

QQ-S-691c

December 8, 1965

SUPERSEDING

Int. Fed. Spec. QQ-S-00691b (Navy-Ships)

June 15, 1964, and

Fed. Spec. QQ-S-691a

August 4, 1955

(See 6.8)

FEDERAL SPECIFICATION**STEEL PLATE, CARBON-SILICON, CARBON
MOLYBDENUM AND MANGANESE-
MOLYBDENUM ALLOYS HOT ROLLED,
(MARINE BOILER QUALITY)**

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers steel plates of marine boiler quality, for use at temperatures not over 800° F. for carbon steel and 875° F. for the alloy grades for marine boilers and other pressure vessels where fusion welding, flanging or forming is required; for boiler shells, drums, headers, baffles, supporting plates, and similar applications.

1.2 Classification.

1.2.1 Classes. Steel plates shall be of the following classes, as specified (see 6.1):

- A—Carbon-silicon, marine boiler, low strength level (similar to ASTM A201, grade A).
- B—Carbon-silicon, marine boiler, intermediate strength level (similar to ASTM A201, grade B).
- C—Carbon-silicon, marine boiler, high strength level (similar to ASTM A212, grade B).
- D—Carbon-molybdenum, high strength level (similar to ASTM A204, grade B).
- E—Manganese-molybdenum, high strength level (similar to ASTM A302, grade B).

**2. APPLICABLE SPECIFICATIONS,
STANDARDS, AND OTHER PUBLICA-
TIONS**

2.1 Specifications and standards. The following specifications and standards of the issues in effect on date of invitation for bids, form a part of this specification to the extent specified herein:

Federal Standards:

- Fed. Std. No. 102—Preservation, Packaging, and Packing Levels.
- Fed. Std. No. 123—Marking for Domestic Shipment (Civilian Agencies).
- Fed. Test Method Std. No. 151—Metals; Test Methods.

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

(Single copies of this specification and other product specifications required by activities outside the Federal Government for bidding purposes are available without charge at the General Services Administration Regional Offices in Boston, New York, Washington, D. C., Atlanta, Chicago, Kansas City, Mo., Dallas, Denver, San Francisco, Los Angeles, and Seattle, Wash.

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

FSC 9515

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Military Standard:

**MIL-STD-163—Steel Mill Products
Preparation For Shipment And
Storage.**

(Copies of Military Specifications and Standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials (ASTM) Publications:

- A201—Specification for Carbon-Silicon Steel Plates of Intermediate Tensile Ranges for Fusion-Welded Boilers and Other Pressure Vessels.
- A204—Molybdenum-Steel Plates for Boilers and other Pressure Vessels.
- A212—High Tensile Strength Carbon-Silicon Steel Plates for Boilers and Other Pressure Vessels.
- A302—Manganese-Molybdenum Steel Plates for Boilers and Other Pressure Vessels.

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

*American Iron and Steel Institute (AISI)
Publications:*

- Steel Products Manual, Alloy Steel Plates.
- Steel Products Manual, Carbon Steel Plates.

(Application for copies should be addressed to the American Iron and Steel Institute, 150 Forty-Second Street, New York, N. Y., 10017.)

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

3. REQUIREMENTS

3.1 Material. The steel plates shall be made from ingots or slabs which have been produced by the open hearth or electric furnace process.

