

MIL-S-24645(SH)
4 September 1984

MILITARY SPECIFICATION

STEEL PLATE, SHEET, OR COIL, AGE-HARDENING ALLOY,
STRUCTURAL, HIGH YIELD STRENGTH (HSLA-80)

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 80,000 pounds per square inch (lb/in²) high yield strength, age-hardening alloy steel coil, sheet and plate (HSLA-80) intended primarily as a replacement for HY-80 steel for approved uses in critical structural applications where a notch-tough high-strength material is required.

1.2 Classification. Steel plate, sheet or coil covered by this specification shall be of the following types, as specified (see 6.2.1):

Type I - Plate, sheet or coil, where ultrasonic testing for soundness and thickness is not performed.

Type II - Plate over 1/2 inch in thickness where ultrasonic testing for soundness and thickness is performed.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Standards. Unless otherwise specified, the following standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

STANDARDS

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MIL-STD-163 - Steel Mill Products, Preparation for Shipment and Storage.

MIL-STD-248 - Welding and Brazing Procedure and Performance Qualification.

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 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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- MIL-STD-271 - Nondestructive Testing Requirements for Metals.
- MIL-STD-1688 - Fabrication, Welding, and Inspection of HY-80/100 Submarine Applications.
- MIL-STD-1689 - Fabrication, Welding, and Inspection of Ships Structure.
- MIL-STD-2149 - Standard Procedures for Explosion Testing Ferrous and Non-Ferrous Metallic Materials and Weldments.

2.1.2 Government publications. The following Government publications form a part of this specification to the extent specified herein.

PUBLICATIONS

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

- 0900-LP-003-8000 - Metals, Surface Inspection Acceptance Standards.
- 0900-LP-005-6000 - Surface Standards for High Yield Strength Nickel Bearing Alloy Steel.

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue in the current DoDISS and the supplement thereto, if applicable.

ASTM

- A 6 - Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use, General Requirements for. (DoD adopted)
- A 20 - Steel Plates for Pressure Vessels, General Requirements for. (DoD adopted)
- A 370 - Mechanical Testing of Steel Products, Methods and Definitions for. (DoD adopted)
- A 505 - Steel Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled, General Requirements for. (DoD adopted)
- A 673 - Sampling Procedure for Impact Testing of Structural Steel. (DoD adopted)
- E 112 - Determining Average Grain Size. (DoD adopted)
- E 208 - Conducting Drop-Weight Test to Determine Nil-Ductility Transition Temperature of Ferritic Steels.
- E 604 - Dynamic Tear of Metallic Materials, Test for.

(Application for copies should be addressed to ASTM, 1916 Race Street, Philadelphia, PA 19103.)

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

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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, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2.1), a sample shall be subjected to first article inspection (see 4.3 and 6.3).

3.2 Materials. Plates, sheets or coils shall be made from ingots or slabs which have been made by the same process used for production of the first article plates. Unless otherwise approved by NAVSEA, the steel shall be fully killed, vacuum degassed and produced to fine grain practice. The steel may be cast by conventional methods or may be strand cast, in which case only the product of a single ladle may be cast at one time. The ratio of reduction from strand cast slab to plate shall be a minimum of 3 to 1. Other production practices if approved by NAVSEA may be used to produce this steel.

3.2.1 For thicknesses of 3/8 inch and less, vacuum degassing is not required.

3.2.2 Low sulfur melt practice with calcium treatment or other NAVSEA approved low sulfur melt practices shall be used in the production of this steel.

3.2.3 Recovered materials. Unless otherwise specified herein, all material incorporated in the products covered by this specification shall be new and shall 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.

3.3 Chemical compositions. The chemical composition shall be as specified in table I. In cases where both heat and product analysis are determined the product analysis shall be used to determine acceptance or rejection (see 4.6.1).

TABLE I. Chemical composition (heat and product analysis).

Element	Maximum percent by weight ^{1/} unless a range is shown or otherwise noted
Carbon	0.07
Manganese	0.40 - 0.70
Phosphorus	0.025
Sulfur ^{2/}	0.010
Silicon	0.40
Nickel	0.70 - 1.00
Chromium	0.60 - 0.90
Molybdenum	0.15 - 0.25
Copper	1.00 - 1.30
Columbium	0.02 - 0.06
Aluminum	<u>3/</u> <u>4/</u>

See footnotes at end of table.

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TABLE I. Chemical composition (heat and product analysis). - Continued

Element	Maximum percent by weight ^{1/} unless a range is shown or otherwise noted
Vanadium	<u>4/</u>
Titanium	<u>4/</u>
Arsenic	<u>4/</u>
Antimony	<u>4/</u>

- 1/ The chemical tolerances as specified in ASTM A 6 are to be applied to both heat and product analysis.
- 2/ Low sulfur practice with calcium treatment for inclusion shape control shall be used (see 3.2.2).
- 3/ Minimum acid-soluble aluminum content of 0.015 percent or minimum total aluminum content of 0.010 percent for each ladle of each heat.
- 4/ Chemical composition shall be reported.

3.4 Mechanical properties. The material shall meet the tensile property requirements as specified in table II and the impact property requirements as specified in table III after all heat treatments.

TABLE II. Tensile properties.

Ultimate tensile strength, (lb/in ²)	<u>1/</u>
Yield strength, 0.2 percent offset (lb/in ²)	<u>2/</u> 80,000 to 99,500
Elongation, in 2 inches, minimum (percent)	<u>3/</u> 20
Reduction in area, minimum, round specimen (percent)	50

- 1/ To be recorded for information only.
- 2/ For material less than 1/4 inch in thickness, the yield strength shall be 80,000 to 109,500 lb/in².
- 3/ For material less than 1/4 inch in thickness, the elongation requirement shall be 14 percent.

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TABLE III. Impact requirements.

Test	Thickness nominal (inch)	Specimen size ^{5/}	Energy ^{2/ 3/ 6/} foot-pounds, average of three tests, minimum	Test (coolant) temperature (°F)
Charpy V-notch ^{1/} transverse	7/16 inch and over ^{7/}	10 mm x 10 mm	35 60	-120 \pm 3 0 \pm 3
Drop weight ^{4/} Nil-ductility	5/8 inch and over	-----	-----	-70 \pm 3

- ^{1/} As an alternative to Charpy impact testing of plate with a minimum thickness of 5/8 inch, dynamic tear testing may be substituted at the option of the contractor when approved by the command or agency concerned. The transverse dynamic tear energy required is 450 foot-pounds (ft-lb) at minus 40 \pm 3 degrees Fahrenheit (°F).
- ^{2/} Three tests transverse to the final direction of plate rolling.
- ^{3/} No single value shall be below the minimum average required by more than 5 ft-lb or equivalent fraction as designated by the appropriate standard subsize specimen.
- ^{4/} Drop weight nil-ductility tests shall be conducted in accordance with ASTM E 208 and shall exhibit "no-break" condition at minus 70 \pm 3°F.
- ^{5/} Subsize specimen as provided in ASTM A 673.
- ^{6/} Equivalent absorbed energy for subsize specimens as specified (see 6.2.1).
- ^{7/} Unless otherwise specified (see 6.2.1), minimum plate thickness for Charpy V-notch testing.

