Designation: G5 – 14 (Reapproved 2021)

Standard Reference Test Method for Making Potentiodynamic Anodic Polarization Measurements[1]

This standard is issued under the fixed designation G5; 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 reference test method covers an experimental procedure for checking experimental technique and instrumentation. If followed, this reference test method will provide repeatable potentiodynamic anodic polarization measurements that will reproduce data determined by others at other times and in other laboratories provided all laboratories are testing reference samples from the same lot of Type 430 stainless steel.

1.2 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *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 establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

E1338 Guide for Identification of Metals and Alloys in Computerized Material Property Databases

G3 Practice for Conventions Applicable to Electrochemical Measurements in Corrosion Testing

G107 Guide for Formats for Collection and Compilation of Corrosion Data for Metals for Computerized Database Input

3. Significance and Use

3.1 The availability of a standard procedure, standard material, and a standard plot should make it easy for an investigator to check his techniques. This should lead to polarization curves in the literature which can be compared with confidence.

3.2 Samples of a standard ferritic Type 430 stainless steel (UNS S43000) used in obtaining standard reference plot are available for those who wish to check their own test procedure and equipment.[3]

3.3 Standard potentiodynamic polarization plots are shown for a lot of material originally purchased in 1992. This reference test method is not applicable for standard material purchased before 1992. These reference data are based on the results from different laboratories that followed the standard procedure, using that material in 1.0 *N* H_2SO_4. The four sigma probability bands for current density values are shown at each potential to indicate the acceptable range of values.

3.4 This reference test method may not be appropriate for polarization testing of all materials or in all environments.

3.5 This reference test method is intended for use in evaluating the accuracy of a given electrochemical test apparatus, not for use in evaluating materials performance. Therefore, the use of the plots in Fig. 1 is not recommended to evaluate alloys other than Type 430, or lots of Type 430 other than those available through Metal Samples. The use of the data in this reference test method in this manner is beyond the scope and intended use of this reference test method. Users of this reference test method are advised to evaluate test results relative to the scatter bands corresponding to the particular lot of Type 430 stainless steel that was tested.

[1] This reference test method is under the jurisdiction of ASTM Committee G01 on Corrosion of Metals and is the direct responsibility of G01.11 on Electrochemical Measurements in Corrosion Testing.

Current edition approved Aug. 1, 2021. Published August 2021. Originally approved in 1969. Last previous edition approved in 2014 as G5–14ε1. DOI: 10.1520/G0005-14R21.

[2] 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.

[3] These standard samples are available from Metal Samples, 152 Metal Samples Rd., Mumford, AL 36268. Generally, one sample can be repolished and reused for many runs. This procedure is suggested to conserve the available material.

