



Designation: A 708 - 79

AMERICAN SOCIETY FOR TESTING AND MATERIALS

1918 Race St., Philadelphia, Pa., 19103

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Standard Recommended Practice for DETECTION OF SUSCEPTIBILITY TO INTERGRANULAR CORROSION IN SEVERELY SENSITIZED AUSTENITIC STAINLESS STEEL¹

This Standard is issued under the fixed designation A 708; 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.

1. Scope

1.1 This recommended practice covers the procedure for conducting the acidified copper sulfate test for detection of susceptibility to intergranular corrosion of severely sensitized austenitic stainless steel (Note 1). The presence or absence of attack in this test is not necessarily a measure of the performance of the material in other corrosive environments.

NOTE 1—This method is less sensitive than those described in Recommended Practice A 262 and will detect only severe sensitization. This method shall not be used in place of Recommended Practices A 262 where A 262 is specified in the basic material specification.

1.2 The test is to be used to detect severe sensitization resulting from the fabrication, welding, heat treatment, or combination of those applied to austenitic stainless steel.

1.3 This recommended practice may be applied to wrought products (including tubes), castings, and weldments of austenitic stainless steel.

2. Applicable Documents

2.1 ASTM Standards:

A 213, Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat Exchanger Tubes²

A 262, Recommended Practices for Detecting Susceptibility to Intergranular Attack in Stainless Steels³

2.2 American Welding Society Standard:

A5.4, Specification for Corrosion-Resisting

Chromium and Chromium-Nickel Steel Covered Welding Electrodes⁴

3. Apparatus

3.1 *Container*—A suitable glass or other inert container for the acidified copper sulfate solution, fitted with a condenser capable of avoiding loss of acid by evaporation. If a reflux condenser (see Fig. 8 in Recommended Practice A 262) is used, its connection to the flask should be made through a ground-glass joint. Rubber or cork stoppers are not suitable.

NOTE 2—Some samples, such as from castings or heavy bar stock, may require the use of a larger Erlenmeyer flask.

3.2 *Specimen Supports*—Glass hooks, stirrups, or cradles may be used for supporting the specimens in the flask. Their design should prevent specimens from coming in contact with each other when tested in the same container.

3.3 *Heater*—A means for heating the test solution and of keeping it boiling throughout the test period. A gas or electrically-heated hot plate is satisfactory for this purpose.⁵

¹ This recommended practice is under the jurisdiction of ASTM Committee A-1 on Steel, Stainless Steel and Related Alloys, and is the direct responsibility of Subcommittee A01.14 on Methods of Corrosion Testing.

Current edition approved July 27, 1979. Published October 1979. Originally published as A 708 - 74. Last previous edition A 708 - 74.

² *Annual Book of ASTM Standards*, Part 1.

³ *Annual Book of ASTM Standards*, Parts 3 and 10.

⁴ Can be obtained from the American Welding Society, 2501 North West 7th St., Miami, Fla. 33125.

⁵ A Glascol heater with a Variac has been found suitable.

4. Reagent

4.1 *Acidified Copper Sulfate Solution*—Dissolve 100 g of copper sulfate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) in 700 ml of distilled water, add 100 ml of sulfuric acid (H_2SO_4 , cp, sp gr 1.84), and make up to 1000 ml with distilled water.

NOTE 3—This solution will contain approximately 6 % of anhydrous CuSO_4 and 16 % of H_2SO_4 (by weight).

5. Test Specimens

5.1 Size:

5.1.1 The size of the test specimen and method of selection shall be that specified in the product specification or by agreement between the purchaser and seller as stated in the purchase contract. Consideration should be given to the volume of solution to be used, whether the product is wrought or cast, how the specimen is to be selected, and the method of bending the specimen for inspection. The size of the specimen should permit easy entrance and removal through the relatively narrow neck of the Erlenmeyer flask.

5.1.2 Weld metal specimens shall be prepared in accordance with AWS Specification A5.4 for Corrosion-Resisting Chromium and Chromium-Nickel Steel Covered Welding Electrodes.

5.1.3 The sizes given in Table 1 may be used as guides for referee purposes. The exact length will be governed by the equipment used for bending the specimen.

5.2 *Sheared Edges*—When specimens are cut by shearing, the sheared edges shall be refinished by machining or wet grinding prior to testing.

5.3 Surface Finishing:

5.3.1 Any scale on the as-received surface should be removed by mechanical finishing. Unless it is desired to test specimens with some particular surface finish all surfaces of the specimen, including edges, should be finished with 120-grit iron-free aluminum oxide abrasive, taking care to avoid overheating.

5.3.2 *Cleaning*—The specimen shall be degreased using a suitable solvent, such as acetone, a mixture of alcohol and ether, or a vapor degreaser, then dried.

5.4 *Sensitizing Treatment*—Heat treatment of test material will be specified in the product

specifications or by agreement between the purchaser and seller as stated in the purchase contract.

6. Test Conditions

6.1 *Volume of Solution*—A sufficient quantity of the acidified copper sulfate test solution to cover the specimens and to provide a volume of at least 50 ml/in.² (8 ml/cm²) of specimen surface area shall be used.

6.2 *Number of Specimens per Flask*—The best practice is to use a separate container for each specimen. However, it is acceptable to treat as many as three specimens in the same container, provided they are all the same grade and that the specimen supports prevent the specimens from contacting each other, and provided the solution volume to sample area ratio is maintained. If any specimen tested in the same flask fails the test, new specimens representative of the failed material shall be retested separately.

6.3 Boiling Time:

6.3.1 After the test specimen has been placed in the test solution, it should be brought to a boil and kept boiling throughout the test period (Note 4).

6.3.2 The test should consist of one 72-h boiling period unless otherwise specified (Note 5).

NOTE 4—"Bumping" of the solution while boiling may be minimized by the use of glass beads, sections of porcelain crucibles, abrasive aluminum oxide rings, or boiling stones.

NOTE 5—When more than one 72-h boiling period is specified, fresh test solution should be used for each period.

7. Bend Test

7.1 Bending:

7.1.1 The test specimen shall be bent through 180 deg and over a diameter equal to the thickness of the specimen being bent (see Fig. 11 in Recommended Practice A 262). In no case shall the specimen be bent over a smaller radius or through a greater angle than that specified in the product specification. In cases of material having low ductility, such as severely cold-worked material, a 180-deg bend may prove impractical. Determine the maximum angle of bend without causing cracks in such material by bending an untested specimen