3.5 Heat treatment. Unless otherwise specified (see 6.2.1), the contractor shall determine the detailed procedure to produce products meeting the mechanical requirements of this specification with the following restrictions:

- (a) The heat treatment shall be as specified (see 6.2.1) for classes 1, 2 or 3 as follows:
- (1) Class 1 - Rolled and precipitation heat treated. This class is usually used for thin plate, sheet or coil in order to maintain flatness requirements, and shall be less than 5/16 inch in thickness.
 - (2) Class 2 - Normalized and precipitation heat treated. This class cannot provide adequate strength in thicker plates and is permissible only for thin coil, sheet or plate intended for fabrication of built-up shapes where control of material flatness is important. Class 2 thickness shall be less than 5/16 inch.
 - (3) Class 3 - Solution treated, quenched and precipitation heat treated. This class provides the optimum combination of strength and toughness and is recommended for material 5/16 inch to 2-1/2 inches in thickness.

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- (b) The plate shall not be stress relieved.
- (c) Temperature of the precipitation heat treatment or reheat treatment shall exceed 1100°F unless otherwise approved by NAVSEA.

3.6 Surface quality. The depth of rolled-in scale, pits or other defects shall not exceed 0.015 inch and shall not result in an undergage condition. Isolated, individual pits not over 0.030-inch deep or within 6 inches of each other are acceptable provided plate, sheet or coil thickness is not reduced below the specified minimum. NAVSEA 0900-LP-005-6000 may be used for guidance. Surface imperfections may be removed by grinding, provided the thickness is not reduced below the minimum required and the ground area is smoothly faired into surrounding metal.

3.6.1 Weld repair of mill defects after heat treatment. Unless otherwise specified (see 6.2.1), weld repair after final heat treatment shall be permitted. Mill imperfections may be repair welded by the contractor or referred to the consignee for acceptance and so noted on the inspection reports with subsequent repair welding to be performed by the consignee. Areas of the plate, sheet and coil found to have less than the minimum specified thickness may have the thickness restored by welding the depressed area. The following limitations shall apply to all weld repairs:

- (a) The total area to be repaired shall not exceed 1 percent of the surface of one side of the plate, sheet or coil.
- (b) The depth of any area to be repaired shall not exceed one-half the minimum plate or coil thickness specified or 1/2 inch whichever is less. The depth of the area to be repaired shall be a minimum of 1/16 inch.
- (c) Areas within 2 inches of each other which require weld repair shall be combined to form a single repair.
- (d) Areas to be welded shall be ground to assure that the welds are made on clean, sound metal.
- (e) After preparation for repair and prior to welding, the depressed areas shall be magnetic particle inspected in accordance with MIL-STD-271, and shown to be free of linear discontinuities.
- (f) Weld repairs shall be made in accordance with MIL-STD-1688, MIL-STD-1689, or the applicable fabrication document (see 3.8). Procedures and personnel shall be qualified in accordance with MIL-STD-248.
- (g) The final repaired surface shall be ground smooth and shall be essentially flush with the adjacent surface and free of undercut in excess of 0.020 inch. No point of the finished weld surface shall be below the adjacent surface.
- (h) Surface weld repairs shall be magnetic particle inspected after final grinding (or subsequent heat treatment, if applicable) in accordance with MIL-STD-271. Welds and adjacent heat affected zone surfaces shall be free of relevant linear indications longer than 1/8 inch in accordance with NAVSEA 0900-LP-003-8000.
- (i) Repaired areas shall be marked. The markings shall remain legible and shall not be removed prior to performing all inspections required by this document.

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- (j) Notations of repaired areas shall be made on the plate, sheet or coil inspection form as part of the records.
- (k) If a nonheat treatable electrode is used, reheat treatment of the plate, sheet or coil shall be prohibited.

3.6.1.1 Weld repairs of mill defects prior to heat treatment. Weld repairs of mill imperfections may be accomplished prior to heat treatment within the limitations as specified in 3.6.1 except, such weld repairs shall be made using a NAVSEA approved heat treatable electrode.

3.6.2 Edge defects. Visual laminar edge defects less than 1/4-inch long shall be acceptable. Laminar edge defects 1/4-inch long and over shall be explored by ultrasonics on the surface adjacent to the affected area. Edge defects that extend into the material which will result in rejectable defects according to the ultrasonic acceptance standards specified in table IV shall be cause for rejection. Laminar edge defect weld repairs shall be made using a NAVSEA approved weld procedure.

3.7 Internal soundness and thickness. Type II plates over 1/2 inch in thickness or other thicknesses when specified (see 6.2.1), shall be ultrasonically inspected for internal soundness and ultrasonically measured for decimal thickness. The plate shall meet the internal soundness requirements as specified in table IV. Ultrasonic inspection shall be in accordance with appendix A.

TABLE IV. Ultrasonic indications and acceptance standards.

Recordable indications	Acceptance standards
(a) Back reflection amplitude is reduced (but not transposed) over 50 percent. (b) The transposed back reflection "T" has an amplitude over 50 percent (see 3.7.1(b)).	Material is rejectable whenever it is found, using procedures in accordance with appendix A, that the transposed back reflection is continuous in one plane over an area 4 square inches or larger.

3.7.1 Classification and reporting of internal soundness. Internal conditions evaluated by ultrasonic inspection shall be classified and reported as follows:

- (a) When the back reflection amplitude is reduced below 50 percent but not transposed, report its height as percentage of full back reflection.
- (b) When an indication to the left of the first back reflection exceeds 50 percent due to transposition, designate this condition by the letter T. Demonstrated T areas shall be outlined in the inspection report.

3.8 Applicable fabrication document. If applicable, the fabrication document shall be specified in the contract to the plate manufacturer (see 6.2.1) and shall cover the repair and the inspection of the base metal.

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3.9 Tolerances.

3.9.1 Thickness, weight and gage. Type I plate, sheet or coil and type II plate or coil shall be ordered to the tolerances specified in ASTM A 6 if thickness is 3/16 inch or greater or as specified (see 6.2.1). For material less than 3/16 inch in thickness the tolerances of ASTM A 505 shall apply.

3.9.2 Flatness and waviness. Plate or coil, 3/16 inch or greater in thickness shall be ordered to the requirements of ASTM A 6 or as specified (see 6.2.1). For material less than 3/16 inch in thickness, the tolerances of ASTM A 505 shall apply.

3.9.3 Camber. Plates or coil shall not exceed the tolerance limits of ASTM A 6 or as specified (see 6.2.1). For material less than 3/16 inch in thickness, the tolerances shall be as specified in ASTM A 505.

3.9.4 Size tolerances. The width and length of the plates shall not vary in excess of the tolerances of ASTM A 6 or as specified (see 6.2.1). For material less than 3/16 inch in thickness, the tolerances shall be as specified in ASTM A 505.

3.10 Cleaning and preservation of plate, sheet or coil surfaces. Unless otherwise specified (see 6.2.1), the surfaces of the plate, sheet or coil shall be descaled and coated as specified in appendix B for the specified environment and exposure duration (see 6.2.1).

