

INCH-POUND  
MIL-S-24371B(SH)  
2 August 1989  
SUPERSEDING  
MIL-S-24371A(SHIPS)  
21 August 1975  
(See 6.10)

## MILITARY SPECIFICATION

### STEEL PLATE, STRUCTURAL, HIGH YIELD STRENGTH (HY-130)

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 HY-130 steel plate intended primarily for use in submarine hulls and other critical structural applications where a notch-tough, high-yield material is required.

1.2 Classification. Steel plates covered by this specification shall be of the following types, as specified (see 6.2):

Type I - Plate for which ultrasonic testing for soundness and thickness is not required.

Type II - Plate for which ultrasonic testing for soundness and thickness is required. Unless otherwise specified (see 4.4.2.2.1 and 6.2), each plate over 1/2 inch in thickness shall be classified as type II.

#### 2. APPLICABLE DOCUMENTS

##### 2.1 Government documents.

2.1.1 Standards. The following standards 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).

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-24371B(SH)

## STANDARDS

### MILITARY

- MIL-STD-163 - Steel Mill Products Preparation for Shipment and Storage.
- MIL-STD-248 - Welding and Brazing Procedure and Performance Qualification.
- MIL-STD-271 - Requirements for Nondestructive Testing Methods.
- MIL-STD-1681 - Fabrication, Welding and Inspection of HY-130 Submarine Hulls.
- MIL-STD-2149 - Standard Procedures for Explosion Testing Ferrous and Non-Ferrous Metallic Materials and Weldments.

(Unless otherwise indicated, copies of military standards 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 documents 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 20 - Standard Specification for General Requirements for Steel Plates for Pressure Vessels. (DoD adopted)
- A 370 - Standard Test Methods and Definitions for Mechanical Testing of Steel Products. (DoD adopted)
- A 673 - Standard Specification for Sampling Procedure for Impact Testing of Structural Steel. (DoD adopted)
- E 604 - Standard Test Method for Dynamic Tear Testing of Metallic Materials. (DoD adopted)

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

(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.

## MIL-S-24371B(SH)

## 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 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 ingot or 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 Recovered materials. Unless otherwise specified, all material incorporated in the products covered by this specification shall be new and may be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. When specified (see 6.2), virgin raw materials may be required.

3.2.2 Inclusion shape control. Low sulfur practice with calcium injection, or other NAVSEA-approved treatments for inclusion shape control, shall be used to meet the requirements for mechanical properties transverse to the rolling direction for plate over 1-1/2 inches in thickness.

3.3 Ingots and slabs. Ingots and slabs shall not be weld repaired.

3.4 Heat treatment. The plates shall be quenched and tempered. The producer shall determine the detailed procedure for heat treating the plates to meet the mechanical property requirements, with the exception that the final austenitizing temperature shall be specified by the mill and shall not exceed 1675 degrees Fahrenheit (°F), and the tempering temperature shall be not less than 1000°F. Plates shall be water-quenched after tempering. The producer shall maintain a complete (austenitizing and tempering temperatures and times) record of the heat treatment given each plate.

3.5 Chemical composition. The chemical analysis (heat and product) shall conform to the requirements of table I (see 4.6.1).

## MIL-S-24371B(SH)

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

Element	Weight percent max, unless a range is shown
Carbon	0.12
Manganese	.60 - 0.90
Phosphorous	.010
Sulfur	.008
Silicon	.15 - .35
Nickel	4.75 - 5.25
Chromium	0.40 - 0.70
Molybdenum	.30 - .65
Vanadium	.05 - .10
Aluminum <sup>1/2/</sup>	.010 - .050
Columbium <sup>2/3/</sup>	.02
Antimony	.025
Arsenic	.025
Tin	.030
Titanium <sup>1/3/</sup>	.02
Copper	.25
Oxygen <sup>4/</sup>	
Nitrogen <sup>4/</sup>	120.p/m
Hydrogen <sup>4/</sup>	

- <sup>1/</sup> The aluminum content shall be 0.01 percent maximum when columbium is added.
- <sup>2/</sup> The columbium content shall be 0.01 percent maximum when aluminum is added.
- <sup>3/</sup> The chemical composition of these elements shall be reported only when intentionally added.
- <sup>4/</sup> For information only. 35 p/m oxygen and 3 p/m hydrogen are recommended.

3.5.1 Product analysis variations. On product analysis, the percentages of the elements shall not be over the upper limits or under the lower limits specified in table I by more than the amounts specified in table II. Where no product analysis variation is allowed, the limits for product analysis and heat analysis are the same.

## MIL-S-24371B(SH)

TABLE II. Product analysis variations.

Elements	Variations	
	Over the upper limit	Under the lower limit
Carbon	0.02	- - - -
Silicon	.02	0.02
Nickel	.07	.07
Vanadium	.01	.01
Phosphorous	.002	- - - -

3.6 Mechanical properties.

3.6.1 Tensile requirements. The material shall meet the requirements for tensile properties specified in table III, after final heat treatment.

TABLE III. Tensile properties (transverse).<sup>1/</sup>

Tensile property	HY-130 nominal thickness	
	3/16 to 3/4-inch incl.	Over 3/4-inch
Yield strength, 0.2 percent offset, lb/in <sup>2</sup>	130,000 to 150,000	130,000 to 145,000
Ultimate tensile strength, lb/in <sup>2</sup>	<sup>2/</sup>	<sup>2/</sup>
Elongation in 2 inches (min percent)	<sup>3/</sup>	15
Reduction of area (min percent)	Not required	50

<sup>1/</sup> Two transverse specimens are required per plate.

<sup>2/</sup> Not required, to be recorded for information only.

<sup>3/</sup> For plates 3/16 to 1/4 inch exclusive in thickness, the elongation requirement is 11 percent minimum. For plates 1/4 to 3/8 inch exclusive in thickness, the elongation requirement is 12 percent minimum. For plates 3/8 to 3/4 inch in thickness, the elongation requirement is 14 percent minimum.

## MIL-S-24371B(SH)

3.6.2 Impact requirements. The material shall conform to the impact requirements specified in tables IV and V, after final heat treatment.

TABLE IV. Application of impact tests.

Plate thickness (inches)	Applicable test
Up to 5/8 inclusive <sup>1/</sup>	Charpy
Over 5/8 to 6 incl. <sup>2/</sup>	Dynamic tear <sup>3/</sup>

<sup>1/</sup> 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).

<sup>2/</sup> Impact properties for nominal plate thicknesses over 6 inches shall be as specified (see 6.2).