3.1.1 When specified in the contract or order, the surface of plates shall be cleaned by shot or sandblasting (see 6.1).

3.1.2 Class E plates shall have a number 5 to number 8 austenitic grain size.

3.2 Chemical requirements. The chemical requirements of the material shall conform to table I.

TABLE I. Chemical composition (ladle analysis)¹

Class	Plate thickness	Carbon (max.)	Man-ganese ² (max.)	Phosphorus (max.)	Sulfur (max.)	Silicon	Molybdenum
		Percent	Percent	Percent	Percent	Percent	Percent
A	Up to 1, incl.	0.20	0.80	0.035	0.04	0.15 to 0.30	
	Over 1 to 2, incl.	.24	.80	.035	.04	.15 to .30	
	Over 2 to 4, incl.	.27	.80	.035	.04	.15 to .30	
	Over 4 to 6, incl.	.31	.80	.035	.04	.15 to .30	
B	Up to 1, incl.	.24	.80	.035	.04	.15 to .30	
	Over 1 to 2, incl.	.27	.80	.035	.04	.15 to .30	
	Over 2 to 4, incl.	.30	.80	.035	.04	.15 to .30	
	Over 4 to 6, incl.	.35	.80	.035	.04	.15 to .30	
C	Up to 1, incl.	.31	.90	.035	.04	.15 to .30	
	Over 1 to 2, incl.	.33	.90	.035	.04	.15 to .30	
	Over 2 to 6, incl.	.35	.90	.035	.04	.15 to .30	
D	1 and under	.20	0.50 to 0.90	.035	.04	.15 to .30	0.45 to 0.60
	Over 1 to 2, incl.	.23	.50 to .90	.035	.04	.15 to .30	.45 to .60
	Over 2 to 4, incl.	.25	.50 to .90	.035	.04	.15 to .30	.45 to .60
	Over 4 to 6, incl.	.27	.50 to .90	.035	.04	.15 to .30	.45 to .60
E	1 and under	.20	1.10 to 1.50	.035	.04	.15 to .30	.45 to .60
	Over 1 to 2, incl.	.23	1.10 to 1.50	.035	.04	.15 to .30	.45 to .60
	Over 2 to 4, incl.	.25	1.10 to 1.50	.035	.04	.15 to .30	.45 to .60
	Over 4 to 6, incl.	.27	1.10 to 1.50	.035	.04	.15 to .30	.45 to .60

¹ When specified, the maximum residual copper content shall be 0.25 percent (see 6.1).

² When steel plates are furnished under this specification to meet impact test requirements (see 6.1), the manganese content shall be between 0.85—1.20 percent.

3.2.1 Standard variation for check analysis. The standard variation for check analysis shall be in accordance with AISI tolerances for carbon or alloy steel plates.

3.3 Mechanical properties.

3.3.1 The material shall conform to the mechanical properties specified in table II.

TABLE II. Mechanical properties

Class	Tensile strength	Yield point (min.)	Elongation ¹ in 8 inches (min.)	Elongation ¹ in 2 inches (min.)
	P.s.i.	P.s.i.	Percent	Percent
A	55,000— 65,000 ²	30,000	25.0	29.0
B	60,000— 72,000 ²	32,000	22.0	26.0
C	70,000— 85,000 ²	38,000	19.0	22.0
D	70,000— 85,000 ³	40,000	19.0	23.0
E	80,000— 100,000 ³	50,000	17.0	20.0

¹ See 3.3.2 for modification of elongation requirements.

² The tensile strength for top tensiles may be 2,000 p.s.i. (max.) above that given in table II.

³ Tensile strength on top tensiles may be 3,000 p.s.i. (max.) above that given in table II.

3.3.2 Modifications in elongation.

3.3.2.1 For material under 5/16 inch in thickness, a deduction of 1.25 percent from the percentage of elongation in 8 inches specified in table II shall be made for each decrease of 1/32 inch of the specified thickness below 5/16 inch.

3.3.2.2 For material over 1/4 to 3/4 inch, inclusive in thickness, if the percentage of elongation of an 8-inch gage length test specimen falls not more than 3 percent below the amount specified in table II, the elongation in 2 inches across the break shall be not less than 25 percent.

3.3.2.3 For material over 3/4 inch in thickness, a deduction of 0.5 percent from the percentage of elongation in 8 inches specified in table II shall be made for each in-

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TABLE III. Bend requirements

Plate thickness <i>Inches</i>	Ratio of pin diameter to plate thickness			Plate thickness <i>Inches</i>	Ratio of pin diameter to plate thickness	
	<i>Class A</i>	<i>Class B</i>	<i>Class C</i>		<i>Class D</i>	<i>Class E</i>
1 and under	1/2	1	2	1 and under	1-1/2	2-1/2
Over 1 to 1-1/2, incl.	1	1-1/2	2	Over 1 to 2, incl.	2	3
Over 1-1/2 to 3, incl.	1-1/2	2	2-1/2	Over 2 to 4, incl.	2	3-1/2
Over 3 to 4, incl.	2	2-1/2	3	Over 4 to 6, incl.	2-1/2	—
Over 4 to 6, incl.	2-1/2	3	3-1/2			

crease of 1/8 inch of the specified thickness above 3/4 inch. This deduction shall not exceed 3 percent.

