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Standard Specification for Stainless Chromium-Nickel Steel-Clad Plate, Sheet, and Strip[1]

This standard is issued under the fixed designation A 264; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification[2] covers plate, sheet, and strip of carbon steel or low-alloy steel base to which is integrally and continuously bonded on one or both sides a layer of stainless chromium-nickel steel. The material is generally intended for pressure vessel use.

1.2 The values stated in inch-pound units are to be regarded as the standard. SI units are provided for information only.

2. Referenced Documents

2.1 *ASTM Standards:*

A 20/A 20M Specification for General Requirements for Steel Plates for Pressure Vessels[3]

A 240/A 240M Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels[4]

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products[4]

A 480/A 480M Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip[4]

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products[4]

2.2 *ASME Code:*

Boiler and Pressure Vessel Code, Section IX, Welding Qualifications[5]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 This material is considered as single-clad or double-clad corrosion-resisting chromium-nickel steel plate, sheet, or strip depending on whether one or both sides are covered.

3.1.2 The terms plate, sheet, and strip as used in this specification apply to the following:

3.1.3 *plate*—Material 3⁄16 in. (2.73 mm) and over in thickness and over 10 in. (254 mm) in width.

3.1.4 *sheet*—Material under 3⁄16 in. (2.73 mm) in thickness and 24 in. (609.6 mm) and over in width, material under 3⁄16in. in thickness and all widths and finishes of Nos. 3 to 8 inclusive, and

3.1.5 *strip*—Cold-rolled material under 24 in. (609.6 mm) in width and 3⁄16 in. (2.73 mm) and under in thickness.

4. Ordering Information

4.1 It is the responsibility of the purchaser to specify all requirements that are necessary for material ordered under this specification. Such requirements may include, but are not limited to, the following:

4.1.1 Quantity (mass or number of pieces),

4.1.2 Name of material (stainless chromium-nickel steel-clad plate, sheet or strip),

4.1.3 Cladding alloy (see Section 10),

4.1.4 Base metal (see Section 10),

4.1.5 Dimensions including the thickness of the cladding alloy,

4.1.6 Product analysis, if required, (see Section 8),

4.1.7 Mechanical properties (see Sections 7, 8, and 15),

4.1.8 Finish (see Section 11),

4.1.9 Restrictions, if required, on repair by welding (see Section 12), and

4.1.10 Additions to the specification or special requirements.

5. Materials and Manufacture

5.1 *Process*:

5.1.1 The steel shall be made by the open-hearth, electric-furnace (with separate degassing and refining optional), or basic-oxygen processes, or by secondary processes whereby steel made from these primary processes is remelted using electroslag remelting or vacuum-arc remelting processes.

5.1.2 The alloy-cladding metal may be metallurgically bonded to the base metal by any method that will produce a clad steel which will conform to the requirements of this specification.

5.2 *Heat Treatment*:

5.2.1 Unless otherwise specified or agreed upon between the purchaser and the manufacturer, all austenitic stainless steel clad plates shall be given a heat treatment consisting of heating

[1] This specification is under the jurisdiction of ASTM Committee A-1 on Steel, Stainless Steel and Related Alloysand is the direct responsibility of Subcommittee A01.17on Flat Stainless Steel Products.

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[2] For ASME Boiler and Pressure Vessel Code applications see related Specification SA-264 in Section II of that Code.

[3] *Annual Book of ASTM Standards*, Vol 01.04.

[4] *Annual Book of ASTM Standards*, Vol 01.03.

[5] Available from American Society of Mechanical Engineers, 345 E. 47 th St., New York, NY 10017.

to the proper temperature for the solution of the chromium carbides in the cladding followed by individual air cooling. For base metals of air-hardening low-alloy steels the above heat treatment shall be followed by a tempering treatment.

5.2.2 When plates over 1 in. (25.4 mm) in thickness are to be cold formed, the purchaser may specify that such plates be heat treated for grain refinement of the base metal.

