

INCH-POUND  
 MIL-S-24645A(SH)  
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 SUPERSEDING  
 MIL-S-24645(SH)  
 4 September 1984  
 (See 6.9)

## MILITARY SPECIFICATION

### STEEL PLATE, SHEET, OR COIL, AGE-HARDENING ALLOY, STRUCTURAL, HIGH YIELD STRENGTH (HSLA-80 AND HSLA-100)

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 (HSLA-80) and 100,000 (HSLA-100) pounds per square inch (lb/in<sup>2</sup>) high yield strength, age-hardening alloy steel plate, sheet, and coil intended primarily as replacements for steel grades HY-80 and HY-100, respectively, for approved uses in critical structural applications where notch-tough high-strength materials are required. The requirements apply to grade HSLA-80 up to and including 1-1/4 inches thick and HSLA-100 up to 4 inches thick.

1.2 Classification. Steel plate, sheet or coil covered by this specification shall be of the following types and grades as specified (see 6.2).

Type I	-	Plate, sheet or coil for which ultrasonic testing for soundness and thickness is not performed.
Type II	-	Plate over 1/2-inch in thickness for which ultrasonic testing for soundness and thickness is performed. Unless otherwise specified (See 4.4.2.7 and 6.2), each plate over 1/2-inch in thickness shall be classified as Type II.
Grade HSLA-80	-	80,000 lb/in <sup>2</sup> tensile yield strength, minimum.
Grade HSLA-100	-	100,000 lb/in <sup>2</sup> tensile yield strength, minimum.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 9515

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## MIL-S-24645A(SH)

## 2. APPLICABLE DOCUMENTS

2.1 Government documents.

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

## STANDARDS

## MILITARY

MIL-STD-163 -	Steel Mill Products, Prepared for Shipment and Storage.
MIL-STD-248 -	Welding and Brazing Procedure and Performance Qualification.
MIL-STD-271 -	Requirements for Nondestructive Testing Methods.
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.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

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

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- A 6 - Standard Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use. (DoD adopted)
- A 20 - Standard Specification for General Requirements for Steel Plates for Pressure Vessels. (DoD adopted)

## MIL-S-24645A(SH)

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) (Continued)

- A 370 - Standard Test Methods and Definitions for Mechanical Testing of Steel Products. (DoD adopted)
- A 505 - Standard Specification for Steel, Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled, General Requirements for. (DoD adopted)
- A 673 - Standard Specification for Sampling Procedure for Impact Testing of Structural Steel. (DoD adopted)
- E 112 - Standard Test Methods for Determining Average Grain Size. (DoD adopted)
- E 208 - Standard Method for Conducting Drop-Weight Test to Determine Nil-Ductility Transition Temperature of Ferritic Steels.
- 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.)

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

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

### 3. REQUIREMENTS

3.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection (see 6.5) in accordance with 4.3.

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 the Naval Sea Systems Command (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 continuous cast. The ratio of reduction from continuous 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 Degassing. For thicknesses of 3/8-inch and less, vacuum degassing is not required.

3.2.2 Inclusion shape control. Very low sulfur ( $S < 0.003$  percent), calcium treatment or other NAVSEA approved melt practices shall be used for sulfide inclusion shape control in the production of this steel.

## MIL-S-24645A(SH)

3.2.3 Recovered materials. Unless otherwise specified herein, all equipment, material, and articles 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 and product shall be as specified in table I.

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

Element	Maximum percent by weight <sup>1</sup> unless a range is shown or otherwise noted	
	Allowable chemical compositions for the following plate gauges and grades	
	Grade HSLA-80	Grade HSLA-100
	≤ 1.25-inch	All plate gauges
Carbon	0.06 <sup>2</sup>	0.06 <sup>2</sup>
Manganese	0.40-0.70	0.75-1.05
Phosphorous	0.020	0.020
Sulfur	0.006 <sup>3</sup>	0.006 <sup>3</sup>
Silicon	0.40	0.40
Nickel	0.70-1.00	3.35-3.65
Chromium	0.60-0.90	0.45-0.75
Molybdenum	0.15-0.25	0.55-0.65
Copper	1.00-1.30	1.45-1.75
Columbium	0.02-0.06	0.02-0.06
Aluminum	<sup>4</sup>	<sup>4</sup>
Tin	0.030	0.030
Vanadium	0.03	0.03
Titanium	0.02	0.02
Arsenic	0.025	0.025
Antimony	0.025	0.025
Nitrogen	<sup>5</sup>	<sup>5</sup>

<sup>1</sup> Except for carbon and sulphur, the chemical tolerances as specified in

## MIL-S-24645A(SH)

ASTM A 6 are to be applied to product analysis. For elements not listed in ASTM A 6, the product analysis shall not exceed the specified maximum.

- <sup>2</sup> For HSLA-80 thicknesses 3/4-inch and under, a maximum of 0.07 percent shall be permitted in heat analysis. The product analysis tolerance shall be 0.02 percent over the specified maximum limit for all thicknesses of HSLA-80 and HSLA-100.
- <sup>3</sup> The product analysis tolerance shall be 0.002 percent over the specified maximum.
- <sup>4</sup> Minimum acid-soluble aluminum content of 0.010 percent or minimum total aluminum content of 0.015 percent for each ladle of each heat.
- <sup>5</sup> For information only.

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.