3.11 Marking. Each plate, sheet or coil shall be indentation stamped with heat number, plate number, the type number, the class number, the grade and the designation HSLA-80. Where the plate, sheet or coil number provides positive identification of any required numbers, the numbers may be omitted from the markings. When the plates, sheets, or coils are cut into smaller sizes for delivery, each piece shall be marked with the required data. The marking may be painted or stenciled in lieu of die stamped on material 1/4-inch thick and less.

3.12 Explosion bulge. When required for first article inspection for plate (see 6.2.1), two crack starter and four explosion bulge specimens shall be subjected to explosion bulge testing (see 4.3.1). For each shot, the temperature of the plate weldment shall be $0 \pm 3^{\circ}\text{F}$, unless otherwise specified (see 6.2.1). Performance is considered satisfactory provided the following requirements are met:

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(a) Crack starter.

First shot:

Crack starter bead must crack.
 Percent reduction in thickness 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.^{1/}

Second shot:

Percent reduction in thickness 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.^{1/}

(b) Bulge.

First shot:

Percent reduction in thickness 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.^{1/}

Second shot:

Percent reduction in thickness 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.^{1/}

Additional shots:

Shots shall continue until a reduction in thickness of 16 percent is obtained on one or both sides.
 The performance is considered satisfactory provided the following conditions are met:
 No piece shall be thrown out of material being tested.
 Through thickness cracks are acceptable.
 No cracks shall extend into the hold-down area.^{1/}
 Shots shall be discontinued when cracks go into the hold-down area, if a through thickness crack occurs, or if the reduction in thickness requirements are met. The material is rejected if the reduction in thickness criteria is not met when shots are discontinued.

^{1/} The bulge area is defined as an unrestricted area of weldment in plate test specimens subjected to explosive loading. For 2 inch thick plates, 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.

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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 Certification of quality compliance. A certificate of quality compliance shall be prepared for each lot of material offered for acceptance in accordance with the data ordering document (see 6.2.2). The certificate shall include actual data of specified chemical and mechanical tests and a record of the final precipitation hardening temperature. Qualitative results of nondestructive tests and other inspections or tests shall be recorded on the certificate. The certificate shall state that each lot has been sampled, tested and inspected in accordance with the specification requirements herein, and that the manufacturer has maintained manufacturing procedures and practices to produce plates, sheet or coils that meet the minimum property requirements throughout the material. The certificate shall state that each lot meets all specification requirements and shall be signed by a responsible representative of the contractor.

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 examination and tests as specified in 4.5 and 4.6 and record the following information:

- (a) Standard specification data (chemistry, mechanical properties, visual, dimensional and ultrasonic inspection results), from typical production stock.
- (b) Charpy V-notch transition curves (transverse to rolling direction) with data points at each temperature of minus 120°F, minus 60°F, minus 30°F, 0°F, plus 30°F and room temperature. A minimum of five specimens for each point is required and individual values shall be reported.
- (c) Report of production line operations (such as melt practice, processing history and heat treatment details).
- (d) Weld procedure qualification test data.
- (e) Dynamic tear test transition curves (transverse to rolling direction) with data points at each of the temperatures: minus 80°F, minus 40°F, 0°F, plus 40°F and room temperature.
- (f) Report the average ferrite grain size measured in accordance with the planimetric procedure of ASTM E 112 of the product in the heat treated condition (see 3.5).

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4.3.1 First article samples. The first article sample shall consist of sufficient material from one heat to obtain measurements of the notch toughness, mechanical properties of the materials and its weldability. When specified by NAVSEA to evaluate weldment performance, weldments shall be required to be explosion bulge tested as specified in MIL-STD-2149 with Government direction.

4.3.2 First article inspection report. A first article inspection report shall be prepared in accordance with the data ordering documents included in the contract or order (see 6.2.2).

4.4 Quality conformance inspection.

4.4.1 Lot.

4.4.1.1 Lot for chemical composition. Each heat for ingot cast and each ladle for strand cast steel shall be a lot for chemical analysis. In the case of continuous casting, the casting shall cease after one ladle of steel is completely cast and the product shall be considered a lot. For remelted vacuum arc remelt (VAR), or electroslag remelt (ESR) products, a lot for heat analysis is defined as a chemical analysis obtained from one remelted ingot of each melt. In the case of argon-oxygen decarburization (AOD), each charge of the AOD vessel shall be considered a lot for heat analysis.

4.4.1.2 Lot for tensile tests. Each plate, sheet or coil with satisfactory properties for 10 consecutive heats or as specified (see 6.2.1) shall constitute a lot. Thereafter, each plate over 1-1/4 inches in thickness and two plates, sheets or coils from each heat or ladle of material 1-1/4 inches or less shall constitute a lot. If a plate, sheet or coil fails to conform to the requirements specified herein, the consecutive item testing shall be reimposed.

4.4.1.3 Lot for impact tests. Each plate, sheet or coil with satisfactory properties for 10 consecutive heats or as specified (see 6.2.1) shall constitute a lot. Thereafter each plate over 1-1/4 inches in thickness and two plates, sheets or coils from each heat or ladle of material 1-1/4 inches or less shall constitute a lot. If a plate, sheet or coil fails to conform to the requirements specified herein, the consecutive item testing shall be reimposed.

4.4.1.4 Lot for drop-weight nil-ductility and dynamic tear tests. When the drop-weight nil-ductility or dynamic tear test is specified (see 6.2.1), two plates from each heat of material 5/8 inch thick to 1-1/4 inches thick and each plate over 1-1/4 inches in thickness shall be drop-weight nil-ductility tested.

4.4.1.5 Lot for examination and inspections. For purposes of visual and dimensional examination and for ultrasonic inspection, each plate, sheet or coil prepared for final inspection shall constitute a lot.

4.4.2 Sampling.

4.4.2.1 Sampling for chemical or spectrographic analysis. Drillings for chemical analysis shall be taken from the transverse tensile test specimen from each heat or lot in the case of continuous castings. Solid samples may be taken from the same specimen or specimen locations for spectrographic analysis.

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4.4.2.2 Sampling for tensile test. After final heat treatment of the plates, sheet or coil, a transverse tensile specimen shall be taken from each end of each plate, sheet or coil or lot (see 4.4.1.2 and 4.4.2.7).

4.4.2.2.1 Location of test specimens in plate, sheet or coil. The specimens shall be located as shown on figures 1 and 2 (see 4.4.2.7). Figure 1 shall be used when the final direction or rolling is parallel to the longitudinal axis of the ingot. Figure 2 shall be used when the final rolling is parallel to the transverse axis of the ingot. The final direction of rolling is the direction of rolling in which the greatest reduction of thickness was achieved.

4.4.2.3 Sampling for impact tests. After final heat treatment of the plate, sheet or coil or lot, the test specimens shall be located not less than three times the plate thickness or 4 inches, whichever is less, from the as-heat treated edge and not more than 12 inches from the ends of the plate, sheet or coil (see 4.4.2.7).

