



Standard Test Method for Electronic Measurement for Hydrogen Embrittlement From Cadmium-Electroplating Processes¹

This standard is issued under the fixed designation F326; 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 test method covers an electronic hydrogen detection instrument procedure for measurement of plating permeability to hydrogen. This method measures a variable related to hydrogen absorbed by steel during plating and to the hydrogen permeability of the plate during post plate baking. A specific application of this method is controlling cadmium-plating processes in which the plate porosity relative to hydrogen is critical, such as cadmium on high-strength steel.

1.2 *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.* For specific hazard statement, see Section 8.

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

2. Referenced Documents

2.1 *ASTM Standards:*²

D1193 Specification for Reagent Water

F519 Test Method for Mechanical Hydrogen Embrittlement Evaluation of Plating/Coating Processes and Service Environments

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *hydrogen pressure peak*—the maximum hydrogen pressure value (see I_H) obtained when the probe is heated following calibration, plating, or fluid testing.

3.2 *Symbols:*

3.2.1 HP = calibration hydrogen pressure peak.

3.2.2 HP_p = plating hydrogen pressure peak.

3.2.3 I_E = probe cathode emission current.

3.2.4 I_H = probe hydrogen pressure.

3.2.5 I_γ = integral of I_H curve from probe on to HP .

3.2.6 λ = time in seconds for hydrogen pressure peak to drop to half its value.

3.2.7 λ = λ obtained from a calibration run.

3.2.8 λ_p = λ obtained from a plating run.

3.2.9 λ_{pc} = normalized test λ , obtained as follows:

$$\lambda_{pc} = \lambda_p (40/\lambda) \quad (1)$$

3.2.10 $\bar{\lambda}_{pc}$ = arithmetic average of normalized λ s for a set of tests.

3.2.11 *range* = difference between maximum λ_{pc} and minimum λ_{pc} for a given set of tests.

3.2.12 *run* = calibration or plating of a probe.

3.2.13 *test* = single evaluation of a plating solution for hydrogen embrittlement determination; run using a previously calibrated probe.

3.2.14 *set of tests*—all consecutive tests on a plating solution for a given operator-instrument-day evaluation.

3.2.15 *window*—test surface of a probe described in Fig. 1(A).

4. Summary of Test Method

4.1 This method uses a metal-shelled vacuum probe as an ion gage to evaluate electrodeposited cadmium characteristics relative to hydrogen permeation. After calibration, a section of the probe shell is electroplated at the lowest current density encountered in the cadmium electroplating process. During the subsequent baking of the probe at a closely controlled temperature, the probe ion current, proportional to hydrogen pressure, is recorded as a function of time. From these data and the calibration data of the probe, a number related to the porosity of the electroplated metal relative to hydrogen is obtained.

4.2 During the initial part of the bakeout, hydrogen continues to diffuse through the metal shell of the probe and the ion

¹ This test method is under the jurisdiction of ASTM Committee F07 on Aerospace and Aircraft and is the direct responsibility of Subcommittee F07.04 on Hydrogen Embrittlement.

Current edition approved Nov. 1, 2012. Published November 2012. Originally approved in 1978. Last previous edition approved in 2006 as F326 – 96 (2006). DOI: 10.1520/F0326-96R12.

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.