3.3.2.4 For material over 3-1/2 inches in thickness, a deduction of 0.5 percent from the percentage of elongation in 2 inches specified in table II shall be made for each increase of 1/2 inch of the specified thickness above 3-1/2 inches. This deduction shall not exceed 3 percent.

3.4 Bend requirements. The bend test specimen shall be bent cold (room temperature) through 180° without cracking around a pin whose diameter bears the relationship to the plate thickness as specified in table III.

When test is made on a specimen reduced in thickness, the rolled surface shall be on the outer curve of the bend.

3.5 Impact. Class E plates shall have an average longitudinal V-notch Charpy energy value of 30 foot-pounds minimum at plus 10° F. Each value shall constitute the average of three specimens taken from each plate with not more than one individual value below the specified minimum of 30 foot-pounds, but in no case below 25 foot-pounds.

3.5.1 When class A, B, or C plates are to be used at low temperatures (see 6.1), the average V-notch Charpy value for a given class shall be 15 foot-pounds when tested at minus 50° F. Each value shall constitute the average of three specimens taken from each plate (see 4.2.2.3) with not more than one value below the specified minimum of

15 foot-pounds, but in no case below 10 foot-pounds.

3.6 Homogeneity¹. The fractured surface of the nick-break specimen shall not show any single seam or cavity greater in length than that specified in table IV in any of the fractures obtained in accordance with 4.3.5. Each fracture shall be examined and the lengths of the seams and cavities determined using optical magnification if necessary.

TABLE IV. Maximum length of single seam or cavity

Plate thickness <i>Inches</i>	Maximum length of single seam or cavity <i>Inch</i>
To 3/4, incl.	1/4
Over 3/4 to 4, incl.	3/8
Over 4 to 6, incl.	1/2

3.7 Heat treatment.

3.7.1 Classes A, B, and C plates over 2 inches in thickness shall be normalized at a temperature that is appropriate to produce grain refinement. The required heat treatment may be obtained in conjunction with the hot-forming operation, provided the temperature to which the plates are heated for hot forming is equivalent to and does not significantly exceed the normalizing temperature. In this case, plates shall be ordered in the as-rolled condition (see 6.1). Plates 2 inches and under in thickness

¹ The object of the homogeneity test (see 4.3.5), is to open and render visible to the eye any discontinuities or inclusions.

shall be furnished in the as-rolled condition, unless the producer deems otherwise.

3.7.2 Class D (carbon-molybdenum steel). Unless otherwise specified in the contract or order (see 6.1 and 6.3), plates over 2 inches in thickness shall be normalized for grain refinement. Plates 2 inches and under in thickness shall be furnished in the unheat-treated condition. However, when specified, plates 2 inches and under shall be furnished stress relieved, normalized, or normalized and stress relieved (see 6.1).

3.7.3 Class E (manganese-molybdenum steel). Unless otherwise specified in the contract or order, plates that are to be heated for hot flanging or hot forming shall be furnished in the unheat-treated condition (see 6.3). If cold forming is to be performed on the plates, they shall be furnished in either the "annealed" or "normalized and tempered or stress-relieved condition," as specified (see 6.1). When plates are furnished in the normalized and tempered or stress-relieved condition, the temper or stress-relief temperature shall be not less than 1200° F. (see 6.4).

3.8 Dimensional tolerances. The dimensions of the plates offered for delivery shall not vary from the ordered dimensions by amounts greater than those specified in AISI Manual of Alloy Steel Plates or Manual of Carbon Steel Plates, for the dimensions specified in table V.

TABLE V. *Dimensional tolerances*

Dimension
<i>Thickness and weight:</i>
Plates 2 inches and under in thickness (carbon and alloy).
Plates over 2 inches in thickness (carbon and alloy).
<i>Width and length:</i>
Sheared plate (carbon steel).
Gas cut plate (carbon steel).
Sheared plate (alloy steel).
<i>Diameter:</i>
Sheared circular plate (carbon steel).
Gas cut circular plate (carbon steel).

