Designation: F 21 – 65 (Reapproved 2002)

Standard Test Method for Hydrophobic Surface Films by the Atomizer Test[1]

This standard is issued under the fixed designation F 21; 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 the detection of the presence of hydrophobic (nonwetting) films on surfaces and the presence of hydrophobic organic materials in processing ambients. When properly conducted, the test will enable detection of fractional molecular layers of hydrophobic organic contaminants. On very rough or porous surfaces the sensitivity of the test may be significantly decreased.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values 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:*

D 351 Classification for Natural Muscovite Block Mica and Thins Based on Visual Quality[2]

3. Terminology

3.1 *Definitions:*

3.1.1 *hydrophilic*—having a strong affinity for water; wettable.

3.1.2 *hydrophobic*—having little affinity for water; nonwettable.

4. Summary of Test Method

4.1 The atomizer test[3] is performed by subjecting the dry surface to be tested to a fine water spray. The interpretation of the test is based upon the pattern of wetting. In the absence of hydrophobic films, the impinging water droplets will wet the surface and spread immediately to form a continuous water film. In areas where hydrophobic materials are present on the surface, the sprayed droplets will not wet the surface and spread but will tend to remain as fine droplets.

5. Significance and Use

5.1 The atomizer test as described in this test method is nondestructive and may be used for control and evaluation of processes for the removal of hydrophobic contaminants. The test may also be used for the detection and control of hydrophobic contaminants in processing ambients. For this application, a surface free of hydrophobic films is exposed to the ambient and subsequently tested.[4]

6. Interferences

6.1 Loss of sensitivity may result from either of the following factors:

6.1.1 The presence of hydrophilic substances on the surface to be tested, test equipment, or test materials, or

6.1.2 An unusually rough or porous surface condition.

7. Apparatus

7.1 *Spray Gun Atomizer.*[5]

7.2 *Low Power Microscope* (5× to 50×), and light source for observation of small piece parts.

8. Reagents and Materials

8.1 *Acetone*, reagent grade.

8.2 *Mice Blanks*, preferably 1 in. (25 mm) by 2 in. (50 mm) by 0.015 in. (0.38 mm) or larger, having a minimum ASTM quality V6 as described in Classification D 351.

8.3 *Oleic or Stearic Acid*—A 0.005 to 0.05% solution in acetone.

8.4 *Oxygen*—Filtered low-pressure (15 psi min) oxygen or other suitable gas that is free of hydrophobic and hydrophilic substances.

NOTE 1—The freedom of the water and the gas from hydrophobic and hydrophilic contamination may be determined in accordance with Section 9.

8.5 *Water*—Deionized or distilled water is preferred. Water of higher ionic content may render the test destructive. The water used must be free of hydrophobic and hydrophilic

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[1] This test method is under the jurisdiction of ASTM Committee E21 on Space Simulation and Applications of Space Technology and is the direct responsibility of Subcommittee E21.05 on Contamination.

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[2] *Annual Book of ASTM Standards*, Vol 10.01.

[3] Linford, H. B., and Saubestre, E. B., "A New Degreasing Evaluation Test: The Atomizer Test," *ASTM Bulletin*, May 1953, p. 47.

[4] Feder, D. O., and Koontz, D. E., "Detection, Removal and Control of Organic Contaminants in the Production of Electron Devices," *ASTM STP 246*, Am. Soc. Testing Mats., p. 40 (1959).

[5] Paasche Air Brush Model VL-1 or its equivalent has been found satisfactory for this purpose.

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substances (see Note 1).

9. Calibration and Standardization

9.1 The degree of freedom of the test equipment and materials from hydrophobic contamination is proportional to the number of alternate spraying and drying cycles required to produce detectable hydrophobic contamination on a freshly cleaved mica surface. This test may be performed with greater sensitivity by masking a portion of the freshly cleaved surface under test with a mica sheet (having both surfaces freshly cleaved) during the sequential test cycle. After the desired number of sprays, the mask shall be removed and the entire surface retested for a detectable difference in wetting behavior between the two areas.

9.2 To assure that test results are not obscured by flooding or by hydrophilic contaminants, a freshly cleaved mica surface from which the solvent from one drop (0.05 to 0.10 mL) of a 0.005 to 0.05% solution of oleic or stearic acid in acetone has been allowed to evaporate shall, when tested, clearly show the demarkation between the clean and contaminated areas.

10. Procedure

10.1 *Testing of Surfaces*—Hold the test surface 10 in. (250 mm) to 20 in. (500 mm) from the atomizer and spray with a fine mist of water for a period of 1 to 10 s.

10.2 *Testing of Ambients*—Expose a freshly cleaved mica surface to the ambient and subsequently perform the test as described in 10.1.

NOTE 2—Exposure may be by immersion of the mica surface in the ambient or by deposition of a sample of the ambient on the mica surface. The procedure described in 9.1 may be used to increase the sensitivity of this test.

11. Interpretation of Results

11.1 Surfaces tested as described in 10.1 shall be considered free of hydrophobic contaminants by this test if the impinging water droplets spread immediately to form a thin, continuous uniform water film as shown in Fig. 1. If hydrophobic contaminants are present, as evidenced by discontinuous or nonuniform water films, the degree of contamination may be estimated by comparison of the pattern of wetting with Figs. 2-5.