	Grade HSLA-80		Grade HSLA-100	
	< 0.25 in	≤ 0.25 in	≤ 0.75 in	> 0.75 in
Ultimate tensile strength, (lb/in <sup>2</sup> )	<sup>1/</sup>	<sup>1/</sup>	<sup>1/</sup>	<sup>1/</sup>
Yield strength, 0.2 percent offset (lb/in <sup>2</sup> ) <sup>4/</sup>	80,000 to 110,000	80,000 to 100,000	100,000 to 130,000	100,000 to 125,000
Elongation in 2 inches, minimum (percent)	14	20	<sup>2</sup> 17	18
Reduction in area, minimum round specimen (percent)	<sup>3/</sup>	<sup>3</sup> 50	<sup>3/</sup>	45

- <sup>1/</sup> To be recorded for information only.
- <sup>2/</sup> For HSLA-100 material less than 1/4-inch in thickness, elongation shall be 12 percent, minimum.
- <sup>3/</sup> A minimum percent reduction in area is not required for plate thicknesses equal to or less than 3/4-inch.
- <sup>4/</sup> For HSLA-80 materials equal to or less than 1/2-inch in thickness, maximum yield strength shall be 110,000 lb/in<sup>2</sup>.

## MIL-S-24645A(SH)

TABLE III. Impact requirements, Charpy V-notch, transverse.<sup>1/</sup>

Thickness nominal (inch)	Test (Coolant) temperature	Energy <sup>2</sup> foot-pounds, average of three tests, minimum		Shear fracture, percent average of three tests, minimum	
	(°F)	Grade HSLA-80	Grade HSLA-100	Grade HSLA-80	Grade HSLA-100
3/8-inch and over 3/	-120 ± 3	60	60	35	35
	0 ± 3		80		90

- 1/ Dynamic tear testing transverse to the final direction of plate rolling shall be performed at minus 40 ± 3 degrees Fahrenheit (°F) on plate thickness over 5/8-inch and the results shall be recorded for information only.
- 2/ No single value shall be below the minimum average required by more than 5 foot-pounds, or equivalent fraction as designated by the appropriate standard subsize specimen, for the Charpy test.
- 3/ For material thicknesses below 7/16-inch, Charpy test subsize specimens shall be as specified in ASTM A 673. Equivalent absorbed energy requirements for subsize specimens shall be as specified (see 6.2).

3.5 Heat treatment. Unless otherwise specified (6.2), the contractor shall determine the detailed procedure to produce products meeting the mechanical property requirements of this specification with the following restrictions:

- (a) The heat treatment shall be as specified (see 6.2) for treatment of class 1 or class 3 as follows:

Class 1 - Controlled rolled and precipitation heat treated. This class is permissible only for HSLA-80 plate, sheet or coil up to and including 1/2-inch in thickness unless otherwise specifically approved by NAVSEA.

Class 3 - Solution treated, quenched and precipitation heat treated.

- (b) The plate shall not be stress relieved.

## MIL-S-24645A(SH)

**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 undergauge condition. Isolated, individual pits not over 0.030 inch deep or within 6 inches of each other will be acceptable provided plate, sheet or coil thickness is not reduced below the specified minimum. 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), weld repair after final heat treatment shall be permitted. Mill imperfections may be repair welded by the contractor or referred to the contracting activity for acceptance with subsequent repair welding to be performed by the contracting activity. 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 area 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 3.9). 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. The finished weld surface shall also be free of underfill.
- (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.
- (i) Repaired areas shall be marked. The markings shall remain legible and shall not be removed prior to performing all inspections specified herein.
- (j) Notations of repaired areas shall be made on the plate, sheet or coil inspection form as part of the records.



## MIL-S-24645A(SH)

- (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 (see 3.8) shall be cause for rejection. Laminar edge defect weld repairs shall be made using a NAVSEA approved weld procedure.

3.7 Dimensional tolerances.

3.7.1 Thickness, weight and gauge. Type I plate, sheet or coil and type II plate shall be ordered to the tolerances specified in ASTM A 6 if the thickness is 3/16 inch or greater or as specified (see 6.2). For material less than 3/16 inch in thickness the tolerances of ASTM A 505 shall apply. For plate ordered by weight, minimum thickness requirements shall be in accordance with table IV.

3.7.2 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). For material less than 3/16 inch in thickness, the tolerances of ASTM A 505 shall apply.

3.7.3 Camber. Plates or coil shall not exceed the tolerance limits of ASTM A 6 or as specified (see 6.2). For material less than 3/16 inch in thickness, the tolerances shall be as specified in ASTM A 505.

3.7.4 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). For material less than 3/16 inch in thickness, the tolerances shall be as specified in ASTM A 505.

3.8 Internal soundness. Material shall be rejected when an ultrasonic discontinuity signal results in a total loss of back reflection and is continuous in one plane over an area 4 square inches or larger (as mapped out using half amplitude method).

3.9 Applicable fabrication document. If applicable, the fabrication document shall be specified (see 6.2) and shall cover the repair and the inspection of the base metal.



TABLE IV. Allowable variation in gauge for plates specified on a weight basis (applicable to single plates).

Specified weight, pounds per square foot	Allowable Under Gauge At Edge For Widths Given (percent)								
	Up to 66 inches inclusive	Over 66 to 80 inches inclusive	Over 80 to 90 inches inclusive	Over 90 to 100 inches inclusive	Over 100 to 115 inches inclusive	Over 115 to 135 inches inclusive	Over 135 to 150 inches inclusive	Over 150 to 160 inches inclusive	Over 168 inches
To 20.4 excl.	6	6	8	8	8	8	8	8	8
20.4 to 25.5 excl.	3.5	4	4.5	5	5.5	6.5	6.5	6.5	6.5
25.5 to 30.6 excl.	3.5	4	4.5	5	5.5	6	6	6	6
30.6 to 40.8 excl.	3	3	3.5	4	4	4.5	5	5.5	6
40.8 and over	3	3	3	3	3	3.5	4	4.5	5

NOTES:

1. The transverse tests (tensile, Charpy impact, dynamic tear and drop weight nil-ductility) are taken perpendicular to the final direction of rolling.
2. The plate, sheet, or coil section from which the test specimens are located may be separated by not more than 12 inches from the ends of the cut plate, sheet or coil.
3. The final direction of rolling is the direction of rolling in which the greatest reduction ratio was achieved.