Dimension
<i>Camber:</i>
Plates 2 inches and under in thickness (carbon steel).
Plates over 2 inches in thickness (carbon steel).
<i>Flatness:</i>
Carbon steel plates.
Alloy steel plates.

3.9 Marking.

3.9.1 Each plate shall be legibly die stamped or stenciled with class designation (A-C-Si, B-C-Si, C-C-Si, D-C-Mo, and E-Mn-Mo). The figures and letters employed for all plates shall be at least 1/4 inch high. All identification markings shall be encircled with white paint free from lead or zinc. The stampings shall be in one corner of each plate not more than 12 inches from either side. In addition, each plate shall also be marked with name or trademark of manufacturer, contract or order number, size and thickness of plate, quality and minimum range of tensile strength.

3.9.2 For plates under 1/4 inch in thickness, all markings shall be legibly hand stenciled or rubber stamped in a permanent noncorrosive and nonwater soluble ink instead of steel die stamped.

3.10 Workmanship.

3.10.1 Quality. All material shall be of uniform quality and condition, free from twists, pipes, seams, laps, blisters, cracks, hard spots, scabs, excessive scale, excessive nonmetallic inclusions or segregations, laminations; or any other defects that may detrimentally affect its suitability for the service intended.

3.10.2 Surface imperfection repair. Surface imperfections may be removed by grinding, provided the thickness is not reduced below the minimum thickness permitted, and provided the ground area is well flared, such conditioning shall be performed in the presence of the inspector. Welding of plate surfaces or edges is prohibited.

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4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.2 Sampling for quality conformance.**4.2.1 Lot.**

4.2.1.1 Lot for chemical composition. Each heat shall be a lot for the analysis of chemical composition.

4.2.2 Sampling.

4.2.2.1 Sampling for chemical check analysis. One sample from each lot shall be selected for a full complement of chemical analysis.

4.2.2.2 Sampling for tension test. Two tensile test specimens shall be taken from each plate as rolled² and shall include the following (see fig. 1):

- (a) One top longitudinal tension test specimen.
- (b) One bottom longitudinal tension test specimen.

Tensile test specimens shall be of the full thickness of the material as rolled and shall be machined to the form and dimensions of Fl, of Fed. Test Method Std. No. 151. When the thickness of the plate is such as to produce tensile test specimens of full thickness beyond the capacity of the testing equipment, type R-1 tensile test specimens may be employed. These specimens shall be obtained from a location similar to that required for full thickness specimens and

from a point about one-quarter of the thickness of the plate.

4.2.2.2.1 Class D (carbon-molybdenum steel). Tensile test specimens taken from plates 2 inches and under in thickness shall be in the same condition of heat treatment as the plates offered for delivery. Tensile test specimens representing plates over 2 inches in thickness which are normalized (see 3.7) at the manufacturer's plant shall be simultaneously treated with the plates. When plates over 2 inches in thickness are furnished in the unheat-treated condition (not normalized), the plate manufacturer shall heat-treat the tensile specimens under conditions he considers appropriate for grain refinement, and shall furnish the consignee and the bureau or agency concerned information on the treatment used (see 6.1 and 6.3).

4.2.2.2.2 Class E (manganese-molybdenum steel). Tensile test specimens representing plates that have been normalized and stress relieved (see 3.7) at the plate manufacturer's plant shall be simultaneously treated with the plates. When plates are furnished in the unheat-treated condition, the manufacturer shall normalize the tensile specimens for grain refinement and then stress-relieve them at a temperature not less than 1,200° F., and shall furnish the consignee and the bureau or agency concerned with information on the treatment used (see 6.1 and 6.3).

4.2.2.3 Sampling for impact tests. Three longitudinal test specimens shall be taken (see fig. 1) from each as rolled² class E plate and when so ordered (see 6.1) from each as rolled² class A, B, or C plate for impact tests. The specimens shall be of the V-notch Charpy type with the long dimension paralleled to the final direction of rolling. The notch shall be perpendicular to the plate surface. On plates of thickness great-

² The term "plate as rolled" refers to the full size sheared or gas cut plate rolled from a slab or ingot, and not to its condition.

er than 1/2 inch, the specimen shall be taken from a location as near as practicable to a point midway between the plate surface and the center of thickness. The specimens shall be prepared in accordance with figure 3 of method 221.1 of Fed. Test Method Std. No. 151.

