ASSOCIATION CONNECTING
ELECTRONICS INDUSTRIES

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Guidelines for Electrically Conductive Surface Mount Adhesives

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A standard developed by IPC

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1.0 SCOPE

This document covers guidelines for selecting electrically conductive adhesives for use in assembly of components to printed circuit boards (PCB) or similar wiring interconnect systems. The focus is on the use of adhesives as solder alternatives. The process discussion attempts to stay within the bounds of the existing solder assembly infrastructure as much as possible. Both major types of adhesives, isotropic (conducting equally in all directions) and anisotropic (unidirectional conductivity), are covered. The two major divisions of polymer adhesives, thermosets and thermoplastics, are described.

1.1 Introduction Polymers are long-chain molecules, such as epoxies acrylics and urethanes, that are widely used to produce structural products such as films, coatings and adhesives. Although polymers occur naturally, most are now synthesized. Their properties can be tailored to meet thousands of different applications. Polymer-based adhesives are used in virtually every industry because of this capability to customize performance. Polymers have excellent dielectric properties and, for this reason, are used extensively as electrical insulators. Most wire insulation is made from polymers. Although a narrow class of conductive polymers, called Intrinsically Conductive Polymers (ICPs), does exist, their other properties do not lend themselves for use as conductive adhesives. Therefore, virtually all conductive adhesives are made by adding conductive fillers to nonconductive polymer binders.

2.0 APPLICABLE DOCUMENTS

2.1 Institute for Interconnecting and Packaging Electronic Circuits[1]

IPC-T-50 Terms and Definitions for Interconnecting and Packaging Electronic Circuits

IPC-TM-650 Test Methods Manual

3.0 BASIC TYPES AND FEATURES

3.1 Benefits and Limitations of Conductive Adhesives Conductive adhesives are very different from metallurgical solders (the two classes of joining materials are contrasted in later sections). These differences produce a large set of benefits that are listed below. Not every adhesive presently has all of the features listed, but conductive adhesives technology has the potential to deliver all of these benefits in a single material.

Benefits

- Compatibility with a wide range of surfaces including non-solderable ones.
- Low temperature processing; low thermal stress during processing.
- Low thermomechanical fatigue; good temperature cycling performance.
- Low or no significant VOCs.
- No residuals; high surface insulation resistance.
- Reduced pre-clean or post-clean requirements; no CFCs or washing equipment.
- No lead or other toxic metals. bulFiner pitch capability.
- Wide processing latitude; easy process control.
- Soldermask not required.

Limitations

- Lower mechanical strength
- No component self-alignment
- Some adhesives require special finishes on parts and printed wiring boards.
- Higher electrical resistance.
- Higher thermal resistance.
- More difficult to rework.

3.1.1 Types of Conductive Adhesives The most common conductive adhesives are silver-filled thermosetting epoxies that are typically provided as thixotropic pastes. They are used to electrically interconnect and mechanically bond components to circuits. Heat is most often used to activate a catalyst or co-reactant hardener that converts the paste to a strong, electrically conductive solid. The products which conduct equally in all directions are referred to as isotropic conductive adhesives. These metal-filled thermosetting conductive adhesives have been used as die attach materials for many decades and are still the most popular products for bonding ICs to lead frames. More recently metal-filled thermosets have been formulated as component assembly materials. New polymer-based materials are now being used to replace metallurgical solders, especially for surface mount assembly.

A number of other types of adhesives have also been developed. Silver-filled thermoplastic adhesives are available in both paste and film form. The films have found use primarily as die attach adhesives. Thermoplastic pastes are made

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