Designation: F 816 – 83 (Reapproved 2003)

Standard Test Method for Combined Fine and Gross Leaks for Large Hybrid Microcircuit Packages[1]

This standard is issued under the fixed designation F 816; 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 applies to hermetic package leak testing to detect leaks of a broad spectrum in size with a minimum detection level equal to the sensitivity of the helium mass spectrometer equipment used in the test.

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.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

F78 Test Method for Calibration of Helium Leak Detectors by Use of Secondary Standards

F98 Practices for Determining Hermeticity of Electron Devices by a Bubble Test[3]

F134 Test Methods for Determining Hermeticity of Electron Devices with a Helium Mass Spectrometer Leak Detector[4]

2.2 *Federal Standard:*

Federal Standard 209B Clean Room and Work Station Requirements, Controlled Environment[5]

3. Summary of Method

3.1 This test method for the hermeticity of packages used for housing multichip and hybrid microcircuits is to be applied generally to those equal to or greater than 1 in.^{2}(645 mm^2) in area or 0.60 cm^3 in volume. A vent hole (See Fig. 1) is designed into the lid of the package. After sealing the lid on the package, the vent hole in the lid is presented to a port in the inlet of the helium leak detector using an interface seal (See Fig. 2). After the internal volume is evacuated, a cloud of helium gas is brought into close proximity to the entire outer surface of the package. Helium passing into the inner volume of the package through any leak orifice in an amount greater than the minimum sensitivity of the leak detector will be detected within a few seconds. The successfully sealed product is then placed into a controlled atmosphere dry box for vacuum purging and back filling the internal volume of the package through the vent hole with an inert gas having some detectable partial pressure level of helium gas. While under this latter condition, the vent hole is sealed off by a suitable manner. The specimen is then immediately retested by the above method to detect successful sealing of the vent hole.

4. Significance and Use

4.1 This test method provides an evaluation of the quality of an in-line sealing process on a real time basis for sealed packages. It eliminates the need to expose the specimen to long exposures of high pressure to drive the helium gas into the package to later be detected by the same method herein used. Previously, separate test methods were required to detect large or small leaks. This method provides only one test to accomplish all test levels without potential for specimens with leaks to escape detection within the range of detection being employed (see Practices F 98).

4.2 Both development and research, along with manufacturing control, may be served by using this test method. Current gross leak test methods and fine leak test methods may be combined into one using this method. No exposure to high pressure processing hazards is involved and safety of operation in production environment is enhanced.

5. Interferences

5.1 The use of the helium leak detector requires a specific gas transit time for the helium to pass through a leak orifice in the specimen and travel into the mass spectrometer sensing element for detection. The value of this time constant should be exceeded for all test conditions to be considered valid. For small leaks, the time constant will be maximum. Allowing the

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[1] This test method is under the jurisdiction of ASTM Committee F01 on Electronics and is the direct responsibility of Subcommittee F01.03 on Metallic Materials.

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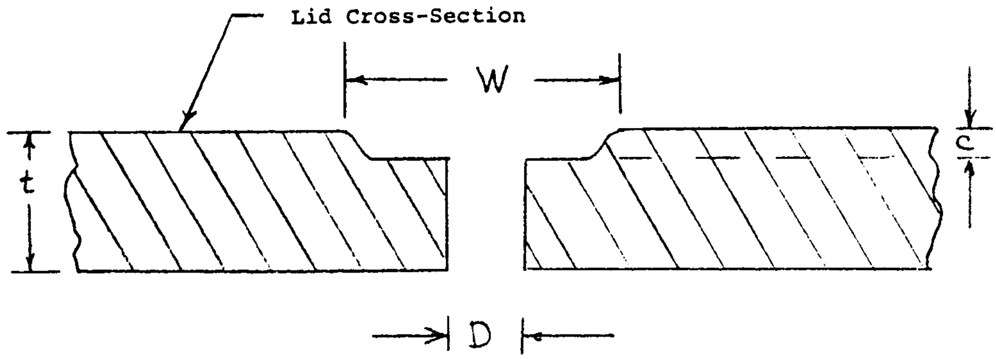
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Discontinued; see *1990 Annual Book of ASTM Standards,* Vol 10.04.