<sup>3/</sup> Unless otherwise specified (see 6.2), Charpy V-notch tests shall also be performed, for information only, on plates over 5/8 inch in thickness. Three specimens shall be tested at each temperature of 30 and minus 120°F.

TABLE V. Transverse impact test requirements.<sup>1/</sup>

Temperature ± 3°F	Dynamic tear test requirement <sup>2/</sup> minimum (average of 2 specimens)	Charpy test requirement <sup>3/</sup> minimum (average of 3 specimens)	
	Foot-Pounds (Ft-lb)	Foot-pounds (Ft-lb)	Fibrous fracture percent
-120		40	50
-20	500		
+30	600	80	95

See footnotes at top of next page.

## MIL-S-24371B(SH)

- 1/ Sampling and location of test specimens shall be as specified in 4.4.2.1 and 4.4.2.5.
- 2/ No single test value shall be below the minimum average by more than 25 ft-lb.
- 3/ No single test value shall be below the minimum average by more than 5 ft-lb.

3.7 Stress relief. Plates shall not be stress relieved after final heat treatment.

3.8 Visual requirements.

3.8.1 Surface quality. The depth of rolled-in scale, pits, or windrowed condition shall not exceed 0.015 inch and shall not result in an undergauge condition. Isolated, individual pits not over 0.030 inch deep and separated by more than 6 inches are acceptable, provided they do not reduce the thickness of the plate below the specified minimum. Surface imperfections may be removed by grinding, provided the thickness is not reduced below the minimum thickness permitted and the ground area is well faired into the surrounding metal.

3.8.2 Weld repair of mill defects prior to heat treatment. Mill defects may be repair welded. Areas of the plate found to have less than the minimum specified thickness may have thickness restored by welding the depressed area. Welding of such areas shall be subject to the following limitations:

- (a) The total area to be repaired shall not exceed 1 percent of the surface of one side of the plate.
- (b) The depth of any area to be repaired shall not exceed one-half the minimum plate thickness specified, or 1/2 inch, whichever is smaller. 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) All of the areas to be welded shall be ground sufficiently to assure that the welds are made on clean, sound material.
- (e) After preparation for repair and prior to welding, all of 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-1681 or the applicable fabrication document (see 3.10) prior to heat treatment, with a procedure qualified in accordance with MIL-STD-248. Procedures and personnel shall be qualified in accordance with MIL-STD-248.

## MIL-S-24371B(SH)

- (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) Plates or segments of plates containing surface repairs as noted above shall be magnetic particle tested in accordance with MIL-STD-271 after final grinding and heat treating to assure freedom from unacceptable discontinuities. Welds and adjacent heat affected zone surfaces shall be free of relevant linear indications longer than 1/8 inch.
- (i) Notations shall be made of such repair areas on the plate inspection form as part of the records.
- (j) Repaired areas shall be marked. The markings shall remain legible and shall not be removed prior to performing all inspections required by this specification.

3.8.3 Weld repairs after heat treatment. Mill defects found after heat treatment shall be repaired in accordance with 3.8.2 and subsequently re-heat treated, or approval shall be required from the contracting activity for repairing the defects following forming.

3.8.4 Edge defects. Visual laminar edge defects less than 1/4 inch long are acceptable. Laminar edge defects 1/4 inch long and over shall be explored by ultrasonics on the plate surface adjacent to the affected area. Edge defects that extend into the plate to the extent that they will result in rejectable defects according to the ultrasonic acceptance standards specified in 3.9 and in appendix A shall be cause for rejection of the plate. Weld repair of laminar edge defects over 1/4 inch long shall be in accordance with a qualified weld procedure.

3.9 Internal soundness. Material shall be rejected when an ultrasonic recordable indication is equal to or greater than 1 square inch in area.

3.10 Applicable fabrication document. If required (see 6.2), the applicable fabrication document shall be specified to the plate manufacturer and shall cover the repair and the inspection of the base metal.

3.11 Dimensional tolerances.

3.11.1 Thickness, weight, and gauge. When plate is ordered to thickness (see 6.2), the maximum allowable variations in thickness measurements shall be as specified in tables VI and VII. When plate is ordered on a pound per square foot (lb/ft<sup>2</sup>) basis (see 6.2), the maximum allowable variations in weight and gauge shall be as specified in table VIII.



TABLE VI. Thickness tolerances<sup>1/</sup> (in inches) over ordered thickness  
for a single plate 2 inches and under in thickness.<sup>2/</sup>

Specified thickness, inches	Tolerances over ordered thickness for widths (in inches) given										
	48 or under	48 - 60 excl.	60 - 72 excl.	72 - 84 excl.	84 - 96 excl.	96 - 108 excl.	108 - 120 excl.	120 - 132 excl.	132 - 144 excl.	144 - 168 excl.	168 and over
3/16	0.027	0.027	0.027	0.027	0.027	-----	-----	-----	-----	-----	-----
1/4	.027	.027	.027	.027	.027	0.027	-----	-----	-----	-----	-----
3/8	.027	.027	.027	.027	.027	.035	0.035	0.042	-----	-----	-----
7/16	.027	.027	.027	.027	.027	.035	.042	.042	0.052	-----	-----
1/2	.027	.027	.027	.027	.027	.035	.042	.042	.052	0.062	-----
9/16	.027	.027	.027	.027	.027	.035	.042	.052	.052	.062	-----
5/8	.027	.027	.027	.027	.027	.035	.042	.052	.052	.062	-----
11/16	.027	.027	.027	.027	.027	.035	.042	.052	.052	.062	-----
3/4	.027	.027	.027	.027	.035	.035	.042	.052	.068	.075	-----
13/16	.027	.035	.035	.035	.035	.042	.052	.052	.068	.075	-----
7/8	.035	.035	.035	.035	.042	.042	.052	.062	.068	.075	-----
15/16	.035	.035	.035	.035	.042	.042	.052	.062	.075	.085	-----
1	.035	.035	.042	.042	.042	.042	.052	.062	.075	.085	0.093
1- 1/16	.035	.035	.042	.042	.042	.052	.052	.062	.075	.085	-----
1- 1/8	.042	.042	.042	.042	.042	.052	.052	.068	.075	.085	-----
1- 3/16	.042	.042	.052	.052	.052	.052	.062	.075	.085	.095	0.102
1- 1/4	.042	.042	.052	.052	.052	.062	.062	.075	.085	.095	-----
1- 5/16	.042	.042	.052	.052	.052	.062	.062	.075	.095	.105	-----
1- 3/8	.047	.052	.052	.052	.052	.062	.068	.085	.095	.105	-----
1- 7/16	.047	.052	.062	.062	.062	.062	.075	.085	.105	.115	-----
1- 1/2	.052	.052	.062	.062	.062	.068	.075	.085	.105	.115	-----
1- 9/16	.052	.052	.062	.062	.062	.068	.075	.095	.105	.130	-----
1- 5/8	.062	.062	.062	.062	.062	.075	.085	.095	.115	.130	-----
1-11/16	.062	.062	.068	.068	.068	.075	.085	.105	.115	.130	-----
1- 3/4	.062	.062	.068	.068	.068	.075	.085	.105	.125	.145	-----
1-13/16	.062	.062	.075	.075	.075	.085	.095	.105	.125	.145	-----
1- 7/8	.062	.062	.075	.075	.075	.085	.095	.115	.125	.145	-----
1-15/16	.068	.068	.075	.075	.075	.085	.095	.115	.141	.157	-----
2	.068	.068	.075	.075	.075	.085	.095	.115	.141	.157	-----

1/ Tolerance under specified thickness, 0.010 inch.