4.2.2.3.1 When plates are furnished in the unheat-treated condition, the plate manufacturer shall normalize the impact test specimen material for grain refinement and then stress-relieve it at a temperature not less than 1200° F. and shall furnish the consignee and the bureau or agency concerned with information on the heat-treatment used (see 6.1 and 6.3).

4.2.2.4 *Bend test specimens.*

4.2.2.4.1 One transverse bend test specimen shall be taken from each plate as rolled (see fig. 1). Specimens shall be machined to the form and dimensions of figure 3 of method 231.1 of Fed. Test Method Std. No. 151.

4.2.2.5 *Homogeneity test specimen.* The nick-break test specimen shall be taken from each plate in full thickness of the material (see fig. 1). For plates 3/4 inch and under in thickness the specimen shall be nicked or grooved transversely in three places, about 1/16 inch deep. The first groove shall be 2 inches from the square end, and each succeeding groove on the opposite side about 2 inches from the preceding one. For plates over 3/4 to 2-1/8 inch, inclusive, in thickness the specimen may be grooved about 1/8 inch deep, at one place on one side. For plates over 2-1/8 inches in thickness the specimen may be grooved at one place on both sides to leave a fracture which will include the horizontal axis of the plate and have a face at least 2 inches in depth. The nick-break test specimen may be made from a broken top longitudinal tension test specimen when an 8-inch gage length, type 2 specimen is used.

4.2.2.6 *Micro-examination for grain size.*

Two specimens for austenitic grain size determination shall be taken to represent each heat of steel. One test specimen shall be taken to represent a plate from the topmost part of the ingot or slab and the other test specimen shall be taken to represent a plate from the bottom-most part of the ingot or slab. The microscopic specimen may be obtained from the unstrained portion of the tension test specimens if desired (see 3.1.2).

4.2.3 *Examination.*

4.2.3.1 *Visual and dimensional examination.* Each plate shall be visually surface examined on both sides and measured for dimensional conformance to determine compliance with this specification.

4.2.3.2 *Preparation for delivery.* Prior to shipment, examination shall be made to determine compliance with the requirements of section 5.

4.3 *Test procedure.*

4.3.1 The samples selected in accordance with 4.2.1.1 shall conform to chemical requirements of table I and 3.2.1.

4.3.2 *Tension test.* Tensile test specimens shall be pulled in tension to determine compliance with table II. The yield point shall be determined by the drop of the beam or halt in gauge of the testing machine.

4.3.3 *Bend test.* Bend test specimens shall be bent cold through 180° to a diameter which shall have a relationship to the plate thickness as specified in 3.4 and table III.

4.3.4 *Impact test.* The Charpy V-notch impact test shall be performed in accordance with method 221.1 of Fed. Test Method Std. No. 151.

4.3.4.1 The test handling tongs shall be cooled for a sufficient length of time to reach the test temperature. The test temperature shall be maintained between 7° to 13° F. for class E and, when required, at

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approximately minus 50° F. for class A, B, or C specimens.

4.3.5 Homogeneity test. The specimen shall be broken at each groove in succession with a hammer or press, the bending being away from the groove. Where the press will not break the large specimen, the specimen may be split with a gas flame or by machining and each section broken. One side of each fracture shall be examined and the lengths of the seams and cavities determined, by optical methods if necessary. The fracture shall be in a transverse direction with respect to direction of rolling of the plate.

4.3.6 Austenitic grain size. The austenitic grain size shall be determined by the McQuaid-Ehn test (outlining the grains with cementite). After carburizing, the test specimen shall be polished, and compared at 100 diameters with standard grain size charts specified in Fed. Test Method Std. No. 151.

4.4 Rejection.

4.4.1 Examination. If representative samples for visual, dimensional, or preparation for delivery fail to meet the requirements of this specification when examined in accordance with 4.2.3, the lot shall be rejected.

