from previous issue. Asterisks 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
(Project MECA-N366)

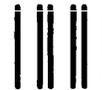
INSTRUCTIONS: In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge (*DO NOT STAPLE*), and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

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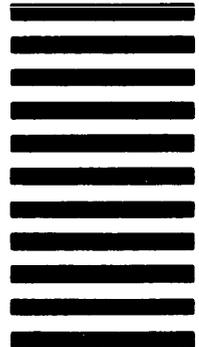
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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER MIL-S-23008D(SH)		2. DOCUMENT TITLE STEEL CASTINGS, ALLOY, HIGH YIELD STRENGTH (HY-80 AND HY-100)	
3a. NAME OF SUBMITTING ORGANIZATION		4. TYPE OF ORGANIZATION (Mark one) <input type="checkbox"/> VENDOR <input type="checkbox"/> USER <input type="checkbox"/> MANUFACTURER <input type="checkbox"/> 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)	

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