H-69-01

Designation: F 74 – 73 (Reapproved 1989)

An American National Standard

Standard Practice for Determining Hydrolytic Stability of Plastic Encapsulants for Electronic Devices[1]

This standard is issued under the fixed designation F 74; 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 practice covers the determination of the changes due to exposure to high humidity (hydrolytic stability) which occur in the properties of plastic materials used to encapsulate electronic devices and to estimate the service life of the encapsulant in such an environment. Procedures are provided for exposing plastics to a maximum of 100°C at a high humidity to accelerate the changes which would take place under humid service conditions and for estimating service life using the resultant data. Only the procedure for humidity exposure and for use of the data are specified, and not the specimen nor the property to be tested and its test method. The effect on a specific property may be determined by selection of an appropriate test method and specimen.

1.2 This practice applies when the degradation may be accelerated by heat at the same relative humidity according to Arrhenius' equation.[2,3] In this case the effect of humidity at the temperature of operation can be accelerated by aging at higher temperatures at the same relative humidity.

1.3 A risk is involved in extrapolation of the results to a lower temperature, since it is possible that a reaction may occur only at high temperatures. However, by selecting the lowest aging temperature reasonably close to the service temperature to which an extrapolation is desired, the risk of a substantial error is minimized. If possible, the lowest aging temperature should be within 20°C of the service temperature.

1.4 No extrapolation can be made to temperatures above the highest aging temperature.

1.5 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems 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 Standard:*

E 104 Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions[4]

2.2 *Other Standard:*

IEEE 101 Institute of Electrical and Electronics Engineers Standard Guide for Statistical Analysis of Test Data[5]

3. Summary of Practice

3.1 This practice describes procedures for the accelerated aging of plastic materials at a high humidity and at a minimum of three elevated temperatures. Failure of the materials is based on predetermined criteria for the property under investigation. The time of failure at the various temperatures is plotted as the logarithm of time against the reciprocal of the absolute temperature. If a straight line plot results, extrapolation to the failure time corresponding to the actual service temperature provides an estimate of service life. If straight line extrapolation is not possible, the procedure is not applicable.

3.2 The property to be tested (for example, hardness, tensile strength, or tear strength), the test method, the failure criteria, the type and number of specimens, and the aging temperatures must be agreed to by the parties concerned.

4. Apparatus

4.1 *Ovens*—Forced-circulation air ovens capable of maintaining the temperature in the test container within ± 1°C over the temperature range from 50 to 100°C. A separate oven for each aging temperature is recommended.

4.2 *Containers*—Noncorroding containers with an interior shelf to support the test specimens above the solution used for maintaining the required humidity. The containers shall be capable of being tightly sealed except for an aperture to permit insertion of thermocouple leads and release of vapor pressure that might otherwise lift the top off the container. A separate container is required for each generic material in each oven used.

4.3 *Thermocouple System*—Welded thermocouples and associated continuous recorders having a range suitable for the temperatures at which the containers are to be maintained and a sensitivity of 0.5°C. A separate thermocouple is required for each sample container.

5. Reagents and Materials

5.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended

---

[1] This practice is under the jurisdiction of ASTM Committee F-1 on Electronics and is the direct responsibility of subcommittee F01.05 on Encapsulation.

Current edition approved March 1, 1973. Published April 1973. Originally published as F 74 – 1971 T. Last previous edition F 74 – 71 T.

[2] Gahimer, F. H., and Nieske, F. W., "Navy Investigates Reversion Phenomena of Two Elastomers," *Insulation*, Vol 14, August 1968, pp. 39–44.

[3] Gahimer, F. H., and Nieske, F. W., "Hydrolytic Stability of Urethane and Polyacrylate Elastomers in Humid Environments," *Journal of Elastoplastics*, Vol 1, October 1969, pp. 266–280.

[4] *Annual Book of ASTM Standards*, Vols 08.03, 10.01, 10.02, and 11.03.

[5] Available from Institute of Electrical and Electronics Engineers, 345 East 47th St., New York, NY 10017.