[4] Discontinued; see *1996 Annual Book of ASTM Standards,* Vol 10.04.

[5] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.



$$\frac{D}{t} = 0.5 \text{ max}$$

D_{max} = 0.51 mm (0.02 in.), typically 0.018 ± 0.002 in.

W_{min} = 2D to 3D

C = 0.008W to 0.1W

t = 0.25 to 1.02 mm, typically 0.01 to 0.04 in.

FIG. 1 Lid Vent Hole Design Option

helium gas to bathe the specimen for a time in excess of this time constant will suffice. This time constant should normally be no longer than 5 s.

5.2 Any contaminating films or seal defects in the interface between the apparatus port and the vent hole in the lid of the package may indicate a false leak. Adequate handling, cleanliness, and operator performance to ensure the integrity of this interface seal is necessary.

5.3 When a large leak is encountered that allows a large charge of helium gas to enter the mass spectrometer, it may be necessary to allow the system to regain a normal (unsaturated) condition before proceeding.

6. Apparatus

6.1 See Test Methods F 134 for helium leak detector test apparatus.

6.2 See Fed. Std. No. 209B.

6.3 See Fig. 2 for a sketch of manifold for specimen interface with leak detector and helium cup enclosure. The elastomer seal material may be made of butyl rubber, neoprene, or fluorocarbon rubber (Viton) depending on the desired compression force being used. The O-ring squeeze should be about 0.2 mm to assure a tight seal on a dry surface.

6.4 The dry box in which the vent hole is sealed may either be provided with a soldering iron or a spot welding head depending upon which method of seal is selected. The dry box shall also be provided with an adequate flow of dry nitrogen or some other inert gas to which can be added up to 10 % by volume of helium gas. A tube connected to a vacuum source shall be available inside the dry box for purging the specimens prior to sealing the vent hole. When spot welding is used to close the vent hole, it will be necessary to supply a thin disk of suitable material to cover over the vent hole and an appropriately sized welding fixture for weld sealing the disk over the vent hole.

7. Reagents and Materials

7.1 *Helium Gas Source*, commercially pure.

7.2 *Inert Gas Source*, nitrogen gas commercially pure.

7.3 *Cleaning Solutions/Solvents*.

7.4 *Soft Solder and Soldering Iron*.

8. Sampling

8.1 No specific sampling plan is to be implied by the use of this test method. The user is encouraged to adopt this method for 100 % testing of production product.

9. Preparation of Apparatus

9.1 Prepare apparatus in accordance with Test Methods F 134.

10. Calibration of Apparatus

10.1 Calibrate apparatus in accordance with Test Method F 78.

11. Procedure

11.1 Place each specimen to be tested on the test port (Note 1), one to each port for multiport manifold apparatus designs, with the vent hole centered on the interface seal surface location.

NOTE 1—A background or tare reading may be taken for each package style (plating) by rotating it 180° so the seal surface location is covered by a portion of the package lid that does not have a vent hole. This establishes a measurement threshold value for each package style and lid plating material.

11.2 Vent the leak test apparatus to evacuation mode by opening Valve A (See Fig. 2).

11.3 Place a helium cloud chamber shroud over the specimen(s) (common or singular units).

11.4 Observe the evacuation pressure to determine that it is normal.

11.5 If it is not normal (equal to the closed port value), inspect for a malfunction of the interface seal to the manifold. Correct any defects before proceeding.

11.6 Set the sensitivity scale of the leak detector to the scale required by the test parameter specification.

11.7 When the helium leak detector apparatus reached a condition of readiness to detect a helium source, momentarily