2/ For intermediate specified thickness, the tolerance of the closer specified thickness shall apply. In case of mid-point, the tolerance for lower specified thickness or an interpolated value shall apply.

MIL-S-24371B (SH)

## MIL-S-24371B(SH)

TABLE VII. Thickness tolerances<sup>1/</sup> (in inches) over ordered thickness for a single plate over 2 inches in thickness when ordered to thickness.

Specified thickness, inches	Tolerances over specified thickness for width (in inches) given					
	To 36 excl.	36 to 60 excl.	60 to 84 excl.	84 to 120 excl.	120 to 132 excl.	132 and over
Over 2 to 3, excl.	0.063	0.094	0.109	0.125	0.125	0.141
3 to 4, excl.	.078	.094	.109	.125	.125	.141
4 to 6, excl.	.094	.125	.141	.156	.156	.172

<sup>1/</sup> Tolerance under specified thickness, 0.010 inch.

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

Specified weight, lb/ft <sup>2</sup>	Allowable percent undergauge at edge for widths (in inches) given								
	Up to 66 inches incl.	Over 66 to 80 inches incl.	Over 80 to 90 inches incl.	Over 90 to 100 inches incl.	Over 100 to 115 inches incl.	Over 115 to 135 inches incl.	Over 135 to 150 inches incl.	Over 150 to 168 inches incl.	Over 168 inches
To 20.4 excl.	6	6	8	8	---	---	---	---	---
20.4 to 25.5 excl.	3.5	4	4.5	5	5.5	6.5	---	---	---
25.5 to 30.6 excl.	3.5	4	4.5	5	5.5	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

## MIL-S-24371B(SH)

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

Specified weight lb/ft <sup>2</sup>	Allowable percent weight tolerance for widths (in inches) given					
	Up to 150 inches incl.		Over 150 to 168 inches incl.		Over 168 inches	
	Over	Under	Over	Under	Over	Under
To 20.4 excl.	8	10	--	--	--	--
20.4 to 25.5 excl.	2	4	--	--	--	--
25.5 to 30.6 excl.	2	4	--	--	--	--
30.6 to 40.8 excl.	2	3.5	3	4	3	4
40.8 and over	2	3	2	3	3	4

3.11.2 Flatness. Plates shall be flat within the tolerance limit specified in table IX. The flatness as specified in table IX shall be an overall flatness. It shall not apply to kinks or waviness. The waviness or kinking permitted shall be judged by laying a 3-foot straightedge across the affected area. The maximum permissible deviation from the straightedge shall be 1/4 inch. Tighter flatness requirements, such as those for steel to be dimpled for flight decks, shall be as specified (see 6.2).

TABLE IX. Flatness tolerances (in inches) for plates ordered on a lb/ft<sup>2</sup> or inch thickness basis. 1/ 2/ 3/

Tolerances from a flat surface for widths (in inches) given

Specified thickness, inches	Specified weight, lb/ft <sup>2</sup>	To 36 excl.	36 - 48 excl.	48 - 60 excl.	60 - 72 excl.	72 - 84 excl.	84 - 96 excl.	96 - 108 excl.	108 - 120 excl.	120 - 144 excl.	144 - 168 excl.	168 and over
3/16 to 1/4 excl.	To 10.2 excl.	15/16	1- 5/16	1- 5/8	2- 1/16	2- 1/4	2- 7/16	-----	-----	-----	-----	-----
1/4 to 3/8 excl.	10.2 to 15.3 excl.	7/8	1- 1/8	1- 5/16	1- 5/8	1- 7/8	2- 1/16	2- 3/16	-----	-----	-----	-----
3/8 to 1/2 excl.	15.3 to 20.4 excl.	3/4	15/16	1- 1/16	1- 1/8	1- 5/16	1- 1/2	1-11/16	1- 7/8	2- 3/16	3	3- 3/4
1/2 to 3/4 excl.	20.4 to 30.6 excl.	11/16	7/8	15/16	1- 1/16	1- 1/8	1- 5/16	1-11/16	1-11/16	1-11/16	2- 5/8	3- 3/8
3/4 to 1 excl.	30.6 to 40.8 excl.	11/16	7/8	15/16	1- 1/16	1- 1/16	1- 1/8	1- 1/4	1- 7/16	1- 1/2	2- 1/4	3
1 to 2 excl.	40.8 to 81.6 excl.	9/16	3/4	7/8	15/16	15/16	1- 1/16	1- 1/16	1- 1/16	1- 1/8	1- 3/4	2- 5/8
2 to 4 excl.	81.6 to 163.2 excl.	1/2	9/16	11/16	3/4	3/4	7/8	7/8	15/16	1- 1/8	1- 1/2	1- 7/8
4 to 6 excl.	163.2 to 244.8 excl.	9/16	11/16	3/4	7/8	15/16	15/16	1- 1/8	1- 5/16	1- 1/2	1- 1/2	1- 1/2

1/ Flatness tolerances for length and width: The longer dimension specified is considered the length and variations in flatness along the length shall not exceed the tabular amount for the specified width in any 12 foot length.

2/ When the longer dimension is under 36 inches, the variation in flatness shall not exceed 1/4 inch.

3/ Table IX covers the flatness tolerances of circular and sketch plates, based on the maximum dimensions of those plates.

MIL-S-24371B(SH)

## MIL-S-24371B(SH)

3.11.3 Camber. Camber of plates shall not exceed the tolerance limits specified in table X.

TABLE X. Camber tolerances for plates ordered on a lb/ft<sup>2</sup> or thickness basis.

