Designation: G 60 – 01

An American National Standard

Standard Practice for Conducting Cyclic Humidity Exposures[1]

This standard is issued under the fixed designation G 60; 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 practice covers procedures for conducting cyclic humidity exposures with a corrosive dip.[2] It sets forth the conditions required in cyclic humidity testing.

1.2 This practice does not prescribe the type of exposure specimen or exposure periods nor the interpretation to be given to the results.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 1193 Specification for Reagent Water[3]

G 1 Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens[4]

3. Significance and Use

3.1 The procedure described is used to observe the behavior of steels under exposure conditions that retard the formation of a protective type of rust. It is also used to evaluate seal coat on insulation.

3.2 This practice should not be used to rank steels that form a protective type of rust under atmospheric exposure conditions.

4. Apparatus

4.1 The apparatus required for cyclic humidity exposures consists of a test chamber, provisions for heating the chamber, a humidifying tower, a drying train, a dip mechanism, provisions for introducing and draining the solution, a supply of compressed air, specimen supports, and necessary means of control.

4.2 The size and detailed construction of the apparatus are optional, provided the conditions obtained meet the requirements of this practice.

4.3 A schematic diagram of the apparatus is shown in Fig. 1.

4.4 The apparatus should be capable of providing an 8-h humidity cycle three times per day, as shown in Fig. 2, and a dip cycle once a day.

4.4.1 The cyclic variation of humidity can be obtained by variation of the temperature of the water in the humidifying tower. The temperature of the water is cycled thermostatically such that the relative humidity of air bubbling through the water at a minimum rate of 1 L/min (.04 ft^3/min) will vary between 100 and 50 % when the temperature of the air in the test chamber is brought to 52 ± 1°C (125 ± 2°F).

4.4.2 The range of relative humidity can be extended by adding a drying period to the humidity cycle described above. The minimum relative humidity shall be ≤20 % and the maximum relative humidity shall be ≥95 % for each cycle.

4.4.3 Drops of solution which accumulate on the ceiling or cover of the chamber shall not be permitted to fall on the specimens being exposed.

NOTE 1—Instruments to continuously record temperature and humidity are not mandatory, but these provide the most reliable and economical way of recording such information. In the absence of such instrumentation, temperature and humidity measurement shall be made, at least twice a day, at the maximum and minimum humidity in a cycle.

4.5 *Materials of Construction*:

4.5.1 The test chamber should be made of inert materials such as plastics, glass, or metals lined with impervious plastics, rubber or epoxy-type materials, or materials exhibiting equivalent corrosion resistance. Material of construction shall be such that it will not affect the corrosiveness of the exposure atmosphere.

4.5.2 The dip solution container should not be affected by or cause contamination of the dip solution.

4.6 *Specimen Supports*:

4.6.1 The specimen-supporting device should not be affected by or cause contamination of the dip solution. See Note 2.

4.6.2 The method of supporting specimens will vary with the apparatus used for conducting the tests, but should be designed to insulate the specimens from each other physically

[1] This practice is under the jurisdiction of ASTM Committee G01 on Corrosion of Metals and is the direct responsibility of Subcommittee G01.05 on Laboratory Corrosion Tests.

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[2] Opinsky, A. J., Thomson, R. F., and Boegehold, A. L., "A Cyclic Humidity Accelerated Corrosion Test for Sheet Steel", *ASTM Bulletin*, January 1953.

[3] *Annual Book of ASTM Standards*, Vol 11.01.

[4] *Annual Book of ASTM Standards*, Vol 03.02.

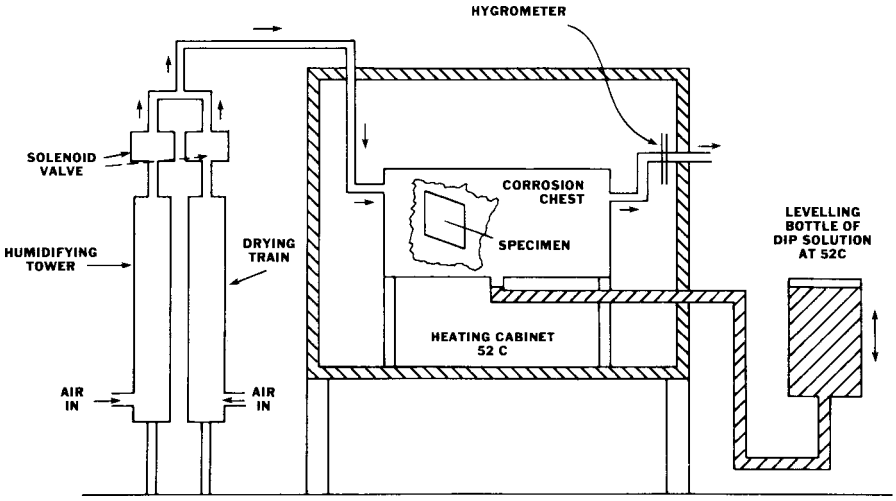

FIG. 1 Main Parts of the Cyclic Humidity Corrosion Exposure Apparatus (Schematic)