MTL-S-24645A(SH)

## MIL-S-24645A(SH)

3.10 Cleaning and preservation of plate, sheet or coil surfaces.  
Unless otherwise specified (see 6.2), the surfaces of the plate, sheet or coil shall be descaled and coated as specified (see 6.2 and appendix B).

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 HSIA-80 or HSIA-100. 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. The steel shall pass the explosion bulge test. Performance is considered satisfactory provided the following requirements are met:

(a) Crack starter.

First shot:

Crack starter bead shall 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 will be 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/

MIL-S-24645A(SH)

Additional shots:

Shots shall continue until a reduction in thickness of 16 percent for HSLA-80 or 14 percent for HSLA-100 is obtained on one or both sides.

The performance will be considered satisfactory provided the following conditions are met:

No piece shall be thrown out of material being tested.

Through thickness cracks will be acceptable.

No cracks shall extend into the hold-down area.<sup>1/</sup>

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 shall be rejected if the reduction in thickness criteria are not met when shots are discontinued.

- <sup>1/</sup> The bulge area is 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 the area outside of this circle.

3.13 Drop weight nil-ductility test. The specimen shall exhibit 'no break' condition at minus  $90 \pm 3^\circ\text{F}$  for HSLA-80 and at the temperature specified for HSLA-100 (see 6.2).

3.14 Workmanship. The steel plate, sheet or coil shall conform to the requirements of this specification.

#### 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 this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the

## MIL-S-24645A(SH)

specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations is an acceptable practice to ascertain conformance to requirements, however this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

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 specified in table V (see 6.3, 6.5 and appendix C).

TABLE V. First article and quality conformance inspections.

Examination and tests	Requirement	Test method	First article	Quality conformance
Chemical analysis	3.3	4.6.1	X	X
Tensile properties	3.4	4.6.2	X	X
Impact properties				
Charpy V-notch	3.4	4.6.3.1	X	X
Dynamic tear	3.4	4.6.3.2	X	X
Drop weight nil-ductility	3.13	4.6.3.3	X	
Microstructure analysis		4.6.5	X	
Explosion bulge	3.12	4.6.6	X1/	
Examination				
Surface quality	3.6	4.5	X	X
Dimensional tolerances	3.7	4.6.7, 4.5	X	X
Internal soundness	3.8	4.6.4	X	X

1/ For HSLA-100 and when specified for HSLA-80 (see 6.2).

4.3.1 Sampling for first article inspection. First article samples shall be taken from products rolled from ingots or slabs continuously cast that represent the largest size to be used at the rolling facility and from one heat. The thickest gauge to be produced at the mill shall be tested.

4.4 Quality conformance inspection. Quality conformance inspection shall consist of the examinations and tests specified in table V (see 6.3).

## MIL-S-24645A(SH)

4.4.1 Lot definitions.

4.4.1.1 Lot for chemical composition. Lots for chemical composition shall be defined as follows: ingot cast, each heat; continuous cast, each ladle; vacuum arc remelt (VAR) or electroslag remelt (ESR), each remelted ingot; argon-oxygen decarburization (AOD), each vessel charge. Unless otherwise qualified by first article testing, continuous casting shall cease after one ladle of steel is completely cast.

4.4.1.2 Lot for tensile tests. Each plate, sheet or coil as-heat treated shall constitute a lot.

4.4.1.3 Lot for impact tests. Each plate, sheet or coil as heat treated shall constitute a lot.

4.4.1.4 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 for quality conformance inspection.

4.4.2.1 Location of test specimens in plate, sheet or coil. The specimens shall be located as shown on figures 1 and 2. Figure 1 shall be used when the final direction of 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 ratio was achieved.

4.4.2.2 Sampling for chemical or spectrographic analysis. Samples for chemical analysis shall be taken from a transverse tensile test specimen from the top plate of each of two ingots or two slabs in the case of continuous casting in each lot. Solid samples may be taken from the same specimen or specimen locations for spectrographic analysis.

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

4.4.2.4 Sampling for impact tests. After final heat treatment of the 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.

4.4.2.4.1 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.

4.4.2.4.2 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.

## MIL-S-24645A(SH)

4.4.2.5 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.

4.4.2.6 Sampling for thickness testing. Each plate, sheet or coil shall be thickness tested in accordance with 4.6.7.

4.4.2.7 Sampling for plate soundness. Each type II plate over 1/2-inch in thickness (and when specified (see 6.2) all plates, sheets and coils) shall be ultrasonically examined.

4.4.2.7.1 Expanded search. If any recordable indication defined in appendix A is observed in the above inspection, an area enclosed by a 1-foot radius circle about that point shall be 100 percent scanned.

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. Paint thickness measurements shall be in accordance with appendix B.

4.6 Methods of inspection. (see 6.3 and 6.4)

4.6.1 Chemical analysis. Quality conformance inspection samples selected in accordance with 4.4.2.2 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 fail to meet the requirements, all material from the lot in question shall be rejected. Samples from rejected lots of plates, sheets and coils may be analyzed individually provided the samples are taken from each in the specified locations, and only those plates, sheets or coils which conform to chemical composition requirements in 3.3 will be accepted. For first article testing, the chemical test methods shall be correlated with National Institute of Standards and Technology, 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. Test results shall meet the requirements of table I.