Specified thickness, inches	Specified weight, lb/ft <sup>2</sup>	Widths, inches	Camber tolerance for thickness and widths given
To 2 incl.	To 81.6 incl.	All	1/8 inch X $\frac{\text{number of feet of length}}{5}$
Over 2 to 6 excl.	Over 81.6	To 30 incl.	3/16 inch X $\frac{\text{number of feet of length}}{5}$
Over 2 to 6	Over 81.6	Over 30 to 60 incl.	1/4 inch X $\frac{\text{number of feet of length}}{5}$

3.11.4 Size tolerances. The width and length of the plates shall not vary in excess of the tolerances specified in tables XI and XII, as applicable.

TABLE XI. Width and length tolerances applicable to sheared plates under 1 inch.

Specified dimensions (inches)		Maximum permissible variations over specified widths given (inches) <sup>1/</sup>			
Widths	Lengths	3/16 to 5/8 excl.		5/8 to 1 excl.	
		Width	Length	Width	Length
To 60 excl. 60 to 84 excl. 84 to 108 excl. 108 and over	To 120 excl.	7/16 1/2 5/8 3/4	5/8 11/16 7/8 1	1/2 5/8 3/4 7/8	3/4 7/8 1 1- 1/8
To 60 excl. 60 to 84 excl. 84 to 108 excl. 108 and over	120 to 240 excl.	1/2 5/8 11/16 3/4	7/8 7/8 15/16 1- 3/16	5/8 3/4 13/16 7/8	1 1 1- 1/8 1- 1/4
To 60 excl. 60 to 84 excl. 84 to 108 excl. 108 and over	240 to 360 excl.	1/2 5/8 11/16 7/8	1- 3/16 1- 3/16 1- 3/16 1- 5/16	5/8 3/4 7/8 1	1- 5/16 1- 5/16 1- 7/16 1- 7/16

See footnote at end of table.

## MIL-S-24371B(SH)

TABLE XI. Width and length tolerances applicable to sheared plates under 1 inch. (Continued)

Specified dimensions (inches)		Maximum permissible variations over specified widths given (inches) <sup>1/</sup>			
Widths	Lengths	3/16 to 5/8 excl.		5/8 to 1 excl.	
		Width	Length	Width	Length
To 60 excl. 60 to 84 excl. 84 to 108 excl. 108 and over	360 to 480 excl.	1/2 5/8 3/4 7/8	1- 5/16 1- 7/16 1- 7/16 1- 9/16	5/8 3/4 1 1	1- 7/16 1- 9/16 1- 9/16 1-11/16
To 60 excl. 60 to 84 excl. 84 to 108 excl. 108 and over	480 to 600 excl.	1/2 5/8 3/4 7/8	1- 5/8 1- 5/8 1- 5/8 1- 3/4	5/8 3/4 7/8 1	1- 3/4 1- 3/4 1- 3/4 1- 7/8
To 60 excl. 60 to 84 excl. 84 to 108 excl. 108 and over	600 to 720 excl.	5/8 3/4 3/4 1	2 2 2 2- 1/8	3/4 7/8 7/8 1- 1/8	2 2 2 2- 3/8
To 60 excl. 60 to 84 excl. 84 to 108 excl. 108 and over	720 and over	3/4 7/8 7/8 1- 1/8	2- 1/4 2- 1/4 2- 1/4 2- 1/2	7/8 1 1 1- 1/4	2- 3/8 2- 3/8 2- 3/8 2- 5/8

<sup>1/</sup> Maximum permissible variation under specified width and length, 1/4 inch.

TABLE XII. Width and length tolerances for gas cut rectangular plates.

Specified thicknesses, inches	Tolerances over <sup>1/</sup> all specified widths or lengths, inches
To 2 excl.	3/4
2 to 4 excl.	1
4 to 6 excl.	1- 1/8

<sup>1/</sup> Maximum permissible variation under specified width and length, 1/4 inch.

3.12 Explosion bulge. Two crack starter and two bulge specimens are required for a complete series. The explosion bulge criteria for performance shall be in accordance with the following:

MIL-S-24371B(SH)

(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 crack shall extend into hold down area.

Second shot:

A minimum of 3 percent reduction in thickness shall be obtained on the two shots.  
No piece shall be thrown out of material being tested.  
Through thickness cracks are acceptable.  
No cracks shall extend into hold down area.

(b) Bulge.

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.

Second shot:

Percent reduction in thickness obtained for information, five percent reduction is expected.  
No piece shall be thrown out of material being tested.  
No through thickness cracks shall be present.  
No crack shall extend into hold down area.  
In the event that 7 percent reduction in plate thickness is obtained on both sides of the weld, or 7-1/2 percent reduction in plate thickness on one side of the weld, the performance is considered satisfactory and the third shot shall not be made 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 hold down area.

MIL-S-24371B(SH)

Third shot:

Percent reduction in thickness obtained for information, 7 percent reduction is expected.

No piece shall be thrown out of material being tested.

Through thickness cracks are acceptable.

No cracks shall extend into hold down area.

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

3.13 Cleaning and preservation of plate surfaces. Unless otherwise specified (see 6.2), the surface of the plate shall be descaled and coated as specified (see appendix B).

3.14 Marking. Each plate shall be indentation stamped with the heat number, plate number, and the designation HY-130. In addition, plates shall be marked to designate the ultrasonic reference base location (see 30.6, appendix A). The marking may be painted or stenciled in lieu of die stamping on plates 1/4 inch thick or less. Where the plate number provides positive identification of the heat number, the heat number may be omitted from the markings. Identification stamping shall be done with round nose dies.

3.15 Workmanship. The steel plate 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 (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection,



## MIL-S-24371B(SH)

as part of the manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material (see 6.3).

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

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

4.3 First article inspection. First article inspection shall consist of the examinations and tests specified in table XIII (see 6.3 and appendix C).

TABLE XIII. First article and quality conformance inspections.

Examinations and tests	Requirement	Examination or test procedure	First article	Quality conformance
Examination				
Visual	3.8	4.5.1	X	X
Ultrasonic	3.9	4.5.2	X	X
Thickness	3.11	4.5.3	X	X
Dimensional	3.11	4.5.4	X	X
Chemical analysis	3.5	4.6.1	X	X
Tensile	3.6.1	4.6.2	X	X
Impact				
Charpy V-notch	3.6.2	4.6.3.1	X	X <u>2</u> /
Dynamic tear	3.6.2	4.6.3.2	X	X <u>2</u> /
Explosion bulge	3.12	4.6.4	X <u>1</u> /	---

1/ When specified (see 6.2).

2/ See table IV.

4.3.1 Sampling for first article inspection. First article samples shall be taken from plates, from one heat, rolled from ingots or continuously cast slabs that represent the largest size to be used at the rolling facility. In addition, the contractor shall provide enough 2 inch thick rolled plate to provide the test data required in 4.3.

