Designation: B 808 – 97

Standard Test Method for Monitoring of Atmospheric Corrosion Chambers by Quartz Crystal Microbalances[1]

This standard is issued under the fixed designation B 808; 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 monitors the reactivity of a gaseous test environment in which metal surfaces (for example, electrical contacts, assembled printed wiring boards, and so forth) and other materials subject to pollutant gas attack undergo accelerated atmospheric corrosion testing. This test method is applicable to adherent corrosion films whose total corrosion film thickness ranges from a few atomic monolayers to approximately a micrometre.

1.2 The test method provides a dynamic, continuous, in-situ, procedure for monitoring the corrosion rate in corrosion chambers; the uniformity of corrosion chambers; and the corrosion rate on different surfaces. Response time in the order of seconds is possible.

1.3 With the proper samples, the quartz crystal microbalance (QCM) test method can also be used to monitor the weight loss from a surface as a result of the desorption of surface species (that is, reduction of an oxide in a reducing atmosphere). (Alternative names for QCM are quartz crystal oscillator, piezoelectric crystal oscillator, or thin-film evaporation monitor.)

1.4 This test method is not sufficient to specify the corrosion process that may be occurring in a chamber, since a variety of pollutant gases and environments may cause similar weight gains.

1.5 This test method is generally not applicable to test environments in which solid or liquid particles are deposited on the surface of the quartz crystal.

1.6 *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.*

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

2. Referenced Documents

2.1 *ASTM Standards:*

B 810 Test Method for Calibration of Atmospheric Corrosion Test Chambers by Change in Mass of Copper Coupons[2]

3. Summary of Test Method

3.1 A single crystal of quartz has various natural resonant frequencies depending on the crystal's size and shape. The decrease in natural frequency is linearly proportional to the crystal mass and the mass of well-bonded surface films. For crystals with reactive metal films on the surface (usually driving electrodes), the mass of the crystal/metal film increases as the metal oxidizes or forms other compounds with gases adsorbed from the atmosphere.[3,4] Thus, by measuring the rate of resonant frequency change, a rate of corrosion is measured. Non-adherent corrosion films, particles, and droplets yield ambiguous results. A review of theory and applications is given in Lu and Czanderna.[5]

3.2 The chamber environmental uniformity and corrosion rate can be measured by placing matching quartz crystals with matching reactive metal films at various locations in the chamber. If the chamber and corrosion rate have been standardized, the corrosion rate on various surface materials that have been deposited on the quartz crystal can be determined.

4. Significance and Use

4.1 Corrosion film growth with thicknesses varying from a monolayer of atoms up to 1 µm can readily be measured on a continuous, real-time, in-situ, basis with QCMs.

4.2 The test results obtained for this test method are influenced by various factors, including geometrical effects, temperature, humidity, film thickness, film materials, electrode conditions, gases in the corrosion chamber, and so forth.

[1] This test method is under the jurisdiction of ASTM Committee B-2 on Nonferrous Metals and Alloys and is the direct responsibility of Subcommittee B02.11 on Electrical Contact Test Methods.

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[2] *Annual Book of ASTM Standards*, Vol 03.04.

[3] King, W. H. Jr., *Analytical Chemistry*, Vol 36, 1964, p. 173.

[4] Karmarkar, K. H. and Guilbaut, G. G. *Analytical Chemistry Acta*, Vol 75, 1975, p. 111.

[5] Lu, C. and Czanderna, A. W. Eds., *Applications of Piezoelectric Quartz Crystal Microbalances*, Elsevier, c1984.