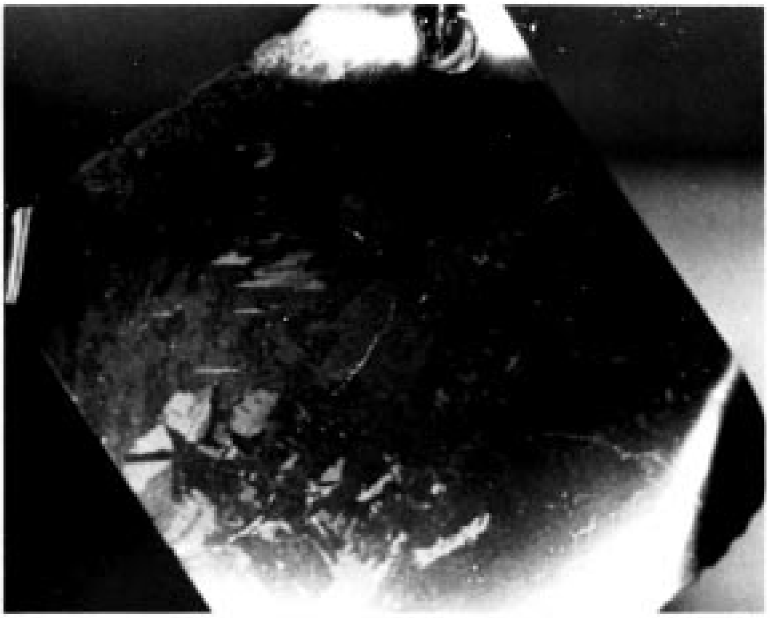

FIG. 1 Atomizer Test of Nickel Specimen with No Detectable Hydrophobic Contaminant (×2 Reduced One-Half in Reproduction)

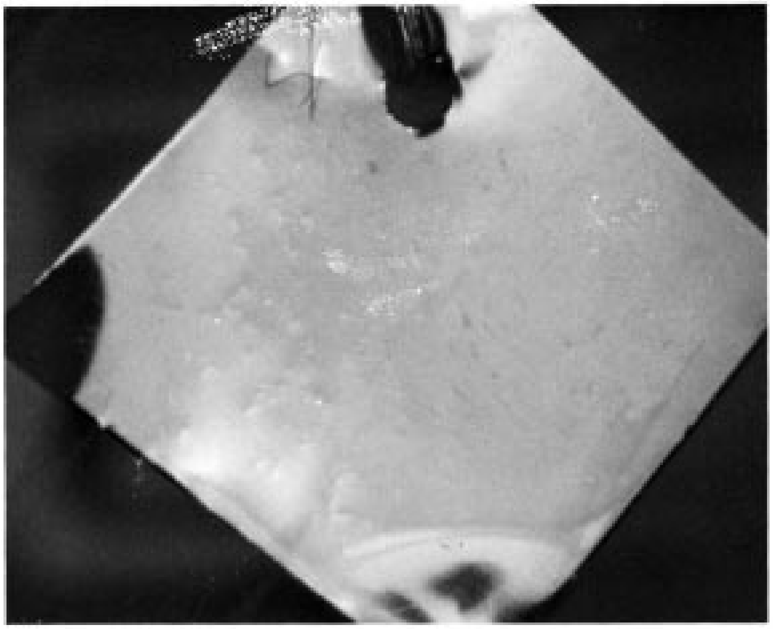

FIG. 2 Atomizer Test of Nickel Specimen Showing Trace of Hydrophobic Contaminant (×2, Reduced One-Half in Reproduction). Note Slight Discontinuities in Otherwise Uniform Water Film

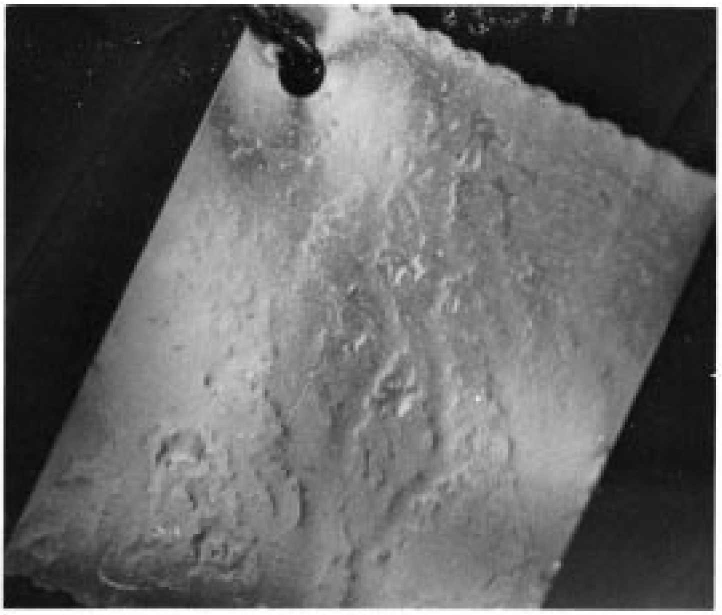

FIG. 3 Atomizer Test of Nickel Specimen Showing Traces of Hydrophobic Contaminant (×2, Reduced One-Half in Reproduction)

FIG. 4 Atomizer Test of Partially Contaminated Nickel specimen (×2, Reduced One-Half in Reproduction)

FIG. 5 Atomizer Test of Nickel Specimen with Hydrophobic Film Covering Surface (×2, Reduced One-Half in Reproduction)

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