4.4 Quality conformance inspection. Quality conformance inspection shall consist of the examinations and tests specified in table XIII (see 6.3). Each lot shall be inspected (see 4.4.1).

## MIL-S-24371B(SH)

4.4.1 Lot definitions.

4.4.1.1 Lot for examination. For purposes of visual and dimensional examination and ultrasonic inspection, each plate as submitted for final inspection shall constitute a lot.

4.4.1.2 Lot for chemical analysis. Lots for chemical composition shall be defined as follows: ingot cast, each heat; continuous cast, each ladle; vacuum arc remelt (VAR) or electroslog 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.

4.4.1.3 Lot for tensile tests. Each plate as heat treated shall constitute a lot.

4.4.1.4 Lot for impact tests. Each plate as heat treated shall constitute a lot.

4.4.2 Sampling. Samples shall be taken for examination and testing as follows:

4.4.2.1 Location of test specimens. 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 direction 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 examination. Each plate shall be examined visually, ultrasonically, and dimensionally. With respect to coating applications, the number of plates subject to paint film thickness measurements should be held to the minimum necessary to assure continued satisfactory performance.

4.4.2.2.1 Ultrasonic inspection (soundness and thickness). Unless otherwise specified (see 6.2), each plate over 1/2 inch in thickness shall be ultrasonically measured for thickness and ultrasonically inspected for internal soundness. Ultrasonic inspection and measurement shall be in accordance with appendix A. When plate is specified on a lb/ft<sup>2</sup> basis, ultrasonic inspection for thickness is not required. Ultrasonic soundness criteria shall be as specified in 3.9.

4.4.2.3 Sampling for chemical and 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.

## MIL-S-24371B(SH)

4.4.2.4 Sampling for tensile test. After final heat treatment of the plate, one top transverse tensile test specimen and one bottom transverse tensile test specimen shall be taken from each plate. The tensile test specimens for plate 3/4 inch and under in thickness shall be the thickness of the plate. The test specimens shall conform to the requirements for rectangular tension test specimens of ASTM A 370. Either the 1-1/2 inch wide specimen or the 1/2 inch wide specimen is acceptable. The 1/2 inch wide specimen shall have a maximum nominal thickness of 3/4 inch. For plates up to 4 inches, inclusive, in thickness, tension test specimens may be full thickness of the plate and conform to the requirements of the 1-1/2 inch wide specimen of ASTM A 370 when adequate testing machine capacity is available. For plates over 3/4 inch in thickness, except as permitted previously, tensile test specimens shall conform to the 0.500 inch round specimen of ASTM A 370. The axis of round specimens shall be located as nearly as practicable midway between the center of thickness and the top or bottom surface of the plate.

4.4.2.5 Sampling for impact test.

4.4.2.5.1 Charpy V-notch testing. From each plate, three transverse Charpy V-notch test specimens shall be taken from each location for each test temperature. The specimens shall be in accordance with ASTM A 370. The specimens shall be so located in the thickness of the plate that, for 1/2 inch thick to 7/8 inch thick, the plate surface (after light machining) shall be one face; for plates 7/8 inch thick to 4 inches thick inclusive, the mid thickness of the plate shall be the mid thickness of the specimens; and, for plates 4 inches to 6 inches thick inclusive, the mid thickness of the specimen shall be the quarter thickness of the plate. The notch shall be perpendicular to the plate surface. The specimens shall be located not less than three times the plate thickness or 4 inches, whichever is less, from the "as-heat treated" edge of the plate.

4.4.2.5.2 Dynamic tear testing. From each plate, two transverse dynamic tear test specimens shall be taken from each location for each test temperature. The test specimens shall be in accordance with ASTM E 604. The dynamic tear specimens shall be located in the thickness of the plate such that the mid thickness of the plate shall be the mid thickness of the specimen for plate thicknesses to 4 inches inclusive. For plates greater than 4 inches to 6 inches inclusive, the mid thickness of the specimen shall be the quarter thickness of the plate. The notch shall be perpendicular to the plate surfaces. The specimens shall be located not less than three times the plate thickness or 4 inches, whichever is less, from the "as-heat treated" edge of the plate.

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

## MIL-S-24371B(SH)

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

4.5 Examination. Each plate shall be examined visually, ultrasonically, and dimensionally for conformance to the requirements of this specification.

4.5.1 Visual inspection. The plate surface and edges shall be inspected to assure conformance to the requirements of 3.8.

4.5.2 Ultrasonic testing and gauging. Ultrasonic procedures shall be as specified in appendix A.

4.5.3 Thickness. Each plate shall be inspected with a calibrated micrometer at three evenly distributed points along each longitudinal edge and at two evenly distributed points along each transverse edge. Type II plates shall also be gauged using the ultrasonic technique in appendix A.

4.5.3.1 Paint film thickness. Procedures for determining paint film thickness shall be in accordance with appendix B.

4.5.4 Dimensional inspection. Plates shall be measured to ensure the size or weight is as specified and within tolerances (see 3.11).

4.6 Testing procedures.

4.6.1 Chemical analysis. Samples selected in accordance with 4.4.2.3 shall be analyzed in accordance with a standard ASTM method or a method that will ensure equally accurate results for conformance to 3.5, as applicable. If the sample from the topmost plates fails to meet the requirements, all plates from the heat in question shall be rejected. Samples from rejected plates may be analyzed separately, provided the samples are taken in the specified locations, and those plates which conform in chemical composition to 3.5 will be accepted. The methods shall be correlated with National Bureau of Standards standard reference materials, when available, to ensure the validity of the method that is used as a control in chemical analysis or for calibration in instrumental methods of analysis.

4.6.1.1 Continuous cast slabs. The sample selected in accordance with 4.4.2.3 shall be analyzed to determine conformance to 3.5. If either sample fails to meet the requirements, all plates from the heat shall be rejected. Plates may be analyzed separately provided the samples are taken in the specified locations, and those plates which conform in chemical composition to 3.5 will be accepted.

4.6.2 Tensile test. Tensile test specimens selected in accordance with 4.4.2.4 shall be tested in accordance with ASTM A 370.

## MIL-S-24371B(SH)

4.6.3 Impact tests.

4.6.3.1 Charpy V-notch impact test. The test specimens shall be tested in accordance with ASTM A 370 with coolant temperatures of minus  $120 \pm 3^{\circ}\text{F}$  and  $30 \pm 3^{\circ}\text{F}$ . The specimen shall have reached the temperature of the coolant and the tongs used in handling the specimen shall be cooled with the specimen. The specimens shall be taken from the coolant and broken at the designated temperature.