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

4.6.3 Impact toughness.

4.6.3.1 Charpy V-notch test. Quality conformance inspection 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 prior to testing 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,

## MIL-S-24645A(SH)

that for 5.1 to 35.7 lb/ft<sup>2</sup> (1/8 to 7/8-inch thick) the plate surface (after light machining) shall be one face of the specimen and for plates, 35.7 lb/ft<sup>2</sup> (7/8-inch thick) and heavier, the centerline of the plate shall be in one face of the specimen. The notch shall be perpendicular to the plate surface. For first article testing Charpy V-notch transition curves (transverse to rolling direction) with data points at each temperature of minus 120°F, minus 90°F, minus 60°F, minus 30°F, 0°F, and room temperature shall be provided. A minimum of three specimens for each point is required and individual values shall be recorded.

4.6.3.2 Dynamic tear test. The test specimen shall be tested in accordance with ASTM E 604 with a coolant temperature of minus 40 ± 3°F. The dynamic tear specimens shall be located, such that for plates 25.5 lb/ft<sup>2</sup> (5/8-inch thick) to 51.0 lb/ft<sup>2</sup> (1-1/4 inches thick), the plate surface (after light machining or grinding to remove paint and heat-treatment scale) shall be one face of the specimen, and for plates 51.0 lb/ft<sup>2</sup> (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.

4.6.3.3 Drop weight nil-ductility test. For first article inspection the test specimen shall be tested in accordance with ASTM E 208.

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

4.6.4 Ultrasonic soundness testing. Ultrasonic soundness tests shall be performed in accordance with appendix A. For first article testing, a 100 percent scanning pattern shall be used in lieu of a grid pattern.

#### 4.6.5 Microstructure analysis.

4.6.5.1 Prior austenite grain size. The average prior austenite grain size shall be determined in accordance with the planimetric procedure of ASTM E 112 for the product in the final heat treated condition.

4.6.5.2 Microstructure. The microstructure at the centerline of the thickest plate to be qualified shall be reported in the form of photomicrographs showing the relative quantities and morphologies of the phases present.

4.6.6 Explosion bulge test. The explosion bulge test shall be conducted and specimens fabricated in accordance with MIL-STD-2149. Two crack starter and two explosion bulge specimens shall be tested. The thickness of the specimen shall be 1-inch for HSLA-80 and 2-inch for HSLA-100 plates. Specimens shall be tested with weld reinforcement in place. Unless otherwise specified (see 6.2), the temperature of the plate weldment shall be 0 ± 3°F for each shot. The tests will be conducted under Government direction to evaluate plate and weldment performance.



## MIL-S-24645A(SH)

4.6.7 Thickness. Each plate, sheet or coil shall be measured with 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 gauged using the ultrasonic technique specified in appendix A.

4.7 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, qualified pieces (see 4.7.2 through 4.7.4) in the rejected lot may be retested as specified for acceptance or rejection.

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

4.7.2 Tensile retest. If the results of an original tensile specimen are within 1,000 lb/in<sup>2</sup> 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.

4.7.2.1 Elongation and reduction-in-area retest. 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 gauge length, or within the gauge length and less than 25 percent of the gauge length from either datum point, another specimen from the same location may be selected in its place.

4.7.3 Charpy impact retest. In the event a Charpy specimen does not meet individual value requirements, a retest of three additional specimens (selected from the same approximate location) 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.

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

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

## MIL-S-24645A(SH)

## 5. PACKAGING

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

5.1 Preservation and packing. Unless otherwise specified (see 6.2), plates shall be cleaned and preserved as specified in 3.10. Packing shall be level A or commercial as specified (see 6.2) in accordance with MIL-STD-163.

5.2 Marking. In addition to any special marking required (see 6.2, 3.6.1(i) and 3.11), marking shall be in accordance with MIL-STD-163.

## 6. NOTES

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

6.1 Intended use. Grades HSLA-80 and HSLA-100 high strength age-hardened alloy steel plates are intended primarily for use in structural applications where notch tough, high strength welded steels are required. The use of steel at these strength levels and at these required toughness levels, as fabricated structure or equipment, entails much more than a material specification and caution is advised in the area of welding, fabrication, and nondestructive testing. The yield/tensile strength ratios of HSLA-80 and HSLA-100 may be higher than those of HY-80 and HY-100, respectively, and should be noted and considered by designers.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- (a) Title, number and date of this specification
- (b) Type and grade of steel plate, sheet or coil required (see 1.2).
- (c) If steel plate over 1/2-inch is not classified as type II (see 1.2).
- (d) Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2 appendix A, 20.1.1 and appendix B, 20.1.1).
- (e) When first article is required (see 3.1).
- (f) Absorbed energy required of subsize specimens (see footnote 3 of table III).
- (g) Detailed procedure for heat treatment, if other than specified and class of heat treatment required (see 3.5 and 3.5(a)).
- (h) If weld repair after final heat treatment is not permitted (see 3.6.1).
- (i) Document by which tolerances are to be governed, if other than specified (see 3.7.1 through 3.7.4).
- (j) Applicable fabrication document required (see 3.9).

## MIL-S-24645A(SH)

- (k) When descaling and coating are not required (see 3.10).
- (l) Type and thickness of coating required (see 3.10).
- (m) Test temperature required when nil-ductility testing HSLA-100 (see 3.13).
- (n) When explosion bulge testing for HSLA-80 is required (see footnote 1 of table V).
- (o) If type II plates 1/2-inch or less or other thicknesses are to be ultrasonically tested for soundness and thickness (see 4.4.2.7).
- (p) When explosion bulge test temperature is other than specified (see 4.6.6).
- (q) Levels of packing or commercial packing required (see 5.1).
- (r) Plate preservation required, if other than specified (see 5.1).
- (s) Special marking required (see 5.2).
- (t) Duration of exposure required of protective coating (see 40.1(a) of appendix B).