4.4.2 Tests. All product represented by tests which fail to comply with requirements when tested in accordance with 4.3 shall be subject to rejection, unless re-treated or retested, or both.

4.4.3 Retests. When any plate is rejected (see 4.4.1 and 4.4.2), additional samples may be obtained for re-evaluation of the material, subject to the retest provisions of Fed. Test Method Std. No. 151.

4.4.4 Retreatment. Plates not meeting the impact, tensile, bend, or homogeneity standards set forth in this specification, may be reheat treated and retested for compliance to the requirements of this specification.

5. PREPARATION FOR DELIVERY

(For civil agency procurement, the definitions and applications of the levels of preservation, packaging, and packing shall be in accordance with Fed. Std. No. 102.)

5.1 Preservation. Plate shall be prepared for shipment in accordance with level A or C, as specified (see 6.1).

5.1.1 Level A. Preservation for shipment shall be in accordance with MIL-STD-163.

5.1.2 Level C. Preservation for shipment shall be in accordance with commercial practice.

5.2 Packing. Plate shall be packed for shipment in accordance with level A or C, as specified (see 6.1).

5.2.1 Level A. Packing for shipment shall be in accordance with MIL-STD-163.

5.2.2 Level C. Packing for shipment shall be in accordance with commercial practice adequate to insure carrier acceptance and safe delivery at the lowest rates.

5.3 Marking for shipment.

5.3.1 Civil agencies. In addition to any special marking specified in the contract or order, marking for shipment shall be in accordance with Fed. Std. No. 123.

5.3.2 Military activities. In addition to any special marking specified in the contract or order, marking for shipment shall be in accordance with MIL-STD-163.

6. NOTES

6.1 Ordering data. Purchasers should exercise any desired options offered herein, and procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Class of plate required (see 1.2).
- (c) When shot or sandblasting is required (see 3.1.1 and 6.6).

- (d) When class A, B, C, or D plates over 2 inches in thickness are to be furnished unheat-treated (see 3.7).
- (e) When class D plates 2 inches and under are to be heat treated (see 3.7.2).
- (f) When class E plates for hot flanging or hot forming are to be furnished in the heat-treated condition (see 3.7.3) and when class E plates for cold forming are to be furnished in the "annealed" or "normalized and tempered or stress-relieved condition". (See 3.7.3 and 6.4.)
- (g) Dimensions (thickness, width, and length) of plate required (see 3.8).
- (h) When impact tests are to be made (see 3.2 and 3.5).
- (i) Whether the maximum residual copper shall be 0.25 percent (see table I).
- (j) The level of preservation, packing, packaging, and marking required (see 5.1, 5.2, and 5.3).
- (k) When consignee desires mill test data (see 4.1).

6.2 Plates should not be sheared or cut with a torch closer to the finished dimensions than one-half the thickness of the plate along each end and each side. This allowance should be specified in the contract or order.

6.3 When class D or E plates are to be heated for hot forming subsequent to shipment from the steel mill, they should be ordered in the unheat-treated condition, and the heat treatment to obtain grain refinement shall be performed in conjunction with the hot forming operation. The temperature to which the plates are heated for hot forming shall be equivalent to and shall not significantly exceed the normalizing temperature. After hot forming, class E (manganese-molybdenum steel) plates should be stress-relieved at not less than 1200° F. before further fabrication (see 3.7).

6.4 Following cold fabrication, class E (manganese-molybdenum) steel plates fur-

nished in the annealed condition should be "normalized and then stress-relieved or tempered" at not less than 1200° F. as a final heat treatment; or if class E steel plates are furnished in the "normalized and tempered or stress-relieved" (see 3.7.3) condition should also be stress-relieved at not less than 1200° F., as a final heat-treatment.

6.5 In order that class E plates will meet the impact test requirements (see 3.5), it may be necessary to accelerate cooling of the plates to not less than 1000° F. from the hot forming (see 6.3) or normalizing (see 6.4) temperature.

6.6 Blast cleaning (shot or sand).

6.6.1 Plates, 5/8 inch and over in thickness, for the pressure parts of boilers should be shot or sandblasted by the fabricator after the last heating operation is completed. When shot or sandblasting of plates 5/8 inch and over in thickness for parts other than for the pressure parts of boilers is required, it should be so specified (see 6.1) in the contract or order so that they will be delivered by the manufacturer commercially free from scale.

