HERMETICITY
OF
ELECTRONIC PACKAGES

by

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NOYES PUBLICATIONS
Park Ridge, New Jersey, U.S.A.
WILLIAM ANDREW PUBLISHING, LLC
Norwich, New York, U.S.A.

Library of Congress Catalog Card Number: 99-29617
ISBN: 0-8155-1435-2
Printed in the United States
Published in the United States of America by
Noyes Publications / William Andrew Publishing, LLC Norwich, New York, U.S.A.
10987654321

PREFACE

The technology of hermeticity addresses the transfer of fluids in and out of sealed enclosures. This technology is based on physics and chemistry, and (like many such technologies) is difficult to grasp when the exposure is brief or infrequent. One's first exposure to this technology usually involves an application related problem. The understanding of, and particularly the solution to, the problem requires a considerable specific background. Not having such a background, the physical concept of the problem is just out of one's grasp and its solution is nowhere in sight. Subsequent exposure to this technology only helps a little, as the background is still missing and the new application is often slightly different.

The purpose of this monograph is to provide the necessary background and problem solving examples, so that packaging engineers and other specialists can apply this knowledge to solving their problems. Ninety nine problems and their solutions are presented. These problems are representative of the type of problems occurring in industry. Many of the included problems are those that the author has experienced.

The technology of hermeticity is an offshoot from vacuum science. Vacuum science has a long history, going back to two Italians: Gasparo Berti in 1640, and Evangelista Torricelli in 1644. During the next three hundred and some years, scientists have tried to produce better and better vacuums. They realized that the degree of vacuum achieved, not only depends upon how much and how fast the gas can be removed from the vessel, but also upon the amount and rate of gas leaking into the vessel. This lack of an hermetic vessel eventually led to the technology of hermeticity.

One method of finding leaks in a vacuum system was to connect the system to a mass spectrometer which was tuned to the gas; helium. Helium was selected because the amount of helium in the atmosphere is only 1 part in 200,000 (the rate of its diffusion through a leak is greater than any other gas except hydrogen), and that no other gas can be mistaken for helium by a mass spectrometer. Helium was then sprayed at various parts of the system and if there was a leak, the mass spectrometer would so indicate. This technique, slightly modified, would eventually be used to detect leaks in sealed packages when they contained helium.

The leak testing of sealed packages, when the initial atmosphere in the enclosure had some helium, became a common practice by the early nineteen sixties. In 1965 D. A. Howl and C. A. Mann reported on a leak testing method for enclosures which were not sealed in an atmosphere containing helium. This new method forced helium under pressure through the leakage path into the enclosure. A helium mass spectrometer then detected the helium escaping the enclosure. Subsequently, MIL-STD 883 adopted a leak test method based on this work.

Bibliographies at the end of chapters will lead the reader to areas beyond the present scope of this monograph.

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November, 1999

ABOUT THE AUTHOR

Hal Greenhouse received his B.S. in chemistry, and M.S. in physical chemistry from The Ohio State University in 1948 and 1951 respectively. In 1959, he began research and development in hybrid microcircuit technology at the Bendix Radio Division of the Bendix Aviation Corporation in Baltimore, Maryland. His career with Bendix started with the development of thin film technology for use in hybrid microcircuits, including the development of conductors, capacitors and resistor systems. In 1967, he transferred his efforts to the development of thick film technology and by 1980 a high reliability thick film hybrid microcircuit facility was built. The facility was based on processes developed by the author and his colleagues. He was the lead designer of over a dozen high reliability hybrid microcircuits for a missile system and he has design over 100 hybrid microcircuits and multi chip modules.

The author has published 19 papers and 5 patents, one of which is basic and as been issued in over 20 countries. He is a member of IMAPS, IEEE and the Society of Sigma XI. He has also been a member of the Optical Society of America, the American Vacuum Society, the American Crystallographic Society, the American Ceramic Society, and the Electrochemical Society.

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