4.4.2.3.1 Charpy V-notch impact test sampling. From each plate, sheet or coil, three transverse Charpy V-notch test specimens shall be taken from each end for each test temperature (see 4.4.2.7).

4.4.2.3.2 Dynamic tear impact sampling. In the case of dynamic tear testing, one transverse dynamic tear test specimen shall be taken from each end of each plate. The test specimens shall be tested in accordance with ASTM E 604.

4.4.2.3.3 Drop weight nil-ductility impact sampling. In the case of the drop weight nil-ductility testing, two specimens shall be taken from each end of each plate for each temperature.

4.4.2.4 Thermal buffer pad requirements. Where the crop is insufficient to obtain test specimens, thermal buffer pads in accordance with ASTM A 20 shall be used to maintain the proper distance from the heat treated edge of the plate.

4.4.2.5 Sampling for thickness testing. Each plate, sheet or coil shall be thickness tested.

4.4.2.6 Sampling for plate soundness. Each type II plate over 1/2-inch in thickness and when specified for all plates, sheets and coils (see 6.2.1), shall be ultrasonically examined.

4.4.2.6.1 Expanded search. If any recordable indication as specified in table IV is observed in the above inspection, an area enclosed by 1 foot radius circle about that point shall be 100 percent scanned.

4.4.2.7 Coil sampling. Each end of each coil for 10 consecutive heats shall be tested for required specification properties. After 10 consecutive heats, only the outer wrap of the coil shall be tested. If a coil fails to meet the required specification properties, consecutive coil testing shall be reimposed.

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4.5 Visual and dimensional examination. Each plate, sheet, or coil shall be examined visually and dimensionally for conformance to the requirements of this specification. The number of items subjected to paint film thickness measurements shall be held to the minimum necessary to assure continued satisfactory performance.

4.6 Tests.

4.6.1 Chemical analysis. Samples selected in accordance with 4.4.2.1 shall be analyzed in accordance with a standard ASTM method or other methods that will assure equally accurate results. If the samples from the inspected plate, sheet or coil fails to meet the requirements, all material from the heat in question shall be rejected. For first article testing, the chemical test methods shall be correlated with National Bureau of Standards, standard reference materials, when available, to ensure the validity of the test method. Also, for first article testing, the range over which the chemical analysis test methods utilized can be shown to be accurate for the particular element reported shall be provided.

4.6.1.1 Continuous cast slabs. The sample selected in accordance with 4.4.2, shall be analyzed to determine whether the requirements of table I are met. If either sample fails to meet the requirements, all material from the heat shall be rejected. Plates, sheet and coils may be analyzed separately provided the samples are taken in the specified locations, and the samples from the material which meets the requirements will be accepted.

4.6.2 Tensile. Tensile test specimens shall be tested in accordance with ASTM A 370.

4.6.3 Charpy impact. The test specimens shall be tested in accordance with ASTM A 370 with coolant temperatures of $\text{minus } 120 \pm 3^{\circ}\text{F}$ and $0 \pm 3^{\circ}\text{F}$. Precaution shall be taken to assure that the specimen has reached the temperature of the coolant and the tongs used in handling the specimen shall be cooled with the specimen. The specimens shall be so located in the thickness of the plate, that for 5.1 to 35.7 pounds per square foot (lb/ft^2) ($1/8$ to $7/8$ inch thick) the plate surface (after light machining) shall be one face, and for plates, $35.7 \text{ lb}/\text{ft}^2$ ($7/8$ inch thick) and heavier, the centerline of the plate shall be in one face. The notch shall be perpendicular to the plate surface.

4.6.3.1 Dynamic tear impact. The test specimen shall be tested in accordance with ASTM E 604 with a coolant temperature of $\text{minus } 40 \pm 3^{\circ}\text{F}$. The dynamic tear specimens shall be located, such that for plates $25.5 \text{ lb}/\text{ft}^2$ ($5/8$ inch thick) to $51.0 \text{ lb}/\text{ft}^2$ ($1-1/4$ inches thick), the plate surface (after light machining or grinding to remove paint and heat-treatment scale) shall be one face, and for plates $51.0 \text{ lb}/\text{ft}^2$ ($1-1/4$ inches thick) and heavier, the centerline of the plate shall be the centerline of the specimen. The notch shall be perpendicular to the plate surfaces.

4.6.3.2 Drop weight nil-ductility. The test specimen shall be tested in accordance with ASTM E 208 at a coolant temperature of $\text{minus } 70 \pm 3^{\circ}\text{F}$.

4.6.3.3 Marking of test specimens. The test specimens shall be marked to ensure positive identification of the lot being tested.

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4.6.4 Ultrasonic testing and gaging. Ultrasonic testing and gaging procedures shall be reported using the format in accordance with figure 3 of appendix A or equivalent. The products shall be ultrasonically examined on the intersections of a 24-inch grid pattern and at the midpoint of one diagonal in each grid. If mechanized scanning is employed, the plates shall be scanned on parallel lines not more than 8 inches apart.

4.6.5 Explosion bulge. The explosion bulge tests shall be conducted and specimens fabricated in accordance with MIL-STD-2149. Specimens shall be tested with weld reinforcement in place. Unless otherwise specified (see 6.2.1), the temperature of the plate weldment shall be $0 \pm 3^{\circ}\text{F}$ for each shot.

4.6.6 Thickness. Each plate, sheet or coil shall be inspected by a calibrated micrometer at three evenly distributed points along each longitudinal edge and at two evenly distributed points along each transverse edge. Each type II plate and when specified for all plates, sheet and coil, shall be gaged using the ultrasonic technique specified in appendix A. When the coil is provided in the rolled configuration, only the outer wrap shall be tested.

4.7 Test reports. The contractor shall prepare test reports in accordance with the data ordering document (see 6.2.2).

4.8 Retests. When a test specimen representing a lot of material fails to meet specification requirements, the lot shall be rejected. The contractor may rework or retest the lot as provided. The contractor is required to keep rejected lots identified and separate from acceptable lots until the rejected lots are withdrawn by the contractor, or are demonstrated as meeting specification requirements. At the option of the contractor, each piece in the rejected lot may be tested as specified for acceptance or rejection.

4.8.1 Reheat treatment. The contractor shall be permitted to reheat treat material which fail to meet tensile or impact requirements of this specification. All required tests originally performed on the failed material except chemical analysis shall be repeated when the material is reinspected.

4.8.2 If the results of an original tensile specimen are within 1,000 lb/ft² of the required yield strength, or within 2 percent of the required elongation or within 2 percent of the required reduction-in-area, a retest on a duplicate specimen (selected from the same approximate location) shall be permitted.

4.8.2.1 If the percentage of elongation or reduction-in-area of any tensile specimen is less than that specified in table II and any part of the fracture is outside the gage length, or within the gage length and less than 25 percent of the gage length from either datum point, another specimen from the same location may be selected in its place.

4.8.3 Charpy impact retest. In the event a Charpy specimen does not meet individual value requirements a retest of three specimens shall be permitted on the same material. If the retest specimens do not meet requirements (average and individual value), the lot represented by the specimens shall be rejected.