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

<u>Reference Paragraph</u>	<u>DID Number</u>	<u>DID Title</u>	<u>Suggested Tailoring</u>
4.3 and appendix C	DI-MISC-80653	Test reports	
4.4	DI-T-5329	Inspection and test reports	
4.6 and 6.4	DI-MISC-80678	Certification/data report	

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

6.4 Certification/data reports. When specified in the contract or order, a certification/data report should be prepared for each lot of material offered for acceptance. The certificate should include actual data of specified chemical and mechanical tests and a record of the final heat treatment. Qualitative results of nondestructive tests and other inspections or tests should be recorded on the certificate. The certificate should state that each lot has been sampled, tested, and inspected in accordance with the specification requirements and that the manufacturer has maintained manufacturing procedures and practices to produce material to meet the minimum property requirements throughout the plate, sheet or coil. The certificate

## MIL-S-24645A(SH)

should state each lot meets all specification requirements and must be signed by responsible representative of the contractor.

6.5 First article. When first article inspection is required, the contracting officer should provide specific guidance to offerors whether the item(s) should be a preproduction sample, a first article sample, a first production item, a sample selected from the first \_\_\_\_\_ production items, a standard production item from the contractor's current inventory (see 3.1), and the number of items to be tested as specified in 4.3. The contracting officer should also include specific instructions in acquisition document regarding arrangements for examination, 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. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

6.6 Receipt inspection. Plates, sheets, or coil may be subject to receipt inspection (including chemical composition and mechanical property tests), by the contracting activity to verify conformance to the requirements of the specification. Materials not conforming to the requirements of the specification may be rejected by the contracting activity. The manufacturer may verify the results of the contracting activity's receipt inspection.

6.7 Thin plates. Plates under 7.65 lb/in<sup>2</sup> should be ordered under this specification only when they are for structural purposes where strength and gauge are important.

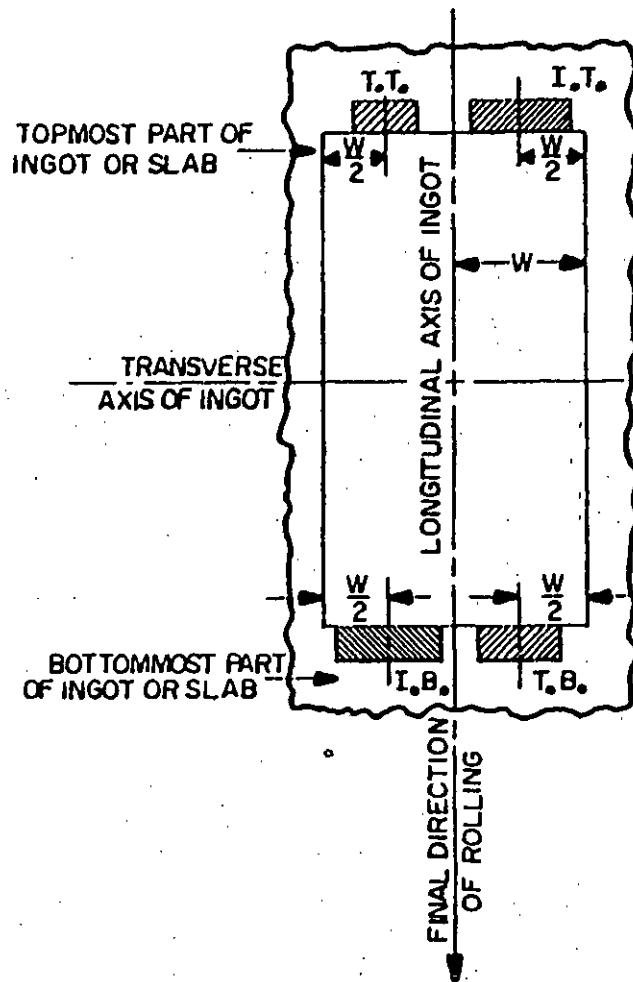
6.8 Subject term (key work) listing.

Charpy V-notch  
Explosion bulge  
High strength  
Ultrasonic inspection

MIL-S-24645A(SH)

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

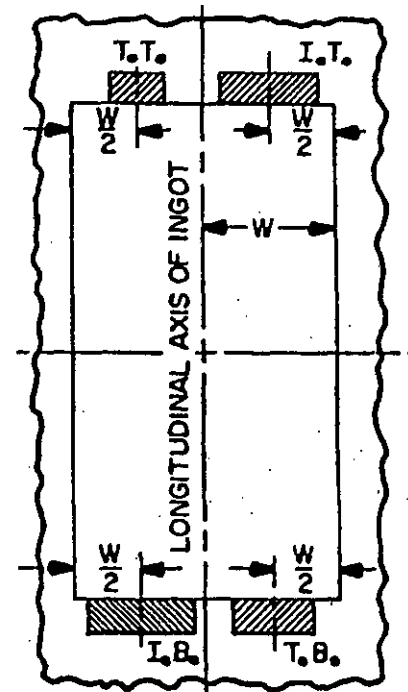
Preparing activity:  
Navy - SH  
(Project 9515-N048)



T.T. = TRANSVERSE TENSILE TEST (TOP)  
 T.B. = TRANSVERSE TENSILE TEST (BOTTOM)  
 W = DISTANCE FROM CENTER LINE TO EDGE  
 I.T. = IMPACT TESTS (CHARPY IMPACT, DYNAMIC TEAR, DROPWEIGHT NIL-DUCTILITY) (TOP)  
 I.B. = IMPACT TESTS (CHARPY IMPACT, DYNAMIC TEAR, DROPWEIGHT NIL-DUCTILITY) (BOTTOM)