6. Chemical Composition

6.1 The composite plate, sheet, or strip may conform to any desired combination of alloy-cladding metal and base metal as described in 6.2 and 6.3 and as agreed upon between the purchaser and the manufacturer.

6.2 *Alloy Cladding Metal*—The alloy-cladding metal specified shall conform to the requirements as to chemical composition prescribed for the respective chromium-nickel or duplex steel in Specification A 240/A 240M.

6.3 *Base Metal*—The base metal may be carbon steel or low-alloy steel conforming to the ASTM specifications for steel for pressure vessels. The base metal shall conform to the chemical requirements of the specification to which it is ordered.

7. Mechanical Properties

7.1 *Plate*:

7.1.1 *Tensile Requirements*:

7.1.1.1 The tensile properties shall be determined by a tension test of the composite plate for clad plates that meet all of the following conditions. However, if the cladding is for corrosion allowance only, the cladding may be removed prior to tensile testing. The tensile properties thus determined shall be not less than the minimum and not more than 5000 psi (35 MPa) over the maximum prescribed in the specification for the base steel used. All other tensile test requirements of the specification for the base steel shall be met.

(a) The composite gage is less than or equal to 1½ in.

(b) The specified minimum tensile strength of the base steel is less than or equal to 70 000 psi (485 MPa).

(c) The specified minimum yield strength of the base steel is less than or equal to 40 000 psi (275 MPa).

7.1.1.2 The tensile properties shall be determined by a tension test of the base steel only for clad plates that meet one of the following conditions. The tensile properties thus determined shall meet all of the tensile test requirements for the base steel.

(a) The composite gage is greater than 1½ in.

(b) The specified minimum tensile strength of the base steel is greater than 70 000 psi (485 MPa).

(c) The specified minimum yield strength of the base steel is greater than 40 000 psi (275 MPa).

7.1.2 *Ductility*—Two bend tests of the composite plate shall be made, one with the alloy cladding in tension and the other with the alloy cladding in compression to determine the ductility of the materials. On double-clad plates, the bend tests shall be made so that one specimen represents the alloy cladding in tension on one side while the other specimen represents the alloy cladding in tension on the opposite side. Bend tests shall be made in accordance with the requirements prescribed in the specification for the base metal.

7.1.3 *Shear Strength*—When required by the purchaser, the minimum shear strength of the alloy cladding and base metals shall be 20 000 psi (140 MPa). The shear test, when specified, shall be made in the manner indicated in Fig. 1.

7.1.4 *Bond Strength*—As an alternative to the shear strength test provided in 7.1.3 and when required by the purchaser, three bend tests shall be made with the alloy cladding in compression to determine the quality of the bond. These bend tests shall be made in accordance with the specifications for the cladding metal. At least two of the three tests shall show not more than 50 % separation on both edges of the bent portion. Greater separation shall be cause for rejection.

7.2 *Sheet and Strip*:

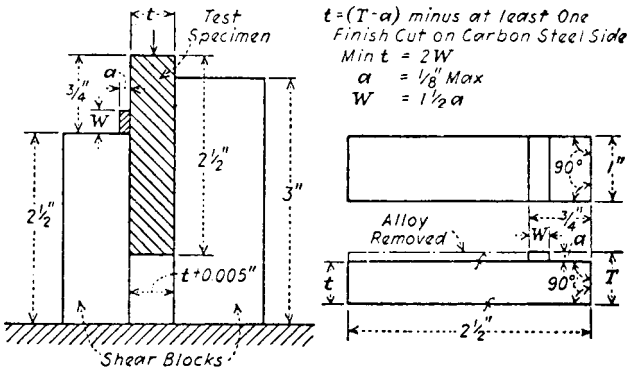
7.2.1 The bend test specimens of sheet and strip shall stand being bent cold through an angle of 180° without cracking on the outside of the bent portion. The bend test specimens shall be bent around a pin the diameter of which is equal to the thickness of the material. The axis of the bend shall be transverse to the direction of rolling.

7.2.2 The bond between the alloy cladding and the base metal shall be ascertained by observation of the behavior of the composite sheet or strip when sheared with the alloy side down.