6.6.2 Plates less than 5/8 inch in thickness should not be shot or sandblasted unless otherwise specified (see 6.1).

6.6.3 Sandblasted plates shall be coated to prevent corrosion with rust-preventive compound conforming to grade 2 of MIL-C-16173.

6.7 **Transportation descriptions.** The transportation descriptions and minimum weights applicable to this commodity are:

Rail:

Plate, not otherwise indexed by name, steel.
Carload minimum weight 40,000 pounds.

Motor:

Plate, not otherwise indexed, steel.
Truckload minimum weight 36,000

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pounds, subject to Rule 115, National Motor Freight Classification.

6.8 Supersession data. This specification replaces Military Specification MIL-S-871b (Navy) dated March 1, 1955.

CUSTODIANS:

Army—MR
Navy—SH

Review activities:

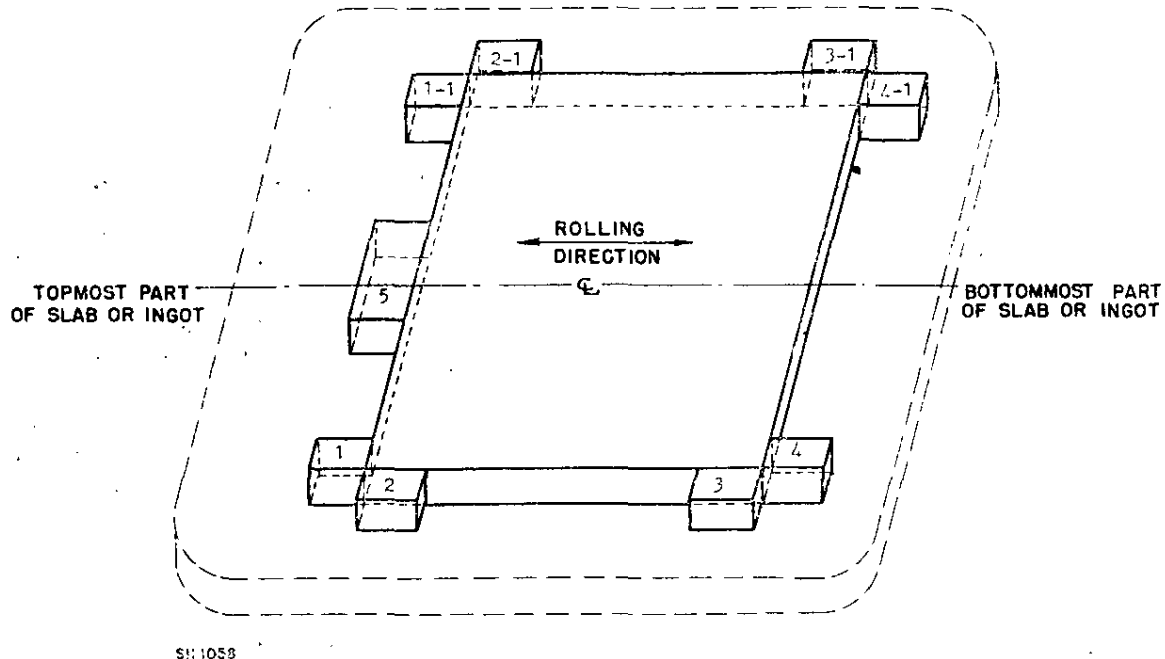
Army—MR, MI
Navy—SH, YD

User activities:

Army—MU

Preparing activity:

Navy—SH



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Class	Top tensile longitudinal	Bottom tensile longitudinal	Bend	Homogeneity	Impact
A, B, or C	1-1, 2-1	3-1, 4-1	5	1	1
D, E	1, 1-1, 2, or 2-1		5	1, 1-1, 2, or 2-1	
E					3, 3-1, 4, or 4-1

FIGURE 1. Unit plate as rolled.²

¹ Same locations as for class E, when so ordered (see 6.1).

² The term "unit plate as rolled" refers to the unit plate rolled from a slab or directly from an ingot.

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