Dilution of Dynasolve 750 Solvent for Solvent Test Improvements

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Abstract

The electronic assurance testing industry has significantly grown in the last decade due to the increase in counterfeit electronic component insertion into the world market place. This study seeks to improve the current standards of heated solvent testing in the destructive testing portion of the electronic testing industry. The evidence in this report supports an economical solution to the issue of exemplar integrated circuit (IC) component casings becoming heavily damaged during heat solvent tests along with counterfeit IC components. The method proposed is to dilute the most commonly used solvent, Dynasolve 750, with 1-Methyl-2-pyrrolidinone in a ratio of 2:8, respectively, while applying the standard testing procedure from standard Dynasolve 750 tests. This dilution produces testing results in exemplar components that show very similar surface topography to untested exemplar components while simultaneously destroying the casings of counterfeit components. Multiple tests of this new method, in conjunction with scanning electron microscope (SEM) inspection, were conducted on various types of IC components in this study to support these findings.

Keywords: integrated circuit; counterfeit electronic testing; heated solvent testing

1. Introduction

Integrated circuit (IC) component testing is a growing industry driven by the expansion of the illegal counterfeit IC component industry mainly originating from China. In this counterfeit IC component industry, various groups in China scour scrapped circuit boards in search for IC components that appear decent enough for re-packaging/re-selling. Most IC component manufacturers use a LASER etching process and white paint to mark their components with unique serial numbers depending on component type and model. The Chinese IC counterfeit industry circumvents this issue by sanding down the outer package of the repurposed IC component, until the serial number is nonexistent, and then they apply a thin layer of cheap epoxy paint to cover the top of the package. A new serial number is then stamped on top of the epoxy paint and the IC component is sold as an OEM part. This process can cause disasters within any company that incorporated these fraudulent parts into their systems. IC component testing services provide a
third party that can subject components to a wide variety of testing and examination with the goal to verify authenticity of the supply chain. There are quite a few different standard tests that

exist for identifying counterfeit IC components such as visual, electrical, X-ray inspection (structural), XRF (chemical), solder wettability, and destructive. The study presented in this paper specifically focuses on heated solvent tests (HST) that fall under the category of destructive testing. HST utilize various organic chemicals in mixed solutions, or in high purity, to confirm that the outer package of an IC component is the original, robust polymer casing it was manufactured with. This process works very well at determining fake casings because of the poor quality paints typically used by the counterfeit industry. At Global ETS-USA, the two standard HST's use Dynasolve 750 and 1-methyl-2-pyrrolidinone. The Dynasolve 750 test requires the solvent to be heated to 105°C and the IC component to be submerged for 40 minutes. The 1-methyl-2 pyrrolidinone test requires the solvent used to be heated to 115°C and the IC component to be submerged for 2 minutes. Both tests are then concluded with a standard cotton swabbing of 5 wipes in one direction and then 5 wipes in the opposite direction. After years of conducting these tests for many clients, inspectors have observed that the 1-methyl-2-pyrrolidinone barely damages both real and fake components, but the Dynasolve significantly damages fake components and moderately damages real ones. The fact that Dynasolve damages real IC packages can be problematic when working with clients that want their pieces to be completely unscathed after passing the test. This study serves to provide a solution to this issue that is shown in Figure 1.

Figure 1. Authentic IC component that has undergone the standard Dynasolve 750 test at Global Electronic Testing Services-USA. The left section represents the package before testing and the right section represents the package after testing. The original manufactured package has been damaged and this is one example of hundreds.

2. Materials and Methods

2.1. Dynasolve 750

Dynasolve 750 is a chemical solution consisting of 1-methoxy-propan-2-ol, 1-methyl-2-pyrrolidinone, 1-phenoxy-2-propanol, methyl alcohol, and potassium hydroxide. Table 1 shows the composition of Dynasolve 750 in concentration by weight as shown in the safety data sheet provided by Versum Materials. The solution's main purpose is to remove polymers and it is used as the standard for counterfeit IC component solvent tests. Companies and agencies such as Component Technology Institute Inc., Ball Aerospace & Technologies Corporation, NASA Electronic Parts and Packaging Program, SMT Corporation, Advanced Components Testing(ACT), and Global Electronic Testing Services (Global-ETS) all perform this test as a way to remove "blacktop" layers from counterfeit components [1,2,3,4]. The only variation in the application of HST is the amount of soak time, for example Global Electronic Testing Services soaks their devices for 40 minutes, NASA standard procedure states 45 ± 5 minutes, and SMT Corporation

prefers 45 minutes [2]. All standard Dynasolve 750 tests include heating it to the same temperature of 105 °C because the solution has a flashpoint of 106 °C [5].
Table 1. Dynasolve 750 composition in weight percentages as
shown in the SDS provided by Versum Materials [5].

2.2. 1-methyl-2-pyrrolidinone

1-methyl-2-pyrrolidinone has good solvent properties that is often used for the removal of "blacktops" on counterfeit IC components much like Dynasolve 750. After closer examination of Table 1, one can see that this is the second major organic solvent used to make Dynasolve 750. 1-Methyl-2-pyrrolidinone, in its pure form, is a less effective solvent than Dynasolve 750 due to the lack of powerful agents such as potassium hydroxide [6]. This chemical in high purity was determined to be not very reliable when removing the "blacktop" of a counterfeit IC component after multiple tests done at Global ETS. In addition, a memorandum by Ball Aerospace & Technologies Corp. confirmed this observation [2]. Figure 2 shows an example of what a standard Dynasolve 750 test looks like next to a standard 1-methyl-2-pyrrolidinone test on a counterfeit IC component