7.3 Methods and practices relating to mechanical testing required by this specification shall be in accordance with Test Methods and Definitions A 370.

8. Product Analysis

8.1 Product analysis may be required on finished product. Chemical analysis may be accomplished by wet chemical or instrumental procedures. If wet chemical procedures are used, millings may be taken only when the composite plate thickness is sufficient to permit obtaining millings without danger of contamination from the adjacent layer. If spectrometric procedures are used, the sample shall be exposed on the center line of the cladding when there is sufficient cladding thickness



Metric Equivalents

in.	mm	in.	mm
0.005	0.127	1	25.4
⅛	3.18	2½	64.5
¾	19.1	3	76.2

FIG. 1 Test Specimen and Method of Making Shear Test of Clad Plate

available so that there is no contamination from the adjacent base metal.

8.2 If product analysis is specified by the purchaser, it shall be made on a sample taken from the finished product or a broken test specimen. For wet chemical analysis, in order to avoid contamination by the base plate metal, millings of cladding samples shall be taken from the test coupon by removal and discard of all the base metal plus 40 % of the cladding thickness from the bonded side, not to exceed 1⁄16 in. (1.598 mm). The material shall be cleaned and sufficient millings taken to represent the full cross-section of the remainder. If there is insufficient cladding thickness available to spectrographically expose on the center line
of the cladding without contamination, 50 % of the cladding shall be removed and the sample exposed on this surface.

8.3 The results of the product analysis shall conform to the requirements of Section 7 of Specification A 480/A 480M.

8.4 Methods and practices relating to chemical analysis required by this specification shall be in accordance with Test Methods, Practices, and Definitions A 751.

9. Dimensions, Mass, and Permissible Variations

9.1 Composite plates, sheets, and strips shall conform to the dimensional and weight requirements prescribed in Table 1, Table 2, Table 3, Table 4, and Table 5.

10. Thickness of Cladding Metal

10.1 The minimum thickness and tolerances on the thickness of the alloy-cladding metal shall be agreed upon between the purchaser and the manufacturer.

11. Workmanship, Finish, and Appearance

11.1 The material shall be free of injurious defects, shall have a workmanlike appearance, and shall conform to the designated finish.

11.2 Plate alloy surfaces shall be sand-blasted, pickled, or blast-cleaned and pickled.

11.3 The finish for the alloy surfaces of sheets and strips shall be as specified in Specification A 240/A 240M.

12. Repair of Cladding by Welding

12.1 The material manufacturer may repair defects in cladding by welding provided the following requirements are met:

12.1.1 Prior approval shall be obtained from the purchaser if the repaired area exceeds 3 % of the cladding surface.

12.1.2 The welding procedure and the welders or welding operators shall be qualified in accordance with Section IX of the ASME Code.

12.1.3 The defective area shall be removed and the area prepared for repair shall be examined by a magnetic particle method or a liquid penetrant method to ensure that all of the defective area has been removed. Method of test and acceptance standard shall be as agreed upon between the purchaser and the manufacturer.

12.1.4 The repair weld shall be deposited in accordance with a welding procedure and welding materials suitable for the cladding material. The surface condition of the repaired area shall be restored to a condition similiar to the rest of the cladding.

12.1.5 The repaired area shall be examined by a liquid penetrant method in accordance with 12.1.3.

12.1.6 The location and extent of the weld repairs together with the repair procedure and examination results shall be transmitted as a part of the certification.

12.2 At the request of the purchaser or his inspector, plates shall be reheat treated following repair by welding.

13. General Requirements for Delivery

13.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification A 20/A 20M.

14. Number of Tests and Retests

14.1 *Plate*:

14.1.1 One or more tension tests, as required by the specifications for the base metal, one face bend test (alloy cladding in tension), one reverse bend test (alloy cladding in compression), and, when specified, one shear test or three bond bend tests shall be made representing each plate as rolled. Each specimen shall be in the final condition of heat treatment required for the plate.