## NOTES:

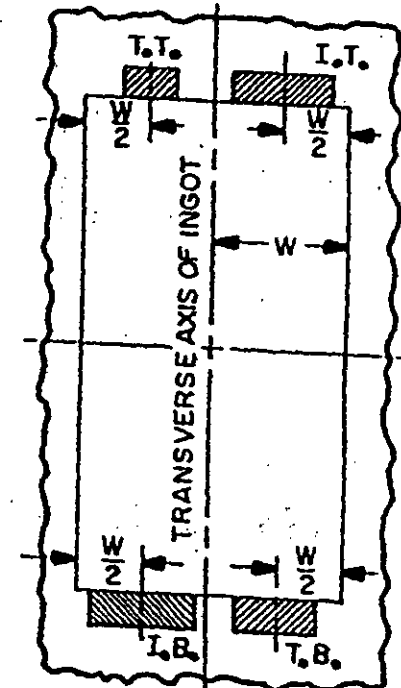
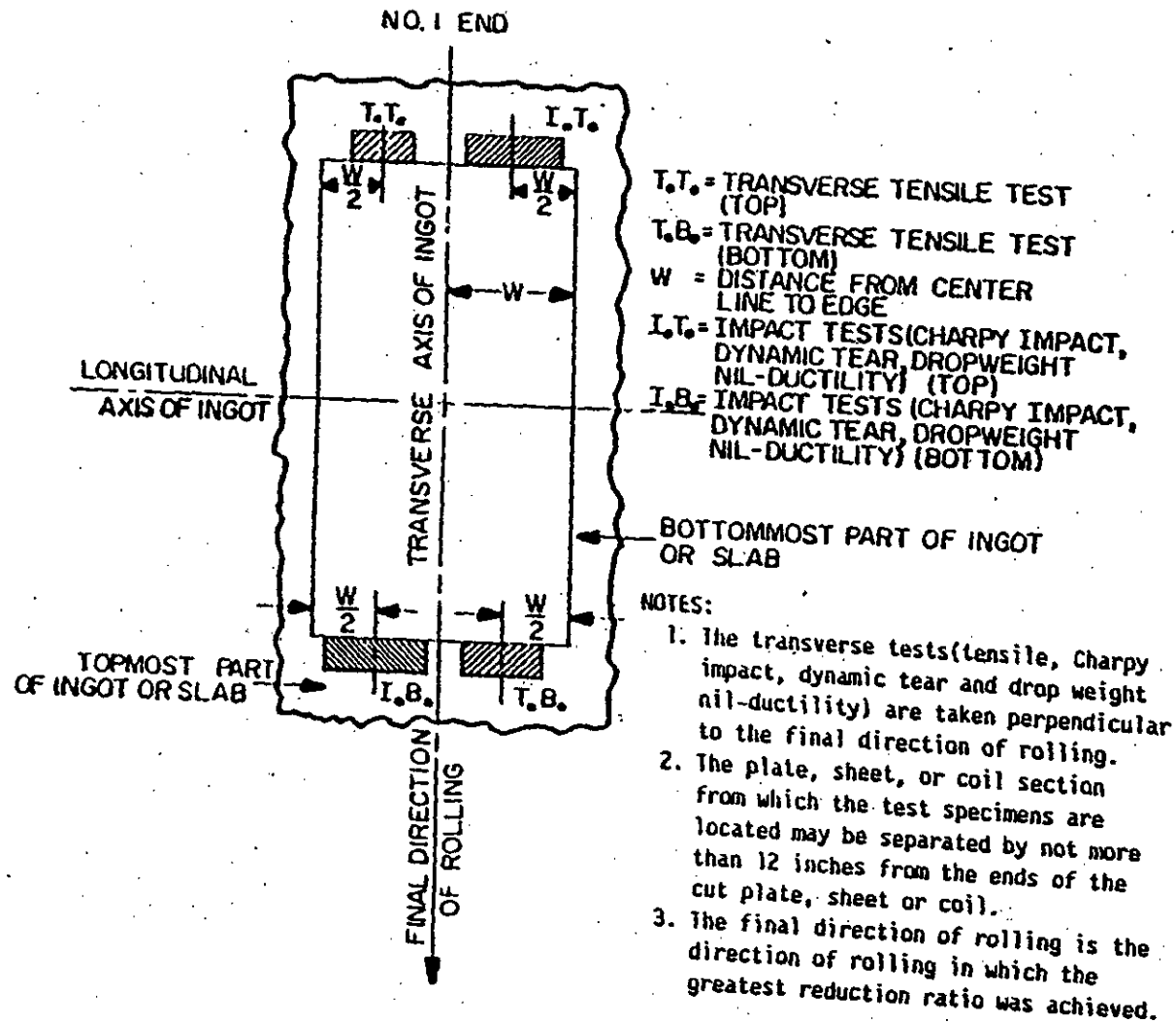
1. The transverse tests (tensile, Charpy impact, dynamic tear and drop weight nil-ductility) are taken perpendicular to the final direction of rolling.
2. The plate, sheet, or coil section from which the test specimens are located may be separated by not more than 12 inches from the ends of the cut plate, sheet or coil.
3. The final direction of rolling is the direction of rolling in which the greatest reduction ratio was achieved.



MIL-S-24645A(SH)

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.



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.



## MIL-S-24645A(SH)

## 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 contains the minimum requirements for equipment, personnel and extent of evaluation in the inspections for acceptance or rejection. It shall in no way restrict the supplemented use of other tests, where the applicability requires them, to define or otherwise determine the acceptability or need for repair of these plates. Ultrasonic gauging and soundness inspection shall be performed in accordance with MIL-STD-271 unless otherwise specified herein. This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

## 20. APPLICABLE DOCUMENTS

20.1 Government document.

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

## STANDARD

## MILITARY

MIL-STD-45662 - Calibration Systems Requirements.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

## 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.

MIL-S-24645A(SH)  
APPENDIX A

30.2 Equipment requirements.

30.2.1 Mechanical micrometer. Micrometers shall be maintained and calibrated in accordance with MIL-STD-45662 monthly, using certified Johansson blocks, or equal.