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4.8.4 Dynamic tear retest. If dynamic tear specimens do not meet the requirements specified in table III, a retest of two additional specimens from that plate may be performed. If either retest specimen does not meet the requirements specified in table III, the lot represented by the specimens shall be rejected. At the option of the contractor, each plate in the rejected lot may be impact tested, and each plate that fails to meet the requirements as specified in table III shall be rejected.

4.8.5 Defective specimen. If any test specimen shows defective machining or obvious lack of continuity of metal, it may be discarded and another selected.

4.9 Inspection of packaging. The inspection of the preservation-packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5.

5. PACKAGING

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

5.1 Preservation and packing. Unless otherwise specified (see 6.2.1), plates shall be cleaned and preserved as specified in 3.10. Packing shall be level A, C or commercial as specified (see 6.2.1) in accordance with MIL-STD-163.

5.2 Marking. In addition to any special marking required (see 6.2.1, 3.6.1(i) and 3.11). Marking shall be in accordance with MIL-STD-163.

6. NOTES

6.1 Intended use. Grade HSLA-80 high strength age-hardened alloy steel plate is intended primarily for use in structural applications where a notch tough, high strength steel is required. The use of steel at this strength level and at this required toughness, as fabricated structure or equipment, entails much more than a material specification and caution is advised in the areas of welding, fabrication, and nondestructive testing. This steel is not currently approved for crack arrestor or submarine pressure hull applications.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Type of steel plate, sheet or coil required (see 1.2).
- (c) Sizes and quantity of plate, sheet or coil required.
- (d) When first article is required (see 3.1).
- (e) Absorbed energy required of subsize specimens (see 6/ of table III).
- (f) Minimum plate size required for Charpy V-notch testing, if other than specified (see 7/ of table III).
- (g) Detailed procedure for heat treatment, if other than specified; and class of heat treatment required (see 3.5).
- (h) If weld repair after final heat treatment is not permitted (see 3.6.1).

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- (i) If type II plates 1/2 inch or less or other thicknesses are to be ultrasonically tested for soundness or thickness (see 3.7 and 4.4.2.6).
- (j) Applicable fabrication document required (see 3.8).
- (k) Document by which tolerances are to be governed, if other than specified (see 3.9.1, 3.9.2, 3.9.3 and 3.9.4).
- (l) When descaling and coating are not required (see 3.10).
- (m) Type and thickness of coating required (see 3.10 and appendix B).
- (n) When explosion bulge testing is required for first article (see 3.12) and test temperature, if other than specified (see 4.6.5).
- (o) Number of consecutive heats or ladles for which tensile and impact tests are to be performed on each plate, sheet or coil (see 4.4.1.2 and 4.4.1.3).
- (p) When drop-weight nil-ductility or dynamic tear testing is required (see 4.4.1.4).
- (q) Plate preservation required, if other than specified (see 5.1).
- (r) Levels of packing or commercial packing required (see 5.1).
- (s) Special marking required (see 5.2).
- (t) Type of environment and duration of exposure required of protective coating (see 40.1(a) appendix B).

6.2.2 Data requirements. When this specification is used in an acquisition which incorporates a DD Form 1423, Contract Data Requirements List (CDRL), 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 CDRL incorporated into the contract. When the provisions of FAR 52.227-7031 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 is cited in the following paragraphs.

<u>Paragraph no.</u>	<u>Data requirement title</u>	<u>Applicable DID no.</u>	<u>Option</u>
4.1.1	Certification data report	UDI-A-23264	---
4.3.2	First article inspection report	DI-T-4902	---
4.7	Reports, test	DI-T-2072	10.1.b

(Data item descriptions related to this specification, and identified in section 6 will be approved and listed as such in DoD 5000.19L., Vol. II, 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).

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6.3 First article inspection. Invitations for bids should provide that the Government reserves the right to waive the requirements for samples for first article inspection as 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 Prior to delivery, steel mills which have not previously produced plates under this specification of the strength level specified should demonstrate to the Commander, Naval Sea Systems Command, Materials Engineering Division, that their facilities are capable of quality production of plate conforming to the requirements of this specification.

6.3.2 Where a contract does not exist, first article data testing shall be witnessed by the Defense Contract Administration Services Management Area (DCASMA) representative. The first article inspection report should be forwarded to the Commander, Naval Sea Systems Command, Materials Engineering Division. Upon review of the report, authorization will be forwarded for preparation of test specimens for the explosion bulge tests as specified in MIL-STD-2149, and instructions will be furnished for shipment to designated Government testing locations. When accomplished by non-Government agencies unless otherwise approved by NAVSEA, test specimen preparation shall be verified by DCASMA. The notice of first article approval will be forwarded to the steel mill by the Naval Sea Systems Command.

6.4 Plates under 7.65 lb/ft^2 should be ordered under this specification only when they are for structural purposes where strength and gage are important.

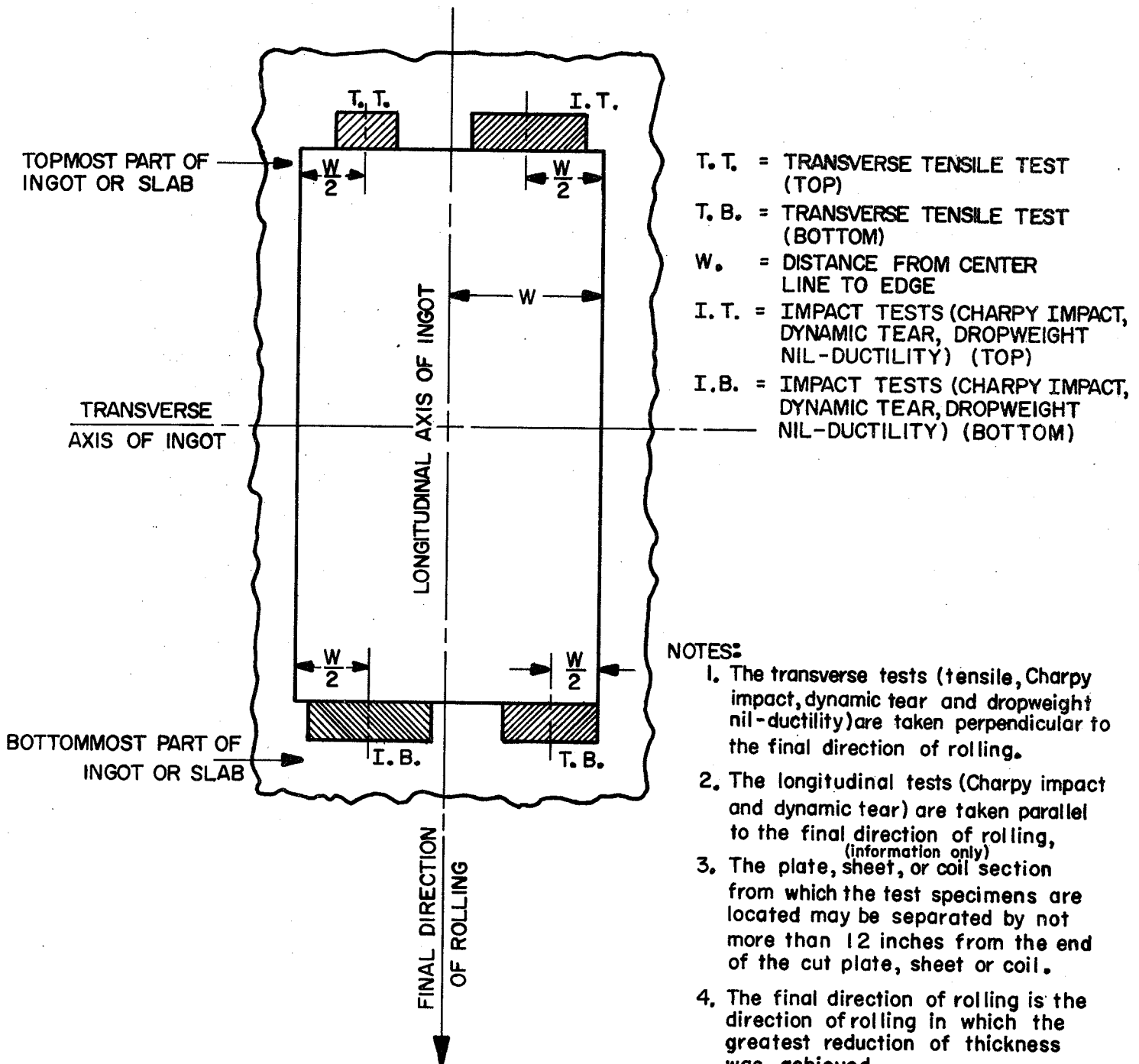
6.5 It is the responsibility of the consignee to determine whether or not plates are satisfactory for the intended application.

