SAE INTERNATIONAL

AEROSPACE STANDARD

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Techniques for Suspect/Counterfeit EEE Parts Detection by Delid/Decapsulation Physical Analysis Test Methods

RATIONALE

The purpose of this document is to provide guidelines and requirements for the use of decapsulation, delidding or disassembly of EEE parts. The document further states the requirements for physical analysis and inspection in order to document characteristics that are consistent with suspect counterfeit parts.

INTRODUCTION

Inspection of the internal structure of a part, such as microelectronic die surface or metallization traces of a thin-film resistor, is a critical task in assessing whether a part may be considered counterfeit. Attributes that are not normally visible during external optical examination of a production part can be examined after a decapsulation or disassembly process. This helps in determining if the attributes are consistent with a part from the original manufacturer.

DISCLAIMER: The images contained herein are provided to illustrate the application of detection methods identified in the document, and are by no means intended to imply that a manufacturer identified in an image and text is involved with the suspect product.

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1. SCOPE

This method standardizes inspection, test procedures and minimum training and certification requirements to detect Suspect/Counterfeit (SC) Electrical, Electronic, and Electromechanical (EEE) components or parts utilizing Delid/Decapsulation Physical Analysis. The methods described in this document are employed to either delid or remove the cover from a hermetically sealed package or to remove the encapsulation or coating of an EEE part, in order to examine the internal structure and to determine if the part is suspect counterfeit. Information obtained from this inspection and analysis may be used to:

a. prevent inclusion of counterfeit parts in the assembly

b. identify defective parts

c. aid in disposition of parts that exhibit anomalies

This test method should not be confused with Destructive Physical Analysis as defined in MIL-STD-1580. MIL-STD-1580 describes destructive physical analysis procedures for inspection and interpretation of quality issues.

Due to the destructive nature of the test method that allows access to materials, design and layout information, the method may also enable observation of trends in design and material or process changes undertaken by the device manufacturer.

If AS6171/4 is invoked in the contract, the base document, AS6171 General Requirements shall also apply.

1.1 Purpose

The purpose of this document is to provide guidelines and requirements associated with the use of decapsulation, disassembly, and internal inspection as part of the process to verify the identity of the manufacturer of a part, and/or to discern and document characteristics that are consistent with suspect counterfeit parts.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AS6171 Test Method Standard, General Requirements, Suspect/Counterfeit, Electrical, Electronic, and Electromechanical Parts.

AS6171/2 Techniques for Suspect/Counterfeit EEE Parts Detection by External Visual Inspection, Remarking and Resurfacing, and Surface Texture Analysis Test Methods.

AS6171/5 Techniques for Suspect/Counterfeit EEE Parts Detection by Radiological Test Methods.

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Aerospace Technical Report.

2.2.1 MIL-STD-1580, Destructive Physical Analysis for Electronic, Electromagnetic, and Electromechanical Parts

2.2.2 MIL-STD-883, Test Method Standard, Microcircuits

2.2.3 MIL-STD-750, Test Method Standard, Test Methods for Semiconductor Devices

2.2.4 Murali, S., N. Srikanth, and Charles J. Vath III. "Effect of wire size on the formation of intermetallics and Kirkendall voids on thermal aging of thermosonic wire bonds." Materials letters 58.25 (2004): 3096-3101.

2.2.5 Park, Jongwoo, et al., "Interfacial degradation mechanism of Au/Al and alloy/Al bonds under high temperature storage test: Contamination, epoxy molding compound, wire and bonding strength." Components and Packaging Technologies, IEEE Transactions on 30.4 (2007): 731-744.

2.2.6 C.J. Hang, et al., “Growth behavior of Cu/Al intermetallic compounds and cracks in copper ball bonds during isothermal aging” Microelectronics Reliability48 (3): 416-424 (2008).

2.3 Definitions

See AS6171 General Requirements, Section 2.2.

2.4 Acronyms

See AS6171 General Requirements, Section 2.3.

3. DESCRIPTION OF THE METHODOLOGY/PROCEDURE - MICROCIRCUITS, HYBRIDS, DIODES, AND TRANSISTORS

The steps described in the subsequent sub-sections outline the methodology for conducting decapsulation and delidding. The procedure starts with the least destructive methods such as optical inspection and radiological inspection. Destructive steps such as manual and automated decapsulation, laser ablation and delidding are then described. At the end, a summary of inspection criteria is provided. Appendix A provides a step-by-step photo-documentation of the steps described in sub-sections below.

3.1 External Optical Examination

Examine the part for any anomalous conditions that may affect the decapsulation process (cracks in the case, uneven surfaces, etc.). See AS6171/2 for detailed external visual inspection (EVI) requirements.

3.2 Radiological

3.2.1 Radiological images shall be obtained in a top-down and side view orientation.

3.2.2 Information shall be obtained regarding the internal structure and alignment in order to minimize the potential damage that can occur from the decapsulation or delidding process. For plastic encapsulated parts, determine the side of the part which needs to be chemically etched in order to expose the die face. Note that while most die face opposite the direction that the leads are mounted, in some instances, the die face may be oriented towards the mounting side of the device (reference Example 2 in Appendix A).

3.2.3 Radiological image shall be obtained at the proper magnification which will help in the location of the die within the case, and will also help with the gasket selection when using an automated decapsulator.