30.2.2 Ultrasonic gauging instruments. Ultrasonic thickness gauging instruments shall be qualified in accordance with MIL-STD-271.

30.2.3 Ultrasonic soundness inspection equipment.

30.2.3.1 Soundness inspection system. The soundness inspection equipment shall consist of the detection instrument, search unit and accessories. The equipment package shall produce, receive and display high-frequency electrical pulses at the required frequencies and energy levels.

30.2.3.2 Detection instrument. The instrument shall be the pulse-echo type, having an "A" scan presentation.

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

30.2.3.4 Equipment qualification. Ultrasonic soundness inspection equipment shall be qualified in accordance with MIL-STD-271.

30.3 Extent of test.

30.3.1 Thickness. Type II plates requiring mechanical and ultrasonic thickness gauging shall be compared to the tolerance limits specified in 3.7.1.

30.3.2 Soundness. Soundness inspection for type II plates and coils (and, when specified, other plates or coils) shall be evaluated to the acceptance standards specified in 3.8.

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.

MIL-S-24645A(SH)  
APPENDIX A

30.5 Couplant. The couplant chosen shall give satisfactory 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. PROCEDURE

40.1 Plate, sheet or coil thickness gauging.

40.1.1 Equipment. The plate gauging equipment shall consist of mechanical micrometers and either pulse-echo or resonance-frequency ultrasonic gauging instrumentation and all shall meet the requirements specified in section 30. For resonance-frequency systems, the operating frequency range shall be specified by the instrument manufacturer. For pulse-echo systems, a transducer frequency of 2.25 to 5.0 MHz provides satisfactory results for most gauging.

40.1.2 Technique.

40.1.2.1 Calibration. The ultrasonic gauging equipment shall be initially calibrated with two blocks (minimum) of known thicknesses (plus or minus .001 inch) and of the same nominal composition and condition of the plate to be inspected. One block shall be below the minimum acceptable plate thickness and one block shall be above the maximum acceptable plate thickness. The precision of the ultrasonic readings shall be a minimum of 0.005 inch. The test locations (see 4.6.7), shall be used as check points to verify the calibration of the ultrasonic instrument before gauging each plate. If necessary, the instrument controls shall be adjusted so that the ultrasonic readings match the micrometer readings (plus or minus 0.005 inch). The calibration shall be verified periodically as specified in MIL-STD-271.

40.1.2.2 Test pattern. Using ultrasonic gauging 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. If mechanized scanning is employed, the average of the readings obtained on each 24-inch scan may be used as plate gauge.

40.1.2.3 Expanded search. Gauging 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.

MIL-S-24645A(SH)  
APPENDIX A

40.1.3 Recording. The mechanical and ultrasonic gauging location and measurement shall be recorded.

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 Calibration. 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 full scale (not saturated), first back reflection on the cathode ray tube. The signal height shall be designated full screen height (FSH). Recalibration shall be accomplished prior to each use or after any interruption in power supply.

40.2.2.2 Technique. Plate soundness shall be tested with a straight beam (longitudinal wave) search. Each type II plate over 1/2-inch up to and including 2-1/2-inch thickness shall be ultrasonically checked on the intersections of a 24-inch grid pattern. If continuous mechanized scanning is employed, the plates shall be scanned on parallel lines not more than 24-inches apart. Each plate over 2-1/2-inches shall be ultrasonically inspected by continuous scanning on a 24 inch grid, and one diagonal in each grid or at the intersection of an 8-inch grid pattern. If mechanized scanning is employed, the plates shall be scanned on parallel lines not more than 8 inches apart. When continuous scanning is used for expanded search in accordance with 4.4.2.7.1, each pass shall be overlapped a minimum of 15 percent of the transducer width until the entire surface (of area) has been inspected.

40.2.2.3 Soundness criteria. The following indications shall be recorded:

- (a) Discontinuities whose amplitude exceed 50 percent FSH and results in total loss of back reflection.
- (b) Reductions in the back reflection amplitude over 50 percent. Record the minimum back reflection amplitude as a percentage of FSH.

50. RECORDS

50.1 General. Records of gauging and soundness inspection shall be maintained and may be subject to verification by cognizant Government representatives.

50.2 Ultrasonic instrument certification. The two most recent certification records of each ultrasonic instrument in service shall be made

MIL-S-24645A(SH)  
APPENDIX A

available to the cognizant Government representative. For gauging instruments, this record shall consist of a report and graph in accordance with MIL-STD-271.

50.3 Gauging. Plate, sheet or coil thickness gauging, as described in 40.1 shall be recorded in the respective locations of a report form (see figure 3 for a typical form). As a minimum, the form shall also include the following:

- (a) Plate, sheet or coil identification.
- (b) Gauging equipment used.
- (c) Inspector's identity, level of certification, and signature.
- (d) Inspection date.
- (e) Notation of reference corner, minimum allowable reading, and maximum allowable reading.
- (f) Micrometer readings and associated calibration UT readings.
- (g) Minimum and maximum readings.
- (h) Location and limits of areas deviating from tolerances.

50.4 Soundness inspection. The extent of plate or coil conditions, as specified in 40.2 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, level of certification, and signature.
- (d) Inspection date.
- (e) Notation of reference corner.
- (f) Recordable indication location as referenced from the top end and left side of the plate.
- (g) The area of discontinuities recorded in accordance with 40.2.2.3(a).
- (h) The minimum back reflection amplitude of discontinuities recorded in accordance with 40.2.2.3(b).
- (i) Notation of rejectable areas that have been authorized to repair by the reviewing activity.