6.6 Inspection after delivery. Post delivery inspection of plates to determine conformity to this specification and for acceptance thereof is the responsibility of the consignee.

6.7 References to "the contractor" in this specification are meant to apply to a specific steel manufacturer's mill facility.

Preparing activity:
Navy - SH
(Project 9515-N041)

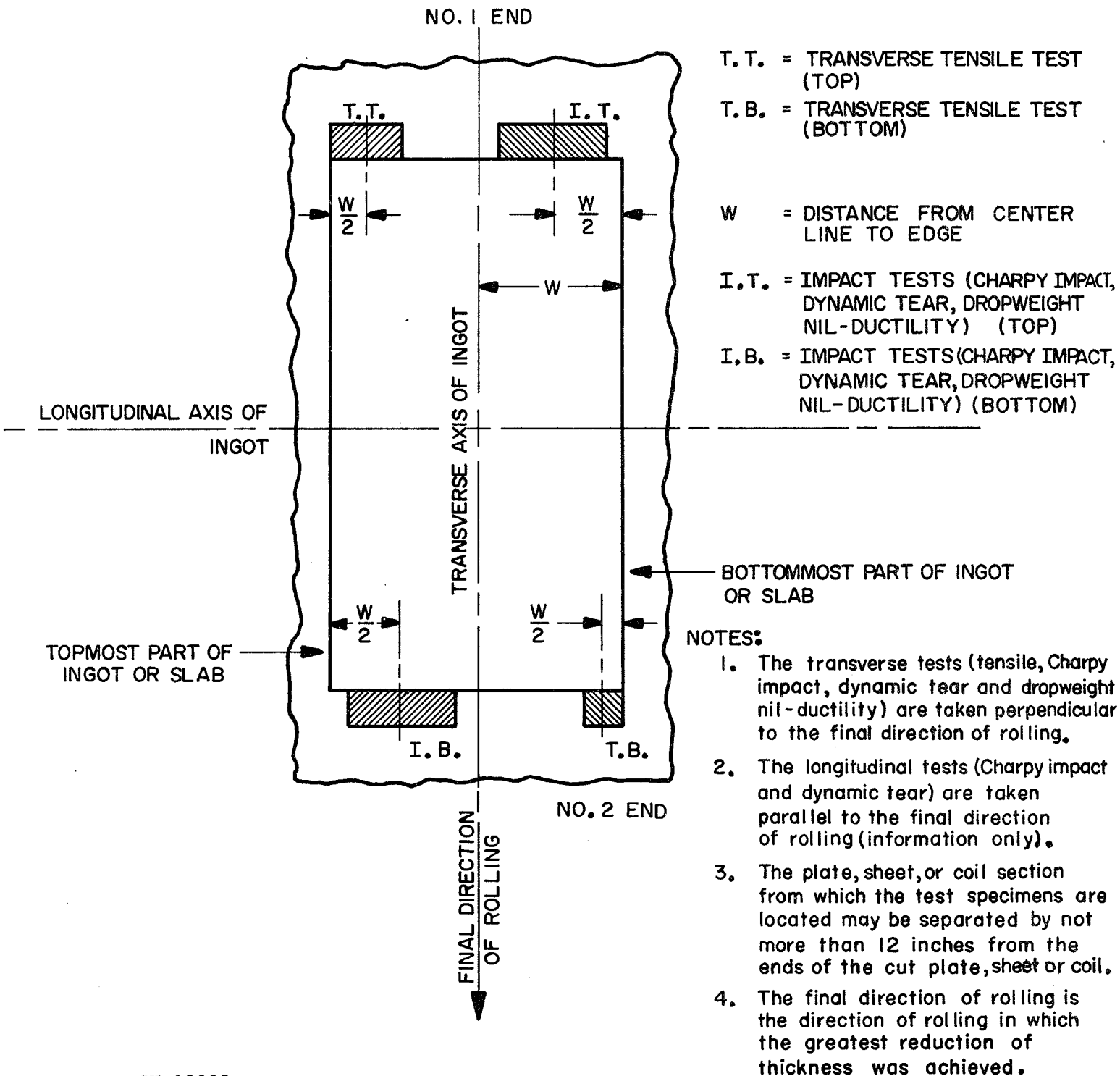
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SH 13007

FIGURE 1. Method of locating test specimens for plates, sheet or coils as rolled directly from ingots or slabs with the final direction of rolling parallel to the longitudinal axis of the ingot.

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SH 13008

FIGURE 2. Method of locating test specimens for plates, sheet or coils as rolled directly from ingots or slabs with the final direction of rolling parallel to the transverse axis of the ingot.

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APPENDIX A

ULTRASONIC PROCEDURES AND EVALUATIONS

10. SCOPE

10.1 Scope. This appendix describes basic methods of ultrasonic testing for soundness and thickness of plate for service acceptability. It shall in no way restrict the supplemented use of other tests, where the application requires them, to define or otherwise determine the acceptability or need for repair of these plates.

10.2 This appendix describes the basic methods of gaging and soundness inspection of plates and contains the minimum requirements for equipment, personnel and extent of evaluation in the inspections to acceptance or rejection standards.

10.3 These methods as described in this appendix shall be used when gaging or soundness testing is required for acceptance of plate by contract or order.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. REQUIREMENTS

30.1 Personnel requirements. Personnel performing ultrasonic inspection shall comply with the qualification requirements as specified in MIL-STD-271. In addition, they shall be thoroughly familiar with inspection requirements and acceptance standards specified herein.

