



Designation: B 432 – 91 (Reapproved 1998)

Standard Specification for Copper and Copper Alloy Clad Steel Plate¹

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1. Scope

1.1 This specification covers base metal plate of carbon steel or low-alloy steel to which a thickness of copper or copper alloy is continuously and integrally bonded on one or both sides.

1.2 The product is designated single-clad plate or double-clad plate depending upon whether one or both sides are clad.

1.3 This specification does not normally pertain to weld deposit clad plates.

1.4 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Documents

2.1 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein.

2.2 ASTM Standards:

A 283/A283M Specification for Low and Intermediate Tensile Strength Carbon Steel Plates²

A 285/A285M Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength²

A 515/A515M Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service²

A 516/A516M Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service²

B 96 Specification for Copper-Silicon Alloy Plate, Sheet, Strip, and Rolled Bar for General Purposes and Pressure Vessels³

B 152 Specification for Copper Sheet, Strip, Plate, and Rolled Bar³

B 171 Specification for Copper-Alloy Plate and Sheet for Pressure Vessels, Condensers, and Heat Exchangers³

B 402 Specification for Copper-Nickel Alloy Plate and Sheet for Pressure Vessels⁴

E 8 Test Methods for Tension Testing of Metallic Materials⁵

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁶

3. Terminology

3.1 Definitions:

3.1.1 *blank*—a piece of flat product intended for subsequent fabrication by forming, bending, cupping, drawing, hot pressing, and so forth.

3.1.2 *capable of*—the term “capable of” as used in this specification means that the test need not be performed by the producer of the material. However, should subsequent testing by the purchaser establish that the material does not meet these requirements, the material shall be subject to rejection.

3.1.3 *lengths*—straight pieces of the product.

3.1.3.1 *specific*—straight lengths that are uniform in length, as specified, and subject to established length tolerances.

3.1.4 *plate*—a wrought, flat product over 0.188 in. (5.0 mm) thick and over 12 in. (300 mm) wide, in straight lengths.

4. Ordering Information

4.1 Orders for products under this specification should include the following:

4.1.1 Quantity (number of pieces),

4.1.2 Name of product: clad steel plate (specify whether clad one or both sides) (1.2) and for tube sheets when applicable,

4.1.3 Base metal required (6.1.1),

4.1.4 Cladding metal required (6.1.2),

4.1.5 If tensile, bend, or shear tests are required (Section 9),

4.1.6 Dimensions: diameter or length and width of plate and thickness of each component (8.1 and 8.2),

4.1.7 Whether product is to be edge machined or flame cut (8.1.1 and 8.1.2),

4.1.8 Flatness tolerance, if required (see 8.3),

4.1.9 Specification number, and

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² *Annual Book of ASTM Standards*, Vol 01.04.

³ *Annual Book of ASTM Standards*, Vol 02.01.

⁴ Discontinued, see 1986 *Annual Book of ASTM Standards*, Vol 02.01.

⁵ *Annual Book of ASTM Standards*, Vol 03.01.

⁶ *Annual Book of ASTM Standards*, Vol 14.02.

4.1.10 Whether ultrasonic testing is required.

5. Materials and Manufacture

5.1 The cladding metal may be bonded to the base metal by any method that will produce a metallurgically bonded clad steel conforming to the requirements of this specification.

6. Chemical Composition

6.1 The clad plate shall conform to any desired combination of base metal and cladding metal components as described in the following paragraphs:

6.1.1 *Base Metal*—The base metal may be carbon steel or low-alloy steel, chemically conforming to an ASTM specification for steel plate. The chemical composition of a specified low-alloy steel not so covered shall be as agreed upon by the manufacturer or supplier and the purchaser. The base metal shall conform to the requirements of the specification to which it is ordered.

6.1.2 *Cladding Metal*—The cladding metal covered by this specification may include any copper or copper alloy that is specified and shall be made according to an ASTM specification covering that copper or copper alloy. If an ASTM specification is not available for that copper or copper alloy, agreement between the purchaser and manufacturer must be obtained before fabrication of the cladding metal as to chemical composition, mechanical properties, tolerances, and so forth.

