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Number 21

APPLICATION NOTE

Stabilant 22 Use with Gold-plating and Solder Alloys

Problems in connectors with gold-plated contacts mated to solder-plated parts

Connectors designed with *low contact to contact pressure,* and including a gold-plated contact mated to a solder-alloy plated contact are not recommended in high-temperature or high humidity environments under any circumstance; even the use of Stabilant 22 may not solve the inherent problems in such an arrangement.

This combination of high humidity and temperature, especially with high frequency operation seems to speed up the formation of a hard black deposit consisting of mixed oxides of tin and lead. This coating is a poor conductor at best and will cause contact problems.

The exception occurs where the connector is designed to maintain sufficient pressure at the point of contact so as to exclude the entry of oxygen. This condition is typically met on good-quality IC sockets. Providing the contact pressure is in the range of 500 to 800 lb./in^2 this will usually keep the junction clean, preventing oxidation under most circumstances. In this case, Stabilant 22 treatment will enhance the contact's reliability over a longer period of time.

A better solution is of course the use of like materials (gold or solder-alloy-plated) for both contacts. In either case, these can be made more reliable by Stabilant 22.

What is Stabilant 22?

Stabilant 22 is a liquid block polymer that is applied to electrical contacts to improve their reliability through a combination of its properties. It is initially nonconductive, but under the effect of an electrical field in the very narrow gaps between metal contacts, it becomes conductive.

The electric field gradient at which this occurs is set so that the material will remain non-conductive between adjacent contacts in a multiple pin environment.

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

While Stabilant 22 exhibits surfactant action it is *not* sold as a contact cleaner. Equally, it exhibits quite good lubricating properties but is *not* sold as a contact lubricant.

Its primary strength is in its *active properties* when used in a connection and the other properties are a bonus.

Examples of the mixed contact materials problem

From service experiences in the early days of personal computers:

1) Many of the first enhancement boards made to fit the Apple MacIntosh™ computer used a "connector clip" which snapped down over the 68000 microprocessor chip on the main board.

   The initial design had gold-plated contacts which exerted only a low pressure over a fairly large area of the corresponding solder-alloy plated IC contact.

   The design of that clip, together with the shielding effect of the board to which it was attached ensured that a higher-temperature environment was created in the vicinity of the contacts. The plastic housing for the clip was molded polycarbonate plastic, which will absorb small amounts of moisture when cool, releasing it when heated up. It was not unusual to find that the enhancement board became erratic after two to three weeks of operation. Examination of the hard black film that formed at the junction of the two metals revealed that it was substantially composed of oxides of tin and lead.

   Redesign of such clips significantly reduced the problem, nevertheless a number of companies servicing this equipment still found it prudent to apply Stabilant to the contacts, and they reported that this took care of the marginal cases.

2) Where older graphic accelerator boards were encountered, the application of Stabilant 22 alone was found to increase the Mean Time Between Failures from a two week period to about seven weeks; but even this magnitude of improvement in MTBF was not acceptable in the application, and additional contact cleaning was necessary.

On the basis of solving similar problems with other types of connectors, our recommendation was that the gold-plate be changed to solder-alloy-plate, and that the contact pressure be increased either by the use of a thicker contact stock or the use of a small dome protrusion on the contact.

We have found that a solder-alloy to solder alloy contact under these circumstances, treated with Stabilant 22, will have a MTBF of years rather than weeks.

Chemicals used to inhibit the formation of oxides

In addition to Stabilant 22, there are contact treatments on the market that aim to remove or suppress oxidation, but the bulk of them are hardly the type of materials that could maintain a good contact in the long term. Stabilant treatment does not chemically reduce oxides, but prevents them from forming by forming a seal around the actual contact area. It is stable enough that one treatment can last many years.

Generalizations about the use of dissimilar metals

It is not good engineering practice to employ a design using contacts where the surfaces are materials with *grossly* different potentials on the galvanic scale (reactivity measured as electronegativity or half-cell potentials). It is an open invitation to "galvanic corrosion". An example of this would be gold-to-aluminum pair with inadequate contact pressure. Corrosion products like oxides, sulfides, carbonates, etc. are usually insulators that interrupt a connection. Even those that are conductive often exhibit semiconductor effects, creating unwanted rectifying junctions that will often demodulate any RF signals present on the lines. This can also cause rise-time problems that can “crash” a computer or peripheral using such a connector.

Proper connector design would include contact pressures high enough to reduce the entry of oxygen into the contact pairs. The use of Stabilant 22 will reduce the problem by negating most of the thin film rectification problems.

That said, it is still better practice to employ connectors where the contacts are of identical materials or are close in their galvanic potential. Even a bit of moisture on the portion of contact material outside the actual mated surfaces can cause dissimilar metals to behave as a short-circuited battery cell!

NATO CAGE/Supplier Code 38948

15ml Stabilant 22 (Concentrate), NATO Part # 5999-21-909-9981

15ml Stabilant 22A (Isopropanol Diluted), NATO Part # 5999-21-900-6937

15ml Stabilant 22E (Ethanol Diluted), NATO Part # 5999-21-909-9984

The Stabilants 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