30.2 Equipment requirements.

30.2.1 Equipment used for thickness gaging shall have periodic performance checks to determine the limits of accuracy.

30.2.2 Mechanical micrometer. Calibration of micrometers shall be performed monthly, using certified Johansson blocks, or equal.

30.2.3 Ultrasonic gaging instruments. Ultrasonic thickness gaging instruments shall be qualified in accordance with MIL-STD-271.

30.2.4 Ultrasonic soundness inspection equipment.

30.2.4.1 The soundness inspection equipment shall consist of the detection instrument, search unit, reference calibration standard and accessories. The equipment package shall be capable of producing, receiving and displaying high-frequency electrical pulses at the required frequencies and energy levels.

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30.2.4.2 The instrument shall be the pulse-echo type, having an "A" scan presentation. Instruments having attenuation-correction circuitry may be employed.

30.2.4.3 The type of search unit used is optional, but shall be compatible with the test instrument. The transducer shall be a straight beam unit capable of transmitting a longitudinal mode of sound vibration into the plate, and receiving the returning sound energy. For evaluation of soundness defects, the maximum size of transducer shall be 1 inch square or 1-1/8 inches in diameter, and the minimum nominal frequency shall be 2.25 megahertz (MHz).

30.2.4.4 Ultrasonic soundness inspection equipment shall be qualified in accordance with MIL-STD-271.

30.3 Extent of test.

30.3.1 Type II plates requiring mechanical and ultrasonic thickness gaging specified in 3.7 and section 40, and shall be compared to the tolerance limits specified in 3.9.

30.3.2 Soundness inspection type II plates and coils or when specified other plates or coils shall be accomplished by ultrasonically scanning as specified in section 30 and shall be evaluated to the acceptance standards specified in 3.7.

30.4 Surface preparation. The scanning surface of the plate or coil shall be grit blasted or sandblasted and may have one coat each of pretreatment and primer. The surface shall be free of all loose dirt, rust or any foreign substance which may interfere with the test. If necessary, conditioning of the test areas may be accomplished by any mechanical means, such as disc grinding and sanding.

30.5 Couplant. The couplant chosen shall give the best results for the equipment in use and the surface conditions prevailing. In addition, the couplant material shall be readily removable from the surface when the test is completed. A water-detergent solution or glycerine gives good test results and is easily removed.

30.6 Reference base designation. The upper left corner of the plate or coil scan surface shall be indicated to designate this as a common reference base location for layout and recording purposes.

40. REFERENCES

40.1 Plate or coil gaging.

40.1.1 Equipment.

40.1.1.1 The plate gaging equipment shall consist of mechanical micrometers and either pulse-echo or resonance-frequency ultrasonic gaging instrumentation and all shall meet the requirements specified in section 30.

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40.1.1.2 For resonance-frequency systems, the operating frequency range shall be specified by the instrument manufacturer.

40.1.1.3 For pulse-echo systems, a transducer frequency of 2.25 to 5.0 MHz provides satisfactory results for most gaging.

40.1.2 Technique.

40.1.2.1 Thickness measurements shall be in accordance with 4.6.6.

40.1.2.2 The test locations (see 4.6.6), shall be used as check points to verify the calibration of the ultrasonic instrument during the ultrasonic gaging of each plate. Deviations in excess of 1 percent shall require recalibration of the instrument and regaging of all measurements made subsequent to the last valid verification check. Verification check shall be performed after each interruption in power supply.

40.1.2.3 Using ultrasonic gaging equipment, the plate thickness shall be measured at each intersection of a grid pattern layout on one major surface of the plate. The layout shall consist of a 6-inch margin inward from each edge of the plate, enclosing a grid pattern of lines at 24-inch intervals. Spacing dimensions shall be referenced from the upper left corner of the margin.

40.1.2.4 If mechanized soundness scanning is employed, the average of the readings obtained on the 24-inch scan lines may be used as plate gage.

40.1.2.5 Gaging readouts that vary from the specified allowable tolerances, shall be submitted to expanded search to determine the extent of plate area not within tolerance limits.

40.1.3 Reporting. The mechanical and ultrasonic gaging locations shall be reported in the suggested format of figure 3.

40.2 Plate or coil soundness inspection.

40.2.1 Equipment. The plate soundness inspection equipment shall meet the requirements specified in section 30.

40.2.2 Technique.

40.2.2.1 Test calibration shall be accomplished by placing a compressional wave search unit on an experimentally determined defect free area. The instrument shall then be adjusted to display a scale 10 (not saturated), first back reflection on the cathode ray tube.

40.2.2.2 Recalibration shall be accomplished prior to each use or after any interruption in power supply.

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40.2.2.3 Plate soundness shall be tested with a straight beam (longitudinal wave) search in accordance with 4.4.2.6. When continuous scanning is used for expanded search, a minimum overlap per pass of 15 percent of the transducer width shall be used until the entire surface (of area) has been inspected.

50. RECORDS

50.1 General. Records of gaging and soundness inspection shall be maintained and furnished to the receiving activity and shall be subject to verification by cognizant Government representatives. Ultrasonic instrument certification records shall be made available on request (see 50.4.1).

50.2 Gaging. Plate, sheet or coil thickness gagings, as specified in 40.1.3, shall be recorded in the respective locations of a report similar to the format of figure 3. As a minimum, the report shall also include the following:

- (a) Plate, sheet or coil identification.
- (b) Gaging equipment used.
- (c) Inspector's identity.
- (d) Inspection date.
- (e) Notation of reference corner, minimum reading and maximum reading.
- (f) Location and limits of areas deviating from tolerances.

50.3 Soundness inspection. The extent of plate, sheet or coil conditions, as specified in 40.2.2.1 and 40.2.2.2 shall be recorded in the appropriate location of a report similar to the format shown on figure 4. As a minimum, the report shall also include the following:

- (a) Plate or coil identification.
- (b) Inspection equipment used.
- (c) Inspector's identity.
- (d) Inspection date.
- (e) Notation of reference corner.
- (f) Flaw location dimensions as referenced from the top end and left side of the plate.
- (g) Notation of "T" area dimension or percentage reduction of back reflection.
- (h) Notation of rejectable areas that have been authorized for repair by the reviewing activity.

50.4 Ultrasonic instrument certification. The two most recent certification records of each ultrasonic instrument in service shall be made available to the cognizant Government representative. For gaging instruments this record shall consist of a report and graph in accordance with MIL-STD-271.

