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Standard Specification for Stainless Chromium-Nickel Steel-Clad Plate¹

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This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification² covers plate of a 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 standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

2. Referenced Documents

2.1 ASTM Standards:³

A6/A6M Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

A20/A20M Specification for General Requirements for Steel Plates for Pressure Vessels

A240/A240M Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A480/A480M Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

A578/A578M Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications

A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

(<https://standards.iteh.ai>)

Document Preview

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¹ This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.11 on Steel Plates for Boilers and Pressure Vessels.

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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 For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

*A Summary of Changes section appears at the end of this standard.

2.2 Other Standards:

ASME Code Boiler and Pressure Vessel Code, Section IX, Welding Qualifications⁴

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, depending on whether one or both sides are covered.

3.1.2 *alloy cladding*—the stainless chromium-nickel steel component of the composite plate.

3.1.3 *base metal (backing steel)*—component to which the alloy cladding is applied, usually the greater percentage of the composite plate and usually consisting of carbon or low-alloy steel.

3.1.4 *integrally and continuously bonded*—the process by which the alloy cladding and base metal are brought together to form a metallurgical bond at essentially the entire interface of the two metals by means other than those processes that do not produce a homogeneous composite plate.

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 (weight or number of pieces).

4.1.2 Cladding alloy specification, (UNS or ASTM Specification A240/A240M and whether cladding is for corrosion allowance only),

4.1.3 Base metal specification.

4.1.4 Bond integrity Class (1, 3, or 5).

4.1.5 Dimensions including the minimum or nominal thickness of the cladding alloy, and the backing steel, or of the total composite plate and if more or less restrictive thickness tolerances apply.

4.1.6 Product analysis, if required (see Section 10). Specify whether applicable to the cladding alloy, backing steel or both.

4.1.7 Mechanical properties, including shear test if required.

4.1.8 Finish (see Section 12).

4.1.9 Restrictions, if required, on repair by welding (see Section 14).

4.1.10 Additions to the specification or special requirements.

4.1.11 Corrosion testing if applicable.

4.2 In addition to the basic requirements of this specification and the backing steel specification, certain supplementary requirements are available when necessary to meet end use requirements. These include:

4.2.1 Nondestructive examination,

4.2.2 Impact testing, and

4.2.3 Simulated Post-Weld Heat Treatment of Mechanical Test Coupons (SPWHT).

4.3 The purchaser is referred to the listed supplementary requirements in this specification and to the detailed requirements in Specification A20/A20M.

4.4 If the requirements of this specification are in conflict with the requirements of Specification A20/A20M, the requirements of this specification shall prevail.

4.5 Special tests.

5. Materials and Manufacture

5.1 Process:

5.1.1 The steel shall be made by the open-hearth, electric-furnace, or basic-oxygen processes, or by secondary processes whereby steel made from these primary processes is remelted using, but not limited to 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 that 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 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.~~

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⁴ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

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. In the case of clad plate manufactured without hot rolling, the base metal and alloy cladding components may be heat treated separately as appropriate prior to bonding.

5.2.2 Duplex stainless steel clad plates shall be provided in a heat treated condition as agreed upon between the purchaser and the manufacturer.

~~5.2.3 When plates are to be cold formed, or when otherwise required by the base metal specification, the purchaser may specify that such plates, following solution annealing, be heat treated for grain refinement of the base metal by normalizing and either air cooled or water quenched as appropriate. In the case of clad plate manufactured without hot rolling, the base metal and alloy cladding components may be heat treated separately as appropriate prior to bonding.~~

5.2.3 When plates are to be cold formed, or when otherwise required by the base metal specification, the purchaser may specify that such plates, following solution annealing, be heat treated for grain refinement of the base metal by normalizing and either air cooled or water quenched as appropriate.

6. Chemical Composition

6.1 The composite plate 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 A240/A240M.

6.3 *Base Metal*—The base metal shall be carbon steel or low-alloy steel conforming to the ASTM specifications for steel for pressure vessels, or other, as agreed by the purchaser and the manufacturer. The base metal shall conform to the chemical requirements of the specification to which it is ordered.

7. Mechanical Properties

7.1 Tensile Requirements:

7.1.1 The tensile properties shall be determined by a tension test of the composite plate for clad plates that meet all of the following conditions.

(1) The composite gage is less than or equal to 1½ in. (38 mm).

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

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

(4) 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.

7.1.2 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 properties thus determined shall meet all of the tensile test requirements for the base steel.

(1) The composite gage is greater than 1½ in. (38 mm).

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

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

7.1.3 If the cladding is for corrosion allowance only, the cladding need not be included in the tensile test. The tensile properties thus determined shall meet the base steel requirements.

7.2 Tests for strength of the bond, when required, must be specified by the purchaser and shall consist of one of the following.

7.2.1 *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. The minimum cladding thickness for shear testing shall be 0.075 in. (1.9 mm), exclusive as ordered. Testing for shear strength for clad plates with minimum cladding thickness of 0.075 in. (1.9 mm) or less shall be permitted upon agreement between the purchaser and the manufacturer.

7.2.2 *Bond Strength*—As an alternative to the shear strength test provided in 7.2.1, or when agreed upon by the purchaser and the manufacturer, or both, 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 the manner of the tension tests indicated in Fig. 2 and shall be bent through an angle of 180° to the bend diameters provided for in either Specification A6/A6M or Specification A20/A20M, Appendix X4 or equivalent, as applicable. 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.

7.3 Methods and practices relating to mechanical testing required by this specification shall be in accordance with the Test Methods and Definitions of A370.

8. Number of Tests and Retests

8.1 One or more tension tests, as required by the specifications for the base metal 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, including any SPWHT if required.

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