Moisture in Microelectronics…
Volatiles Control in Hermetic Electronic Components

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Course Summary

The tutorial includes a basic review of the Mil Spec test methods in place to prevent moisture related failures in military and other systems where functional reliability is of utmost importance (e.g. IC's, Hybrids, MEMs, Class III Medical Implants, Optoelectronics, etc). It's intended to enlighten the student on the negative, and sometimes catastrophic, consequences of too much moisture inside a hermetic enclosure. The class begins with a definition of hermeticity and a description of the latest hermeticity test methods in MIL-STD-883 TM 1014 and associated mil/space spec limits, along with IGA (Internal Gas Analysis) and the latest developments in TM 1018. Moisture failure case studies with significant consequences in terms of cost, schedule, loss of mission and system downtime will be reviewed.

Topics include:

- Moisture Failure Modes and Mechanisms
- Hermeticity and Leak Testing
- Moisture Control and Moisture Analysis
- Case Studies

A critical review of past failures is intended to highlight the FA protocols, causes and corrective actions, and from this guide engineers new to this field, or those dealing with a current related problem, to understand internal water vapor measurements, interpret data, and avoid similar mistakes. Emphasis is placed on the methodology used to understand the underlying physics and chemistry that caused failures and appropriate design and mitigation strategies required to prevent future failures.

Suggested Reference Books Available on Amazon:

1. **Physics and Chemistry of Volatile Species in Hermetic Electronic Devices**
by Philipp Wh Schuessler

2. **Hermeticity of Electronic Packages, Second Edition 2nd Edition**
by Hal Greenhouse

Instructor Bios

Thomas J. Green has more than 36 years combined experience in industry/academia and the Department of Defense, including years developing curriculum and teaching industry professionals about microelectronics assembly-related packaging and processes. Serving as a Research Scientist at the U.S. Air Force Rome Air Development Center, Tom worked as a reliability engineer analyzing component failures from fielded avionic equipment. As a Senior Process Engineer with Lockheed Martin Astronautics in Denver, Tom was responsible for materials and processes used to assemble hybrid microelectronic components for military and aerospace applications. While with Lockheed, he gained invaluable experience in wirebond, die attach, thick- and thin-film substrate fabrication, hermetic sealing, and leak test processes. For the last 15 years, Tom's expertise has helped position his company as a recognized industry leader in teaching and consulting services for high-reliability military, space, and medical device applications. Tom is a Fellow of IMAPS (International Microelectronics and Packaging Society)

Bob Lowry is an electronic materials consultant. After obtaining BS/MS degrees in Chemistry he worked for 32 years at Radiation, Inc., Harris Semiconductor, and Intersil Corp. He was responsible for materials analysis and was Senior Scientist in charge of Analytical Services at Harris and Intersil. He did failure analysis work on early moisture-related failures of NiCr and aluminum-metallized IC's. He patented a surface conductivity dewpoint sensor and helped draft Test Method 1018. He established a DSCC-suitable facility at Harris for statistical control of hermetic sealing capable of the moisture limit thereby assuring compliant product. He conducted extensive split-lot studies of correlations between two different mass spectrometers. He also helped characterize a "consensus standard" circulatable single sample cylinder using humidified gas to improve moisture measurement correlation between laboratories. His consulting work includes package hermeticity and sealed headspace-related failure mechanisms, gas gettering technology, process and materials improvements for manufacturing reliable electronic components, counterfeit component identification and avoidance, and applied electronic materials and components analytical methods to identify problems and improve product quality/reliability.