14.1.2 If any test specimen shows defective machining or develops flaws, it may be discarded and another specimen substituted.

14.1.3 If the percentage of elongation of any tension test specimen is less than that specified in 8.1.1 and any part of the fracture is more than ¾ in. (19.1 mm) from the center of the gage length of a 2-in. (50.8-mm) specimen or is outside the middle third of the gage length of an 8-in. (203.2-mm) specimen, as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed.

14.2 *Sheet and Strip*:

14.2.1 In the case of single-clad sheet or strip produced in coil form, two bend tests shall be made from each end of the coil. On double-clad sheet or strip produced in coil form, one bend test shall be made from each end of the coil.

14.2.2 In the case of single-clad sheet or strip produced in discrete cut lengths, four bend tests shall be made on each 100 or less pieces of the same heat and nominal thickness, provided the 100 pieces weigh not less than 1000 lbs. In the event that 100 pieces weigh less than 1000 lbs, four bend tests shall be made from each 1000 lbs or less of the same heat and nominal thickness. On double-clad sheet or strip, two bend tests shall be made on each lot as defined in the two preceding sentences.

14.2.3 On double-clad materials, the bend tests shall be made so that one specimen will represent the alloy-cladding metal in tension on one side while the other specimen will represent the alloy-cladding metal in tension on the opposite side.

15. Test Specimens

15.1 *Plate*:

15.1.1 The tension test specimens from plate shall conform to the requirements prescribed in the specifications for the base metal.

15.1.2 Bend test specimens, shall be taken from the middle of the top of the plate as rolled, at right angles to its longitudinal axis.

TABLE 1 Permissible Variations in Thickness of Cold-Rolled Strip

NOTE 1— Permissible variations in thickness are based on measurements taken ⅜ in. (9.53 mm) in from the edge on cold-rolled strip 1 in. (25.4 mm) or over in width, and at any place on the strip on material less than 1 in. (25.4 mm) in width

