



Standard Test Method for Electrochemical Reactivation (EPR) for Detecting Sensitization of AISI Type 304 and 304L Stainless Steels¹

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1. Scope

1.1 This test method describes a laboratory procedure for conducting an electrochemical reactivation (EPR) test on AISI Type 304 and 304L (UNS No. S30400 and S30403, respectively) stainless steels. This test method can provide a nondestructive means of quantifying the degree of sensitization in these steels (**1, 2, 3**).² This test method has found wide acceptance in studies of the effects of sensitization on intergranular corrosion and intergranular stress corrosion cracking behavior (see Terminology G 15). The EPR technique has been successfully used to evaluate other stainless steels and nickel base alloys (**4**), but the test conditions and evaluation criteria used were modified in each case from those cited in this test method.

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

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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

- A 262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels³
- D 1193 Specification for Reagent Water⁴
- E 3 Methods of Preparation of Metallographic Specimens⁵
- E 7 Terminology Relating to Metallography⁵
- E 112 Test Methods for Determining Average Grain Size⁵
- G 1 Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens⁶
- G 3 Practice for Conventions Applicable to Electrochemical

Measurements in Corrosion Testing⁶

G 5 Reference Test Method for Making Potentiostatic and Potentiodynamic Anodic Polarization Measurements⁶

G 15 Terminology Relating to Corrosion and Corrosion Testing⁶

G 28 Test Methods for Detecting Susceptibility to Intergranular Attack in Wrought Nickel-Rich, Chromium-Bearing Alloys⁶

G 61 Test Method for Conducting Cyclic Potentiodynamic Polarization Measurements for Localized Corrosion Susceptibility of Iron-, Nickel-, or Cobalt-Based Alloys⁶

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *integrated charge (Q)*—the charge measured, in coulombs, during reactivation as given by the time integral of current density below the reactivation peak of the curve.

3.1.2 *maximum anodic current density (I_r)*—the current density measured at the peak of the anodic curve during reactivation.

3.1.3 *normalized charge (P_a)*—the integrated current normalized to the specimen size and grain size. P_a represents the charge (in coulombs/cm²) of the grain-boundary area. The method for calculating P_a is given in 9.2.

3.1.4 *reactivation*—in the electrochemical reactivation (EPR) test, the potential sweep from the passivation potential returning to the corrosion potential.

3.1.5 *scan rate*—the rate at which the electrical potential applied to a specimen in a polarization test is changed.

4. Summary of Test Method

4.1 The EPR test is accomplished by a potentiodynamic sweep from the passive to the active regions of electrochemical potentials in a process referred to as reactivation. The EPR test measures the amount of charge associated with the corrosion of the chromium-depleted regions surrounding chromium carbide precipitated particles. Most of these particles in a sensitized microstructure are located at grain boundaries (see Terminology E 7). Discrete particles located within the grain (referred to as intragranular precipitates) will also contribute to the total measured charge. Therefore, it is important to examine the alloy microstructure following an EPR test, to determine the relative proportion of corrosion site associated with intergranular versus intragranular precipitates.

¹ This test method is under the jurisdiction of ASTM Committee G-1 on Corrosion of Metals and is the direct responsibility of Subcommittee G01.11 on Electrochemical Measurement in Corrosion Testing.

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² The boldface numbers in parentheses refer to the list of references at the end of the text.

³ *Annual Book of ASTM Standards*, Vol 01.03.

⁴ *Annual Book of ASTM Standards*, Vol 11.01.

⁵ *Annual Book of ASTM Standards*, Vol 03.01.

⁶ *Annual Book of ASTM Standards*, Vol 03.02.