MIL-S-24645A(SH)  
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. MHZ	
AUXILIARY EQUIPMENT			
INSPECTOR(S)		DATE	
REVIEWED BY?		DATE	

SH 13009

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

	0	30	54	78	102	126	150	174	MILL MARK NO.
0	+	+	+	+	+	+	+	+	HEAT/MELT NO.
30	+	+	+	+	+	+	+	+	SLAB/PLATE/COIL NO.
54	+	+	+	+	+	+	+	+	MATERIAL      LENGTH      WIDTH      GAGE
78	+	+	+	+	+	+	+	+	"                  "                  "                  "
102	+	+	+	+	+	+	+	+	SOUNDNESS DEFECTS - CLASS & LOCATION
126	+	+	+	+	+	+	+	+	FLAW DIMENSION TO:
150	+	+	+	+	+	+	+	+	CLASS TOP LEFT CLASS TOP LEFT
174	+	+	+	+	+	+	+	+	* END SIDE * END SIDE
198	+	+	+	+	+	+	+	+	
222	+	+	+	+	+	+	+	+	
246	+	+	+	+	+	+	+	+	
270	+	+	+	+	+	+	+	+	
294	+	+	+	+	+	+	+	+	*
318	+	+	+	+	+	+	+	+	LBR=LOST BACK REFLECTION WITH DISCONTINUITY SIGNAL >50 PERCENT FSH
342	+	+	+	+	+	+	+	+	RBR=REDUCED BACK REFLECTION
366	+	+	+	+	+	+	+	+	<input type="checkbox"/> SOUNDNESS SATISFACTORY <input type="checkbox"/> REFER EVALUATION
390	+	+	+	+	+	+	+	+	REMARKS
414	+	+	+	+	+	+	+	+	
438	+	+	+	+	+	+	+	+	SPECIFICATION / PROCEDURE
									INSTRUMENT :         MODEL NO.
									SEARCH UNIT :         SIZE         FREQUENCY MH z
									INSPECTOR(S) :         DATE
									REVIEWED BY :         DATE

SH 13010

**FIGURE 4. Suggested ultrasonic report format.**



## MIL-S-24645A(SH)

## APPENDIX B

## COATINGS

## 10. SCOPE

10.1 Scope. This appendix outlines the cleaning and preserving procedures and requirements for ships' plates intended for Naval service. It allows the maximum latitude in cleaning and preserving methods and materials commensurate with the intended storage time and conditions prior to their use. The coatings shall be selected in terms of the particular use. This appendix is a mandatory part of this specification. The information contained herein is intended for compliance.

## 20. APPLICABLE DOCUMENTS

20.1 Government documents.

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

## STANDARD

## FEDERAL

FED-STD-595 - Colors.

## 30. DESCALING AND CLEANING

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

30.1.1 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.

30.1.2 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 procedures. 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.

MIL-S-24645A(SH)  
APPENDIX B

- (c) The pickling bath shall consist of a sulphuric acid solution to which has been added 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 acid 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 calibrated thickness gauge, 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 conform to the following:

- (a) One coat of primer in accordance with FED-STD-595 (color number 37778 - white for HSLA-80 and color number 31668 - pink for HSLA-100) 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 mil at any point. The contractor shall choose a coating compatible with the intended application and duration of protection as specified (see 6.2).
- (b) Organic coatings containing lead, chromium, asbestos, arsenic and mercury shall not be used. This restriction applies to all compounds and derivations.

## MIL-S-24645A(SH)

## APPENDIX C

## TEST REPORTS TECHNICAL CONTENT REQUIREMENTS

## 10. SCOPE

10.1 Scope. This appendix covers the technical content requirements that shall be included when test reports are required by the contract or order. This appendix is mandatory only when data item description DI-MISC-80653 is cited on the DD Form 1423.

## 20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

## 30. FIRST ARTICLE INSPECTION REPORT

30.1 First article inspection report content. When specified, the first article inspection report shall contain the following information:

- (a) Report on production line operations (such as melt practice, processing history, and heat treatment details).
- (b) The quality control procedures which will be used to ensure uniform properties throughout the plate, sheet or coil.
- (c) A detail controlled rolling and testing plan for class 1 material.
- (d) Standard specification data (chemistry, mechanical properties, visual, dimensional and ultrasonic inspection results from typical production stock).
- (e) The transverse to longitudinal rolling ratio for each plate and complete heat treatment record for each plate, sheet or coil.
- (f) Charpy V-notch transition curve (transverse to rolling direction) with data points at each temperature of minus 120°F, minus 90°F, minus 60°F, minus 30°F, 0°F and room temperature. A minimum of three specimens for each point is required and all individual points shall be reported.
- (g) Dynamic tear test transition curve (transverse to rolling direction) with data points at each temperature of minus 80°F, minus 40°F, 0°F, plus 40°F and room temperature. A minimum of two specimens for each point is required and all individual points shall be reported.
- (h) Plate shall be ultrasonically tested using the 100 percent scanning technique specified in appendix A.
- (i) Weld procedure qualification data in accordance with 3.6.1. The plate used for weld inserts shall have been characterized by impact, tensile and chemical composition tests.
- (j) Explosion bulge test data (see 3.12).
- (k) Drop weight nil-ductility test data (see 3.13).

MIL-S-24645A(SH)  
APPENDIX C

- (l) The microstructure in the form of photomicrographs, at the centerline of the thickest plate to be qualified (see 4.6.5.2).
- (m) The average prior austenite grain size in the final heat treated condition (see 4.6.5.1).
- (n) The laying-out of test specimens, and the testing shall be witnessed by American Bureau of Shipping (ABS) or Defense Contract Administration Services Management Area (DCASMA) representatives. ABS or DCASMA should be informed, 24 hours in advance, to witness if they wish, the ingot or continuous casting and the rolling operations.