Specified Thickness, in. (mm)	Permissible Variations in Thickness, ±, for Widths Given, in. (mm)									
	3/16 to ½ (4.76 to 12.7)	½to 1 (12.7 to 25.4)	1 to 1½ (25.4 to 38.1)	1½ to 3 (38.1 to 76.2)	3 to 6 (76.2 to 152.4)	Over 6 to 9 (152.4 to 228.6)	Over 9 to 12 (228.6 to 304.8)	Over 12 to 16 (304.8 to 406.4)	Over 16 to 20 (406.4 to 508.0)	Over 20 to 23 15/16 (508.0 to 608.1)
0.249 to 0.161 (6.632 to 4.09), incl	0.002 (0.0508)	0.002 (0.0508)	0.003 (0.0762)	0.003 (0.0762)	0.004 (0.1016)	0.004 (0.1016)	0.004 (0.1016)	0.005 (0.1270)	0.006 (0.1524)	0.006 (0.1524)
0.160 to 0.100 (4.08 to 2.54), incl	0.002 (0.0508)	0.002 (0.0508)	0.002 (0.0508)	0.002 (0.0508)	0.003 (0.0762)	0.004 (0.1016)	0.004 (0.1016)	0.004 (0.1016)	0.005 (0.1270)	0.005 (0.1270)
0.099 to 0.069 (2.53 to 1.75), incl	0.002 (0.0508)	0.002 (0.0508)	0.002 (0.0508)	0.002 (0.0508)	0.003 (0.0762)	0.003 (0.0762)	0.003 (0.0762)	0.004 (0.1016)	0.004 (0.1016)	0.004 (0.1016)
0.068 to 0.050 (1.74 to 1.27), incl	0.002 (0.0508)	0.002 (0.0508)	0.002 (0.0508)	0.002 (0.0508)	0.003 (0.0762)	0.003 (0.0762)	0.003 (0.0762)	0.003 (0.0762)	0.004 (0.1016)	0.004 (0.1016)
0.049 to 0.040 (1.26 to 1.02), incl	0.002 (0.0508)	0.002 (0.0508)	0.002 (0.0508)	0.002 (0.0508)	0.0025 (0.0635)	0.003 (0.0762)	0.003 (0.0762)	0.003 (0.0762)	0.004 (0.1016)	0.004 (0.1016)
0.039 to 0.035 (1.01 to 0.88), incl	0.002 (0.0508)	0.002 (0.0508)	0.002 (0.0508)	0.002 (0.0508)	0.0025 (0.0635)	0.003 (0.0762)	0.003 (0.0762)	0.003 (0.0762)	0.003 (0.0762)	0.003 (0.0762)
0.034 to 0.032 (0.87 to 0.81), incl	0.0015 (0.038)	0.0015 (0.038)	0.0015 (0.038)	0.0015 (0.038)	0.002 (0.051)	0.0025 (0.064)	0.0025 (0.064)	0.0025 (0.064)	0.003 (0.0762)	0.003 (0.0762)
0.031 to 0.029 (0.80 to 0.74), incl	0.0015 (0.038)	0.0015 (0.038)	0.0015 (0.038)	0.0015 (0.038)	0.002 (0.051)	0.0025 (0.051)	0.0025 (0.064)	0.0025 (0.064)	0.003 (0.0762)	0.003 (0.0762)
0. 028 to 0.026 (0.73 to 0.66), incl	0.001 (0.025)	0.001 (0.025)	0.0015 (0.038)	0.0015 (0.038)	0.0015 (0.038)	0.002 (0.051)	0.002 (0.051)	0.002 (0.051)	0.0025 (0.064)	0.003 (0.0762)
0.025 to 0.023 (0.65 to 0.58), incl	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.0015 (0.038)	0.002 (0.051)	0.002 (0.051)	0.002 (0.051)	0.0025 (0.064)	0.0025 (0.064)
0.022 to 0.020 (0.57 to 0.51), incl	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.0015 (0.038)	0.002 (0.051)	0.002 (0.051)	0.002 (0.051)	0.0025 (0.064)	0.0025 (0.064)
0.019 to 0.017 (0.50 to 0.43), incl	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.0015 (0.038)	0.0015 (0.038)	0.002 (0.051)	0.002 (0.051)	0.002 (0.051)
0.016 to 0.015 (0.42 to 0.38), incl	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.0015 (0.038)	0.0015 (0.038)	0.0015 (0.038)	0.002 (0.051)	0.002 (0.051)
0.014 to 0.013 (0.37 to 0.33), incl	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.0015 (0.038)	0.0015 (0.038)	0.0015 (0.038)	0.002 (0.051)	0.002 (0.051)
0.012 (0.30)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.0015 (0.038)	0.0015 (0.038)	0.0015 (0.038)	0.0015 (0.038)
0.011 (0.28)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.0015 (0.038)	0.0015 (0.038)	0.0015 (0.038)
0.010 (0.25)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.001 (0.025)	0.0015 (0.038)	0.0015 (0.038)
0.009 to 0.006 (0.23 to 0.15), incl	0.00075 (0.019)	0.00075 (0.019)	0.00075 (0.019)	0.00075 (0.019)	0.00075 (0.019)	. . .	. . .	. . .	. . .	. . .
Under 0.006 (Under 0.15)	0.005 (0.013)	0.005 (0.013)	0.005 (0.013)	0.005 (0.013)	0.005 (0.013)	. . .	. . .	. . .	. . .	. . .

15.1.3 When required by the purchaser, the shear test specimen shall be taken from a top or bottom corner of the plate as rolled, parallel to its longitudinal axis.

15.1.4 All tests shall be made on specimens in the same condition of heat treatment to which the composite plate is furnished.

15.1.5 When specified in the purchase order, additional test specimens representing the as-furnished composite plate shall be thermally treated to simulate a post-weld heat treatment. The temperature range, time, and cooling rates shall be specified in the purchase order. Mechanical properties in the simulated post-weld heat-treated condition shall meet the minimum requirements of the as-furnished composite plate.

15.1.6 For plates 1½ in. (38.1 mm) and under in thickness