4.6.3.2 Dynamic tear impact test. The test specimens shall be tested in accordance with ASTM E 604 at coolant temperatures of minus  $20 \pm 3^{\circ}\text{F}$  and  $30 \pm 3^{\circ}\text{F}$ . The specimen shall have reached the temperature of the coolant and the tongs used in handling the specimen shall be cooled with the specimen. The specimens shall be taken from the coolant and broken at the designated temperature.

4.6.4 Explosion bulge test. 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), the temperature of the plate weldment shall be  $30 \pm 3^{\circ}\text{F}$  for each shot.

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 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. All required tests originally performed on the failed material, except chemical analysis, shall be repeated when the material is reinspected.

4.7.2 Tensile retest.

4.7.2.1 Tolerances for tensile retest. If the result of an original tensile specimen is within 1,000 pounds per square inch ( $\text{lb}/\text{in}^2$ ) 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) will be permitted.

## MIL-S-24371B(SH)

4.7.2.2 Gauge length allowances for tensile retest. If the percentage of elongation or reduction-in-area of any tensile specimen is less than that specified in table III and any part of the fracture is outside 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. If a Charpy specimen does not meet individual value requirements, a retest of three specimens from the same location of the plate and at the same test temperature will be permitted. If any retest specimen does not meet the requirements of table V, the plate represented by the specimens shall be rejected.

4.7.4 Dynamic tear retest. If the dynamic tear energy value of one of the four specimens tested at either test temperature does not meet the minimum requirements specified in table V, a retest of two additional specimens from the same location and at the same temperature will be permitted. If any retest specimen does not meet the requirements specified in table V, the plate represented by the specimens shall be rejected.

4.7.5 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 packaging, packing, and marking for shipment, and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

## 5. PACKAGING

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

5.1 Preservation and packing. Unless otherwise specified (see 6.2), steel plates cleaned and coated as specified in 3.13 and packed level A or commercial as specified (see 6.2).

5.2 Marking. In addition to any special marking required (see 6.2 and 3.14), marking shall be in accordance with MIL-STD-163. Marking for shipment shall be painted on one surface of each plate and shall contain the following information:

- (a) Destination.
- (b) Size.
- (c) Whether plate has been examined by ultrasonic inspection.
- (d) Contractor's purchase order number.
- (e) Contractor and contract or order number.

## MIL-S-24371B(SH)

## 6. NOTES

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

6.1 Intended use. The HY-130 steel plate covered by this specification is intended for combatant submarine hull use. This steel may also be used in fabricated welded pressure vessels, surface ship construction, or other critical structural applications where an as-welded, notch tough, high yield strength steel is required. The use of HY-130 steel in fabricated structures or equipment entails much more than a correct material specification, and proper procedures in accordance with the appropriate fabrication documents are required during welding, fabrication, and nondestructive evaluation at the time of use.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- (a) Title, number, and date of this specification.
- (b) Type of steel plate required (see 1.2).
- (c) If steel plate over 1/2 inch thick 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).
- (e) When first article is required (see 3.1).
- (f) Whether virgin raw materials are required (see 3.2.1).
- (g) Absorbed energy required of subsize specimens (see footnote 1/ of table IV).
- (h) Impact properties for nominal plate thicknesses over 6 inches (see footnote 2/ of table IV).
- (i) When supplemental Charpy V-notch tests are not required (see footnote 3/ of table IV).
- (j) If an applicable fabrication document is required (see 3.10).
- (k) Sizes and quantity of plate required (see 3.11.1).
- (l) If plate is to be ordered on a lb/ft<sup>2</sup> basis (see 3.11.1).
- (m) Tighter flatness requirements, when required (see 3.11.2).
- (n) When descaling and coating are not required (see 3.13).
- (o) Type and thickness of coating required if other than specified (see 3.13).
- (p) When explosion bulge testing is required for first article (see footnote 1/ of table XIII).
- (q) If type II plates 1/2 inch or less, or other thicknesses are to be ultrasonically tested for soundness or thickness (see 4.4.2.2.1).
- (r) When explosion bulge test temperature is other than specified (see 4.6.4).



## MIL-S-24371B(SH)

- (s) Plate preservation required, if other than specified (see 5.1).
- (t) Level of packing required (see 5.1).
- (u) Special marking, if required (see 5.2).

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

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

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 (AMSDDL), 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 will 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 plates to meet the minimum property requirements throughout the plate. The certificate should state each lot meets all specification requirements and must be signed by a 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 items(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 documents



## MIL-S-24371B(SH)

regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

#### 6.6 Ultrasonic test records.

6.6.1 Records. Records of gauging and soundness inspection must be maintained and may be subject to verification by cognizant Government representatives. Ultrasonic instrument qualification records must be made available on request.

6.6.2 Gauging. Plate thickness gauging, as described in appendix A, 40.1.2 must be recorded in the respective locations of a report form (see figure 3 for a typical form). As a minimum, the form must also include the following:

- (a) Plate 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 in plate.
- (h) Location and limits of areas deviating from tolerances.

6.6.3 Soundness inspection. The extent of plate conditions, as described in appendix A, 40.2.2.3 must be recorded in the appropriate location of a report form (see figure 4 for a typical form). As a minimum, the form must also include the following:

- (a) Plate identification.
- (b) Inspection equipment used.
- (c) Inspector's identity, level of certification, and signature.
- (d) Inspection date.
- (e) Notation of a reference corner.
- (f) A listing of all recordable indications, their classifications, and location.
- (g) A sketch of the plate with all rejectable areas classified, mapped, and annotated with the area of the flaws.
- (h) Notation of rejectable areas that have been authorized for repair by the reviewing activity.

MIL-S-24371B(SH)

6.6.4 Ultrasonic instrument qualification. The two most recent qualification records of each ultrasonic instrument in service must be made available to the cognizant Government representative.

6.7 Receipt inspection. The plates are subject to receipt inspection (including chemical composition and mechanical property tests), by the contracting activity to verify conformance to all requirements of the specification. Plates not conforming to the requirements of the specification may be rejected by the contracting activity.

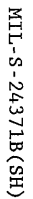
6.8 Field identification. Hardness testing may be used as a supplementary aid for field identification purposes. The Brinell hardness values should be between 293 and 352 when performed in accordance with ASTM A 370.