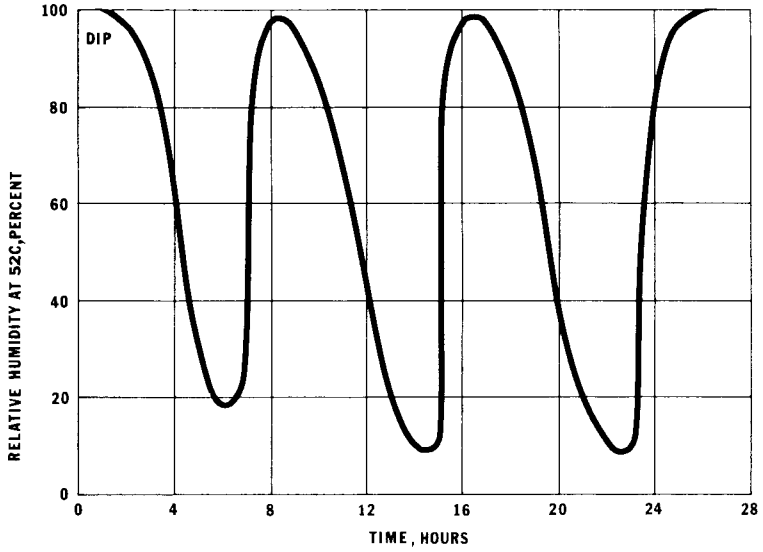

FIG. 2 Humidity Cycle (Schematic)

and electrically and to insulate the specimens from any metallic container or supporting device used within the apparatus. The specimens shall not contact any material capable of acting as a wick.

NOTE 2—Suitable materials for the construction or coating of racks and supports are glass, rubber, plastic, or suitably coated wood. Bare metal shall not be used. Specimens shall preferably be supported from the bottom or the side. Slotted wooden strips are suitable for the support of flat panels. Suspension from glass hooks or waxed string may be used as long as the specified position of the specimens is obtained, if necessary, by means of secondary support at the bottom of the specimens.

4.6.3 Shape and form of the specimen support should assure free contact of the specimen with the corrosive solution, the liquid line, or the vapor phase. In a stacked rack, the first and last specimens should be dummy specimens so that the outermost exposure specimens are shielded by their neighbors in the same manner as specimens in the middle of the stack.

5. Reagents and Materials

5.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.[5]

5.2 *Purity of Water*—Unless otherwise indicated, reference to water shall be understood to mean distilled or deionized water conforming to Type IV reagent water described in Specification D 1193 except that for this test method the limits for chlorides and sodium may be ignored.

5.3 *Dip Solution*—The dip solution should be prepared by dissolving 1 % sodium chloride (NaCl), 1 % calcium chloride ($CaCl_2$), and 0.1 % sulfuric acid (H_2SO_4) by solution weight in water. The solution volume to specimen surface area ratio should be a minimum of 250 mL/cm^2.

[5] *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.

6. Air Supply

6.1 The compressed air supply shall be free of oil and dirt.

7. Exposure Specimens

7.1 The type and number of test specimens to be used, as well as the criteria for the evaluation of the test results, shall be defined in the specifications covering the material or product being exposed or shall be mutually agreed upon between the purchaser and the seller.

7.2 Strip coupons 75 by 38 by 2 mm (3 by 1½ by 1⁄16 in.) may be preferred as corrosion specimens.

7.3 Six to eight identical specimens should be exposed.

7.4 Specimens should be prepared, cleaned, and evaluated in accordance with Practice G 1.

8. Position of Specimens During Exposure

8.1 The position of the specimens in the cyclic humidity chamber during the exposure shall be such that the following conditions are met:

8.1.1 Unless otherwise specified, the specimens shall be supported or suspended between 15 and 30° from the vertical.

8.1.2 Each specimen shall be so placed as to permit free settling of the humidity atmosphere on all specimens.

9. Procedure

9.1 Place specimens in the test chamber when the humidity is 100 %.

9.2 Keep the chamber shut for the remainder of the exposure. Start the first dip cycle immediately after placing the specimens in the chamber.

9.2.1 One dip cycle shall consist of three 5-min immersion periods. Drain the dip solution from the test chamber for a 1-min period between each immersion period.

9.2.2 Maintain the dip solution at 52 ± 1°C (125 ± 2°F).

9.3 Cycle the humidity as shown in Fig. 2 during the exposure period.

9.3.1 Maintain the temperature in the test chamber at 52 ± 1°C (125± 2°F).

9.3.2 Operate the dip cycle once a day at a point in the humidity cycle when the relative humidity is close to 100 %.

9.4 The duration of the exposure should be a minimum of 20 days. Longer exposure times may be used depending upon the purpose of the test. Use fresh dip solution for each test, and change the dip solution at least every 90 days during extended exposure periods.

10. Report

10.1 Data for the exposed specimens should include physical dimensions, chemical composition, metallurgical history, surface preparation, and after-exposure cleaning methods.

10.2 The report should include the exposure period and the method of supporting the specimens in the test chamber.

10.3 The results of the exposure should be expressed as corrosion rate (Practice G 1) such as penetration per unit time (for example, millimetre per year), loss in thickness over the exposure period, or plotted as mass loss per unit area versus time.

10.4 Any disturbances that significantly alter the prescribed test conditions invalidate the test. Do not report results from such exposure.

11. Keywords

11.1 cyclic exposure; exposure cycles; humidity; steels; test equipment