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Guidelines for Design, Selection and Application of Potting Materials and Encapsulation Processes Used for Electronics Printed Circuit Board Assembly

Developed by the Potting and Encapsulation Task Group (5-33f) of the Cleaning and Coating Committee (5-30) of IPC

Users of this publication are encouraged to participate in the development of future revisions.

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1 SCOPE

1.1 Introduction Potting and Encapsulation is a very broad topic and can include anything from toys to high power applications. There is no clear industry-wide definition that would decipher distinct differences between either. This document will cover known terminology associated with this process as related only to electronic printed circuit board assembly and protection.

Encapsulation is used in conjunction with various types of assemblies and components, e.g., printed circuit assemblies (PCA), connectors, transformers, etc. The designer and the users of encapsulation for electronics applications must be aware of the properties of various types of encapsulation and their interactions with assemblies and components in order to protect them in the end-use environment for the design-life of the end item. This document has been written to assist the designers and users of encapsulation in understanding the characteristics of various encapsulation types, as well as the factors that can modify those characteristics when the encapsulation is applied. Understanding and accounting for these materials can ensure the reliability and function of electronics.

1.2 Purpose The terms ''potting'' and ''encapsulation'' (P/E) can be confusing terms and be interpreted to mean many things in various industry assembly processes.

The purpose of this handbook is to assist the individuals who must either make choices regarding encapsulation or who must work in encapsulation operations and to provide guidelines for the design, selection, and application of Potting and Encapsulation as it pertains to electronic components and printed board assembly only.

1.3 Scope For the purpose of this document potting can be thought of as the ''liquid material'' and encapsulation can be interpreted as the application process and cure. Please keep in mind however that the terms potting and encapsulation are commonly interchanged with each other in a variety of electronic protection processes.

Encapsulation, for the purpose of this document, is defined as a potting material, e.g., epoxy, silicone, urethane that is applied in a liquid state and subsequently processed (i.e., cured) to form a rigid or rubber-like state.

Processing characteristics and curing mechanisms are dependent on the encapsulation chemistries used. The desired performance characteristics of an encapsulation depend on the application and must be considered when selecting encapsulation materials and encapsulation processes. Users are urged to consult the suppliers for detailed technical data.

This guide enables a user to select an encapsulant based on industry experience and pertinent considerations. It is the responsibility of the user to determine the suitability, via appropriate testing, of the selected encapsulation and application method for a particular end use application.

Encapsulation may have several functions depending on the type of application. The most common are to:

- Inhibit current leakage and short circuit due to humidity and contamination from service environment.
- Inhibit corrosion.
- Improve fatigue life of solder joints to leadless packages.
- Inhibit arcing and corona, in particular for high voltage applications.
- Provide mechanical support and to prevent damages due to mechanical shock and vibration.
- Provide a mitigation method for the growth of tin-whiskers.

1.4 Terms and Definitions All terms and definitions used throughout this handbook are in accordance with IPC-T-50. Definitions noted with an asterisk (*) are quoted from IPC-T-50. Other specific terms and definitions, essential for the discussion of the subject, are provided below.