6.9 Subject term (key word) listing.

- Charpy V-notch
- Chemical analysis
- Dynamic tear
- Explosion bulge
- Flatness
- Tensile properties
- Ultrasonic inspection

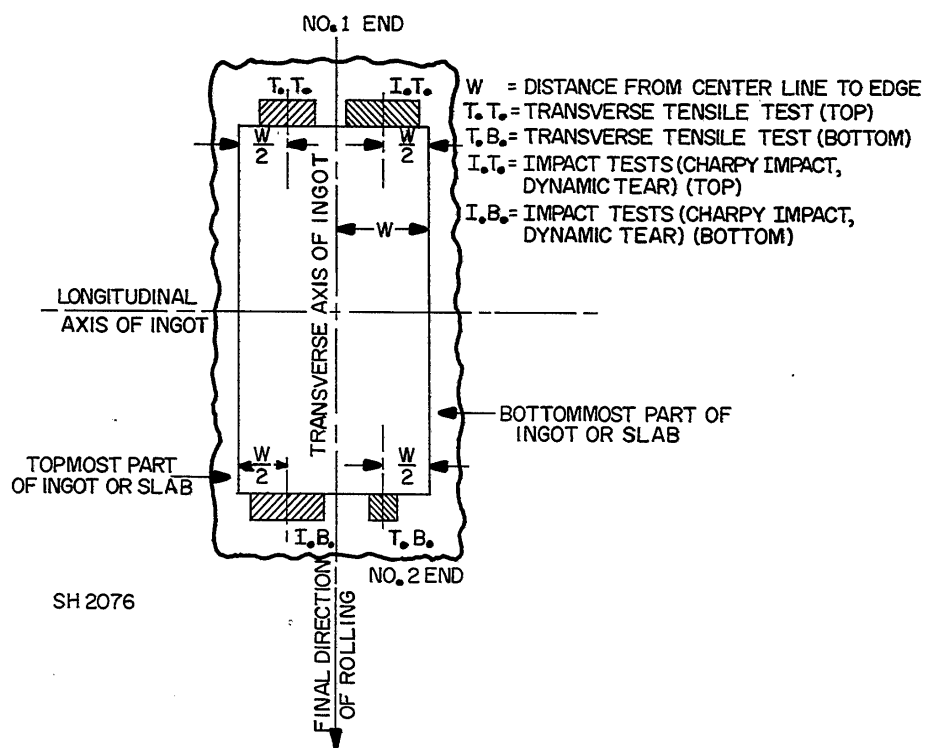
6.10 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing activity:  
Navy - SH  
(Project 9515-N049)



**NOTE:**

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



SH 2076

## NOTE:

1. The transverse tensile test and transverse impact test shall be taken perpendicular to the final direction of rolling.

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

MIL-S-24371B(SH)

MIL-S-24371B(SH)

TOP	6"	18"	30"	42"	54"	66"	78"	90"	102"	114"	126"	
Micrometer →												← Micrometer
6"												
18"												
36"												
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 NO.			
MATERIAL	LENGTH	WIDTH	GAUGE
	"	"	"
THICKNESS	MINIMUM	MAXIMUM	
ALLOWABLE	"	"	
MEASURED	"	"	
DEVIATION	"	"	
SPECIFICATION/PROCEDURE NO.			
INSTRUMENT MODEL NO.			
TRANSDUCER SIZE		FREQ. MHZ	
AUXILIARY EQUIPMENT			
INSPECTOR/CERT. LEVEL DATE			
REVIEWED BY: DATE			

FIGURE 3. Sample plate gauging report (micrometer and ultrasonic).

MIL-S-24371B(SH)

	0	30	54	78	102	126	150	174	
0	+	+	+	+	+	+	+	+	MILL MARK NO.
30	+	+	+	+	+	+	+	+	HEAT/MELT NO.
54	+	+	+	+	+	+	+	+	SLAB/PLATE NO.
78	+	+	+	+	+	+	+	+	MATERIAL
102	+	+	+	+	+	+	+	+	LENGTH
126	+	+	+	+	+	+	+	+	WIDTH
150	+	+	+	+	+	+	+	+	GAGE
174	+	+	+	+	+	+	+	+	RECORDABLE SOUNDNESS DISCONTINUITIES
198	+	+	+	+	+	+	+	+	FLAW DIMENSION TO:
222	+	+	+	+	+	+	+	+	CLASS TOP LEFT
246	+	+	+	+	+	+	+	+	CLASS TOP LEFT
270	+	+	+	+	+	+	+	+	CLASS TOP LEFT
294	+	+	+	+	+	+	+	+	CLASS TOP LEFT
318	+	+	+	+	+	+	+	+	CLASS TOP LEFT
342	+	+	+	+	+	+	+	+	CLASS TOP LEFT
366	+	+	+	+	+	+	+	+	CLASS TOP LEFT
390	+	+	+	+	+	+	+	+	CLASS TOP LEFT
414	+	+	+	+	+	+	+	+	CLASS TOP LEFT
438	+	+	+	+	+	+	+	+	CLASS TOP LEFT
									*KEY (SEE 40.2.2.3.2)
									REC-ACCEPTABLE DISCONTINUITY
									REJ-REJECTABLE DISCONTINUITY
									<input type="checkbox"/> SOUNDNESS
									<input type="checkbox"/> SATISFACTORY
									<input type="checkbox"/> REFER
									<input type="checkbox"/> EVALUATION
									REMARKS
									SPECIFICATION/PROCEDURE
									INSPECTOR/CERT. LEVEL MODEL NO.
									SEARCH UNIT: SIZE FREQUENCY
									INSPECTOR (S): DATE
									REVIEWED BY: DATE

FIGURE 4. Sample plate ultrasonic report.

## MIL-S-24371B(SH)

## APPENDIX A

## ULTRASONIC PROCEDURES AND EVALUATION

## 10. SCOPE

10.1 Scope. This appendix outlines the nondestructive evaluation of plate for service acceptability in submarine or other specialized Naval use. It describes the basic methods of gauging 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 contained herein. These procedures are intended to assure freedom from laminations throughout the plate in excess of the special acceptance or rejection standards. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

## 20. APPLICABLE DOCUMENTS

20.1 Government document.

20.1.1 Standard. The following standard forms a part of this document to the extent specified herein. Unless otherwise specified, the issue of this document is that listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

## STANDARD

## MILITARY

MIL-STD-45662 - Calibration System Requirements.

(Unless otherwise indicated, copies of military standards 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 of MIL-STD-271. In addition, they shall be thoroughly familiar with inspection requirements and acceptance standards as specified herein.

30.2 Equipment requirements.

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

## MIL-S-24371B(SH)

## APPENDIX A

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 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 electric pulses at the required frequencies and energy levels.

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

30.2.3.2 Search unit. The type of search unit used is optional, but must be compatible with the test instrument. The transducer shall be a straight beam unit that transmits a longitudinal mode of sound vibration into the plate and receives 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).