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APPENDIX A

TOP	6"	18"	30"	42"	54"	66"	78"	90"	102"	114"	126"	
Micrometer	← Micrometer											
6"												
18"												
30"												
42"												
54"												
66"												
78"												
90"												
102"												
114"												
126"												
138"												
150"												
162"												
174"												
186"												
198"												
210"												
222"												
234"												
246"												
258"												
270"												
282"												
294"												
306"												
318"												
330"												
342"												
354"												
366"												
378"												
390"												
402"												
414"												
426"												
438"												
450"												
462"												
Micrometer	← Micrometer											

JOB			
MILL MARK NO.			
HEAT/MELT NO.			
SLAB/PLATE/COIL NO.			
MATERIAL	LENGTH	WIDTH	GAGE
THICKNESS	MINIMUM	MAXIMUM	
ALLOWABLE	"		
MEASURED	"		
DEVIATION	"		
SPECIFICATION/PROCEDURE NO.			
INSTRUMENT		MODEL NO.	
TRANSDUCER SIZE		FREQ. MH _Z	
AUXILIARY EQUIPMENT			
INSPECTOR(S)		DATE	
REVIEWED BY:		DATE	

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FIGURE 3. Suggested gaging report format (micrometer and ultrasonic).

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	0	30	54	78	102	126	150	174	
0	+	+	+	+	+	+	+	+	MILL MARK NO.
									HEAT/MELT NO.
30	+	+	+	+	+	+	+	+	SLAB/PLATE/COIL NO.
									MATERIAL
									LENGTH
									WIDTH
									GAGE
54	+	+	+	+	+	+	+	+	"
									"
									"
									"
78	+	+	+	+	+	+	+	+	SOUNDNESS DEFECTS-CLASS & LOCATION
									FLAW CLASS
									DIMENSION TO:
									TOP END
									LEFT SIDE
102	+	+	+	+	+	+	+	+	FLAW CLASS
									DIMENSION TO:
									TOP END
									LEFT SIDE
126	+	+	+	+	+	+	+	+	
150	+	+	+	+	+	+	+	+	
174	+	+	+	+	+	+	+	+	
198	+	+	+	+	+	+	+	+	
222	+	+	+	+	+	+	+	+	
246	+	+	+	+	+	+	+	+	
270	+	+	+	+	+	+	+	+	* LBR=LOST BACK REFLECTION (REJECT)
									XCL=EXCEEDS CALIBRATION LEVEL (REJECT)
294	+	+	+	+	+	+	+	+	RBR=REDUCED BACK REFLECTION (RECORD)
									LCL=LESS THAN CALIBRATION LEVEL (RECORD)
318	+	+	+	+	+	+	+	+	<input type="checkbox"/> SOUNDNESS SATISFACTORY
									<input type="checkbox"/> REFER EVALUATION
342	+	+	+	+	+	+	+	+	REMARKS
366	+	+	+	+	+	+	+	+	SPECIFICATION/PROCEDURE
390	+	+	+	+	+	+	+	+	INSTRUMENT: MODEL NO.
414	+	+	+	+	+	+	+	+	SEARCH UNIT: SIZE FREQUENCY MH _z
438	+	+	+	+	+	+	+	+	INSPECTOR(S): DATE
									REVIEWED BY: DATE

SH 13010

FIGURE 4. Suggested ultrasonic report format.

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APPENDIX B

COATINGS

10. SCOPE

10.1 This appendix outlines the cleaning and preserving procedures and requirements for ships' plates intended for Naval service.

10.2 This appendix allows the maximum latitude in cleaning and preserving methods and materials commensurate with the intended storage time and conditions prior to their use.

10.3 The coatings shall be selected in terms of the particular use.

20. APPLICABLE DOCUMENTS

20.1 Government documents. Not applicable to this appendix.

20.1.1 Drawings and publications. The following Government publication forms a part of this specification to the extent specified herein.

PUBLICATION

DEPARTMENT OF LABOR
Code of Federal Regulations (CFR)
Title 40, Part 261.24

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

30. DESCALING AND CLEANING

30.1 Plates, sheets or coils shall be descaled and cleaned by abrasive blast cleaning or acid pickling.

30.2 Abrasive blast cleaning. Abrasive blast cleaning shall result in a clean metal surface for painting, with mill scale, rust and other surface contaminants completely removed.

30.3 Acid pickling. The acid pickling process shall be as follows:

- (a) Plates, sheets or coils shall be handled on edge throughout the various steps of the procedure. They shall not be laid flat in the solutions.
- (b) Rust preventives, oils, greases, oil paints and other foreign matter shall be removed from the plates prior to immersion in the acid pickling bath. Where alkaline solutions are used for this purpose, the plates shall be thoroughly rinsed with water prior to pickling.

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APPENDIX B

- (c) The pickling bath shall consist of a sulphuric acid solution to which has been added to pickling inhibitor and 1-1/2 percent of sodium chloride. In making the solution initially, 5 gallons of concentrated sulphuric acid are used for each 100 gallons of solution. The acid concentration shall not be allowed to drop below 3.5 percent by volume. The inhibitor shall be used at the concentration recommended by the manufacturer. The bath temperature shall be maintained at 160 to 180°F. When the concentration of iron in the solution reaches 5 percent by weight, the entire bath shall be discarded.
- (d) The water rinse shall consist of fresh circulating water maintained at a temperature of 120 to 180°F. The flow of fresh water shall be maintained so that a complete change of water occurs every 24 hours. The combined concentrations of sulphuric and iron sulphates in the bath, calculated from the acid concentration and the ferrous iron concentration, shall not exceed 2 grams per gallon. This determination shall be made at least once each week.

40. PRESERVATIVE COATINGS

40.1 Coating. The plates, sheet or coils, as prepared for coating, shall be in the descaled condition and free of visible rust. The paint film shall be sufficient to cover surface roughness peaks adequately. Two random dry film thickness measurements per 100 square feet of painted surface, made with a thickness gage, shall be considered for determining conformity to the specified coating thicknesses. Other methods of measurement or quality control may be used for paint film thickness, subject to the approval of the command or agency concerned. The coated product shall comply with the following:

- (a) One coat of white primer shall be applied to a dry film thickness of approximately 1 mil. The thickness of the dry film shall be not less than 0.7 mils at any point. The contractor shall choose a coating compatible with the intended application and duration of protection as specified (see 6.2.1).
- (b) NAVSEA is restricting the use of organic coatings containing lead, chromium, asbestos, arsenic and mercury. This restriction applies to all compounds and derivations. In addition, to reduce the probability of dry dock effluents that violate discharge laws, NAVSEA is requiring a certification of compliance of the primer to the requirements as specified in Code of Federal Regulations (CFR), title 40, part 261.24. In addition, the primer coating shall not contain zinc or its derivatives or any other substances which will adversely affect the welding process or the weld metal or welded material properties.

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.

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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DEPARTMENT OF THE NAVY

COMMANDER
NAVAL SEA SYSTEMS COMMAND (SEA 5523)
DEPARTMENT OF THE NAVY
WASHINGTON, DC 20362



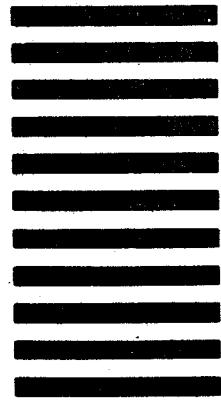
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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL*(See Instructions - Reverse Side)*

1. DOCUMENT NUMBER MIL-S-24645(SH)	2. DOCUMENT TITLE Steel Plate, Sheet, Or Coil, Age-Harden Alloy, Structural, High Yield Strength (HSLA-80)
---------------------------------------	---

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)

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