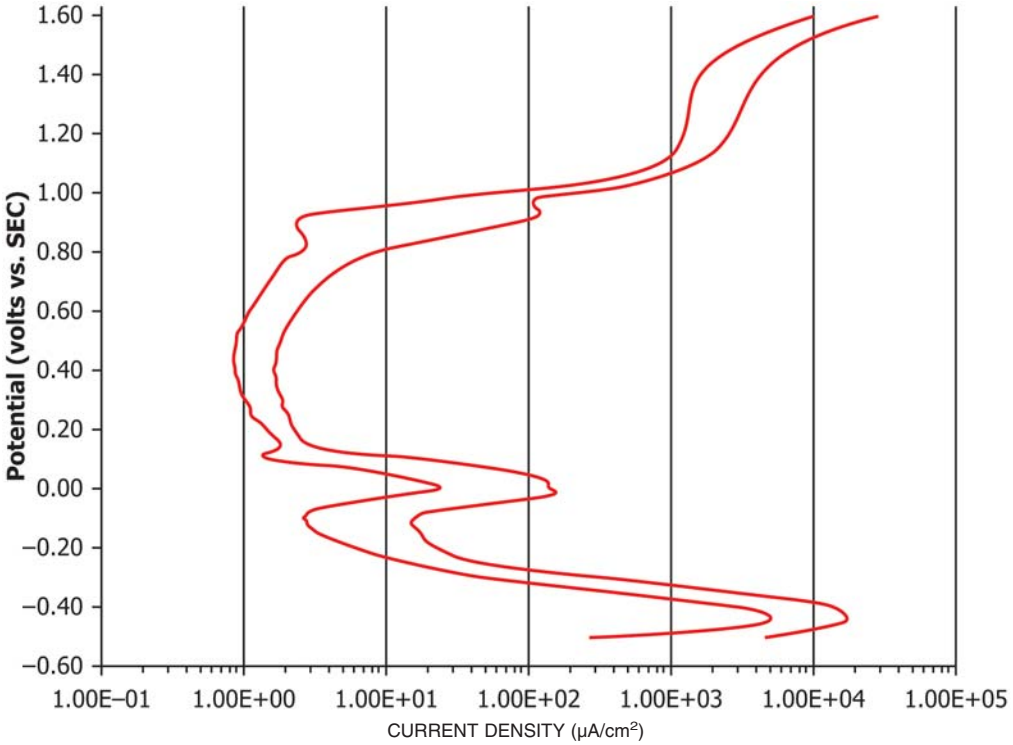

FIG. 1 Typical Standard Potentiodynamic Anodic Polarization Plot

4. Apparatus

4.1 The test cell should be constructed to allow the following items to be inserted into the solution chamber: the test electrode, two auxiliary electrodes, a Luggin capillary with salt-bridge connection to the reference electrode, inlet and outlet for an inert gas, and a thermometer. The test cell shall be constructed of materials that will not corrode, deteriorate, or otherwise contaminate the test solution.

NOTE 1—Borosilicate glass and TFE-fluorocarbon have been found suitable.

4.1.1 A suitable cell is shown in Fig. 2 (**1**).[4] A 1 L, round-bottom flask has been modified by the addition of various necks to permit the introduction of electrodes, gas inlet and outlet tubes, and a thermometer. The Luggin probe-salt bridge separates the bulk solution from the saturated calomel reference electrode, and the probe tip can be easily adjusted to bring it in close proximity with the working electrode.

4.2 *Potentiostat* (Note 2):

4.2.1 A potentiostat that will maintain an electrode potential within 1 mV of a preset value over a wide range of applied currents should be used. For the type and size of standard specimen supplied, the potentiostat should have a potential range from −0.6 V to 1.6 V and an anodic current output range from 1.0 μA to 10^5 μA.

4.3 *Potential-Measuring Instruments* (Note 2):

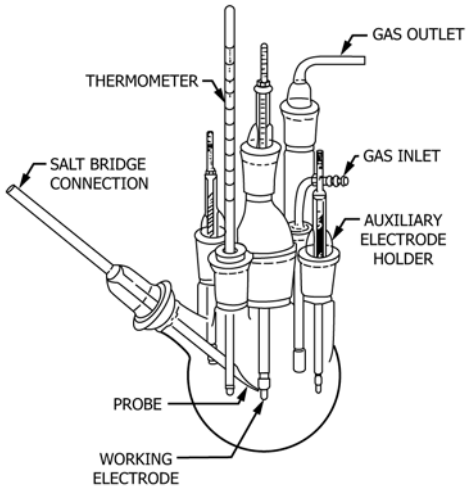

FIG. 2 Schematic Diagram of Polarization Cell (1)

4.3.1 The potential-measuring circuit should have high input impedance on the order of 10^{11} Ω to 10^{14} Ω to minimize current drawn from the system during measurements. Such circuits are provided with most potentiostats. Instruments should have sufficient sensitivity and accuracy to detect a change of 1.0 mV over a potential range between −0.6 V and 1.6 V. Potentiostats that scan potential by making frequent potential steps of less than 1.0 mV and those that make continuous analog potential sweeps are both suitable for this reference test method, providing that they can achieve the required potential scan rate.

4.4 *Current-Measuring Instruments* (Note 2):

[4] The boldface numbers in parentheses refer to the list of references at the end of this test method.