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

30.3 Extent of test.

30.3.1 Thickness. Type II plates requiring mechanical and ultrasonic thickness gauging (and, when specified, other plates) shall be in accordance with the tolerance acceptance standards specified (see 3.11).

30.3.2 Soundness. Soundness inspection for type II plates (and, when specified, other plates) shall be evaluated to the acceptance standards specified (see 3.9).

30.4 Surface preparation. The scanning surface of the plate 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 suitable mechanical means, such as disc grinding and sanding.

30.5 Couplant. The couplant chosen should give satisfactory results for the equipment in use and the surface conditions prevailing. In addition, the couplant material should 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.



## MIL-S-24371B(SH)

## APPENDIX A

30.6 Reference base designation. The upper left corner of the plate scan surface shall be indicated to designate this as a common reference base location for layout and recording purposes. Marking shall be in accordance with 3.14.

## 40. PROCEDURES

40.1 Plate 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 of section 30. For resonance-frequency systems, the operating frequency range shall be as 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 0.001 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 4.5.3), 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 by 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. Grid 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 length may be used as plate gauge. All points on the scan lines shall meet the requirements specified (see 3.9).

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.

40.1.3 Reporting. When specified, the mechanical and ultrasonic gauging reports shall be made available to NAVSEA.

## MIL-S-24371B(SH)

## APPENDIX A

40.2 Plate soundness inspection.

40.2.1 Equipment. The plate soundness inspection equipment shall meet the requirements of 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 full scale (not saturated), first back reflection on the cathode ray tube.

40.2.2.2 Test pattern. Plate soundness shall be tested with a straight beam longitudinal wave search, in a continuous scan of one major surface (or area) in any convenient direction or pattern. Overlap each pass 25 percent of the transducer width until the entire surface or area has been inspected.

40.2.2.3 Soundness criteria. Discontinuities whose amplitude exceeds 50 percent full screen height (FSH) and results in a complete loss of back reflection shall be recorded. Report the maximum amplitude of the indication as a percentage of FSH.

40.2.2.3.1 Mapping. The area of a discontinuity shall be determined by mapping out the extremities of the recordable condition using the half amplitude method. Recordable indications separated by less than D, where D is the maximum dimension of the larger indication, and within 25 percent of the plate thickness to each other in depth shall be considered a single discontinuity.

40.2.2.3.2 Recordable conditions. Recordable conditions shall be classified as one of the following:

REC - An acceptable discontinuity signal.

REJ - A rejectable discontinuity signal.

All REJ areas shall be outlined on the inspection report. The area of each rejectable condition shall be recorded.

40.2.3 Reporting. When specified, the soundness inspection report shall be made available to NAVSEA.

## MIL-S-24371B(SH)

## APPENDIX B

## COATINGS

## 10. SCOPE

10.1 This appendix outlines the cleaning and preserving procedures and requirements for 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. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

## 20. APPLICABLE DOCUMENTS

20.1 Government documents.

20.1.1 Specifications. The following specifications 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.

## SPECIFICATIONS

## MILITARY

- DOD-P-15328 - Primer (Wash) Pretreatment, (Formula No. 117 for Metals) (Metric).
- MIL-P-24351 - Primer, Coating, Alkyd, Blue (Formula No. 6N35-2).

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

## 30. DESCALING AND CLEANING

30.1 Method. Plates shall be descaled and cleaned by abrasive blast cleaning. Chemical pickling is prohibited. Abrasive blast cleaning shall result in a scale-free, clean, metal surface with oil films and contaminants completely removed.

## 40. PRESERVATIVE COATINGS

40.1 Coating. The plates, as prepared for coating, shall be in the descaled condition and free of visible rust. The paint film shall adequately cover surface roughness peaks. Two random dry film thickness measurements per

## MIL-S-24371B(SH)

## APPENDIX B

100 square feet of painted surface, made with a calibrated thickness gauge, shall be sufficient for determining conformity of any one plate 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 plates shall be coated with one coat of pretreatment in accordance with DOD-P-15328 (formula number 117), to a dry film thickness of 0.3 to 0.5 mil, followed by one coat of alkyd primer (blue) in accordance with MIL-P-24351 (formula number 6N35-2) to an approximate dry film thickness of 1 mil. Thickness of the dry film shall be not less than 0.7 mil at any point.

40.2 Drying time. The drying time of the coatings specified in 40.1 at 73°F shall be as follows:

<u>Specification</u>	<u>Formula number</u>	<u>Drying time</u>
DOD-P-15328	117	15 to 30 minutes
MIL-P-24351	6N35-2 (blue)	6 hours maximum

Plate temperature higher than ambient temperature will shorten drying time.

40.2.1 Color cards. Color cards for formula number 6N35-2 may be obtained from Specification Sales (Code 3FRSBS), Building 197, Washington Navy Yard, General Services Administration, Washington, DC 20407. The purpose for which the color cards are desired shall be specified.

## MIL-S-24371B(SH)

## APPENDIX C

## TEST REPORT TECHNICAL CONTENT REQUIREMENTS

## 10. SCOPE

10.1 Scope. This appendix covers the technical content requirements that should be included on drawings when 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 CONTENT

30.1 First article inspection report content. When required by the contract or order, the first article inspection report shall contain the following information:

- (a) Standard specification data (chemistry, mechanical properties, visual, dimensional, and ultrasonic inspection results from plate stock specified in 4.3.1 (see 6.6)).
- (b) The transverse to longitudinal roll ratio for each plate, along with a complete heat treatment record.
- (c) The quality control procedures which will be used to ensure uniform properties throughout the plate.
- (d) Dynamic tear transition curves (longitudinal and transverse), with data points at minus 120°F, minus 90°F, minus 60°F, minus 30°F, 0°F, and room temperature. A minimum of two specimens for each point is required and all individual points shall be reported.
- (e) Charpy V-notch transition curves (longitudinal and transverse) with data points at 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.
- (f) Report of production line operations (such as melt practice, processing history, and heat treatment details).
- (g) Weld procedure qualification test data in accordance with 3.8.2.
- (h) The plate used for explosion bulge tests shall have been characterized by dynamic tear and Charpy V-notch impact, tensile, and chemical composition tests. The explosion bulge tests will be conducted under Government direction to

MIL-S-24371B(SH)

APPENDIX C

evaluate plate and weldment performance. Explosion bulge tests for weldments and plates are required in accordance with MIL-STD-2149 and 4.6.4.

- (i) The ingot, or continuous casting process, the rolling of the ingot or slabs, the laying-out of test specimens, heat treatment, and the testing will be witnessed by American Bureau of Shipping (ABS) or Defense Contract Administration Services Management Area (DCASMA) representatives.