7. Mechanical Requirements

7.1 The product, after bonding, with cladding removed shall be capable of meeting the minimum mechanical properties required of the specified base steel plate.

7.2 The minimum shear strength of the bond between the alloy cladding and base metal shall be 12 ksi (85 MPa).

7.3 When required by the purchase order, the clad steel plate shall be ultrasonically tested for bond integrity. See Supplementary Requirements.

8. Dimensions and Permissible Variations

8.1 Diameter, or Length and Width:

8.1.1 When clad plate is to be supplied in the edge machined condition, the following tolerances shall apply:

Diameter, or Length and Width	Tolerance, Plus and Minus
Under 60 in. (1.52 m)	1/16 in. (1.6 mm)
60 to 84 in. (1.52 to 2.13 m)	1/8 in. (3.2 mm)

8.1.2 When clad plate is to be supplied flame cut, tolerances shall be as agreed upon between purchaser and supplier.

8.2 *Thickness*—Components of clad plate shall be supplied in any standard gage with standard tolerances. Special gages and tolerances may be supplied by special arrangement.

8.3 Flatness:

8.3.1 The flatness of clad plate to be used as tube sheets shall be measured on the cladding component side across the diameter of the circular tube sheet or the width and length dimensions of a rectangular tube sheet and shall conform to the applicable tolerances in Table 1. Variations in flatness along the lengths of plate up to 18 ft (5.5 m) in length or along any 12-ft (3.7-m) length of plate longer than 18 ft (5.5 m) shall not exceed tabular amount specified for width of plate.

8.3.2 The flatness tolerance (maximum concavity across width or length) of rectangular clad plate intended for purposes other than tube sheet shall conform to Table 2 or shall be agreed upon between purchaser and producer.

8.3.3 Measurement of flatness shall be made by placing the plate on a flat surface, applying a straight edge across the plate, and measuring the depth of arc between the straight edge and the plate.

9. Workmanship, Finish, and Appearance

9.1 The material shall be free from defects of a nature that interferes with normal commercial operations. It shall be well cleaned and free of dirt. A superficial film of residual light lubricant is normally present and is permissible unless otherwise specified.

10. Sampling

10.1 All tests shall be made on specimens in the same condition and temper as that in which the composite plate is furnished.

10.2 Test specimens may be taken at the manufacturer's option from the excess portion of the material after the final cut to size or from separate pieces produced under the same specification and temper.

10.3 When the bend test samples are taken from the product to be supplied, these shall be taken from the middle of one end of the plate and the axis of the test coupon shall be transverse to the major axis of rolling of the plate.

11. Number of Tests

11.1 When specified, one or more tension tests, as required by the specification for the base metal one face-bend test (cladding metal in tension), one reverse-bend test (cladding metal in compression), and one shear test shall be made.

TABLE 1 Flatness Tolerances for Tube Sheets, Clad One Side Only^A

Total Thickness, in. (mm)	Maximum Deviation from True Flatness ^B for a Given Diameter, Width, or Length, in. (mm)				
	To 48 (1219)	Over 48 (1219) to 72 (1829)	Over 72 (1829) to 96 (2438)	Over 96 (2438) to 120 (3048)	Over 120 (3048)
To 2 1/2 (63.5)	1/8 (3.18)	1/8 (3.18)	3/16 (4.76)	1/4 (6.35)	1/2 (12.7)
Over 2 1/2 (63.5) to 4 (102)	1/8 (3.18)	1/8 (3.18)	1/4 (6.35)	1/2 (12.7)	1/2 (12.7)
Over 4 (102) to 6 (152)	1/8 (3.18)	1/4 (6.35)	3/8 (9.52)	1/2 (12.7)	1/2 (12.7)
Over 6 (152) to 8 (203)	3/16 (4.76)	3/8 (9.52)	1/2 (12.7)	1/2 (12.7)	1/2 (12.7)

^ATwo side clads by special arrangement.

^BMeasured along the radial arms of a planar reference wheel placed on the plate.