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Number 33

APPLICATION NOTE

Problems with Tin-plated Electromechanical Contacts

Introducing Stabilant 22

Stabilant 22 is an initially nonconductive block polymer which when used in a thin film between metal contacts becomes conductive under the effect of an electrical field. This occurs at an electric field gradient such that the material will remain nonconductive between adjacent contacts in a multiple pin environment. In addition, Stabilant 22 exhibits surfactant action as well as lubrication ability, providing a single component resident solution to virtually all contact problems.

When applied to electromechanical contacts, Stabilant 22 provides the connection reliability of a soldered joint without bonding the contact surfaces together.

In this Application Note, the problems with tin plated contacts are described. Service considerations are introduced, including treatment with Stabilant 22, both in its concentrated form and Stabilant 22A, our isopropyl alcohol diluted product.

Problems encountered with tin plated contacts

From the earliest days of producing Stabilant 22, our customers reported problems with tin plated contacts. Beginning in the early 2000’s, a push began to phase out lead solders. To the extent that electronic manufacturing has adopted lead free solder, more tin is now used. The use of tin plating on connectors continues, especially in low cost (consumer grade) systems that allow for short life cycles. We will discuss mainly the corrosion and wear related concerns with tin. It is also advisable to review some of the extensive literature on tin whiskers - these contribute to short circuit failures, mainly where contacts are closely spaced.

Tin remains a concern in most electronic systems. An example of tin plated connectors is the header type (with square pins, on 0.10 or 0.156 inch centers), commonly used to connect stacked PC boards, or mated with wiring harnesses.

These remain viable for power connectors, but are considered too noisy and have excessive resistance for small signal use. The selection of a connector from a "standard parts" list for cost effectiveness was one of the engineer’s oldest inducements to bypass the technical arguments that favor gold and other more durable plating materials. Even overdesign for current ratings will not solve all of the problems here.

Where tin plated connectors are deemed appropriate, the engineer requires some data concerning the manufacturing technique. If the forming process involves stretching of the tin plating rather than the use of a coining technique (wherein the tin flows under pressure), microscopic cracking may take place in the tin coating.

During manufacture and in service, the lattice structure of tin changes with temperature (even including phase changes). Stresses can be set up that will induce the plating to spall (crack or flake), detaching from the substrate. While this might occur slowly under normal conditions, wearing is accelerated by insertion/removal cycles – tin is highly susceptible to fretting.

A well equipped service group can confirm the extent of tin spalling by having contact surfaces examined by electron microscope. Not only are the flakes of plating usually readily apparent, but the pattern of corrosion on the exposed substrate will sometimes show where the original cracking of the tin plating occurred, revealing stresses that were placed on the plating during manufacturing and assembly.

As with most connector failures, corrosive influences and the wearing effects described above have a multiplying effect when combined. For example, in a sulfur rich atmosphere, spalling allows more corrosion. Then, spalling is increased to the point of causing connector failure within a year of being placed in service.

Using Stabilant 22 for improved reliability

Under most circumstances, the use of Stabilant 22 can increase the MTBF (Mean Time Between Failures) in the field, often by 10x over untreated connectors. A previously erratic connector may only have to be serviced once during its design lifetime (barring exposure to exceptionally corrosive environments). Much of this is due to the combined abilities of Stabilant 22 to reduce fretting and to seal out contaminants.

When spalling, tin whiskers and corrosion have caused a connector to fail, Stabilant 22 can be applied once the "metallic dandruff" has been purged from the contact area. Some flushing with isopropanol or other cleaner is advised for female connectors (sockets). Even in cases where the substrate metal is exposed, the connectors will generally be serviceable once cleaned and treated.

One further note concerns crimped connectors, such as those used on ribbon cables – often used in conjunction with the header connectors described above. These use an insulation piercing design, which aims to provide both a tight metal to metal connection and a sealed environment within the insulation. We advise treatment of these with Stabilant 22A, applying enough to get into the rear contacts of the connector. This will prevent many of the failures that can result when mechanical strain loosens such an assembly, with the attendant invitation to corrosion.

NATO CAGE/Supplier Code 38948

5mL Stabilant 22 (Concentrate), NATO Stock Number 5999-20-002-1112

15mL Stabilant 22 (Concentrate), NATO Stock Number 5999-21-909-9981

15mL Stabilant 22A (Isopropanol Diluted), NATO Stock Number 5999-21-900-6937

15mL Stabilant 22E (Ethanol Diluted), NATO Stock Number 5999-21-909-9984

Stabilant products are patented. Because the patents cover contacts treated with the material a Point-of-Sale license is granted with each sale of the material.

SAFETY DATA SHEETS ARE AVAILABLE ON REQUEST

NOTICE

This data has been supplied for information purposes only. While to our knowledge it is accurate, users should determine the suitability of the material for their application by running their own tests. Neither D.W. Electrochemicals Ltd., their distributors, or their dealers assume any responsibility or liability for damages to equipment and/or consequent damages, howsoever caused, based on the use of this information. This note is based on the original work of William Michael Dayton-Wright and includes updates by D.W.E. staff.