Stabilant 22 Contact Enhancer Application Notes

App. Note 13 - Mobile Radio

What is Stabilant 22?

Stabilant 22 is an *initially non-conductive* block polymer that in a thin film under the effect of an electrical field or when used in a very narrow gap between metal contacts, becomes *conductive*. The electrical field gradient at which this occurs is set s that the material *will not cause leakage* between adjacent contacts in a multiple pi environment.

It provides the connection reliability of a soldered joint without bonding the contacting 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 mÃ©tier is in its *active properties* when used in a connection and the other properties are a bonus.

But to understand how the **Stabilants** operate let's take a quick look at the causes of connector failures.

What connector problems are encountered in mobile and ham radio?

While we will be talking about connectors, let's not forget that these problems are also encountered with switches as well.

Generally, contaminants causing problems in connectors can be broken down into four classes;

- plain contamination,
- corrosive contamination,
- contamination which is modified by materials present in the connector itself or by other contaminants
- galvanic corrosion.

Apart from contamination, vibration of connectors can also lead to failure. The could be caused by wearing away of a protective plating, or even an action that would promote the entry of contamination into the connector itself.

Plain contamination can come from many sources as diverse as: road salts, tar and nicotine, paving material, oils, resins from trees, industrial origin airborne materials, plant resins and plasticizers given off by upholstery, carpeting, undercoating or paints and plastics. While these contaminants are more often found in mobile applications an may actually be concentrated through location of equipment modules near heating vent, or air-conditioning outlets. They are may also be found in the home or office environment as well.

Typically, the contaminant materials will form a thin film on the contact's surface where they will cause problems ranging from simple intermittence and distortion, to RF demodulation. In data circuits or microprocessor-controlled equipment even a single malfunctioning contact can crash the system.

Corrosive contaminants are, as their name implies, chemicals that once in place within a connector, can and will cause corrosion either of the surface plating on the connector parts, or, more serious, cause corrosion of the underlying substrate metal. Because corrosion products occupy more space than the original; metal, they can form pockets which can force clean contacting surfaces away from each other causing the connector to fail. Some contaminants can even penetrate the thin gold plating that is commonly used, destroying the underlying material. This is often encountered in card-edge connectors in the chemical or pulp-and-paper industries.

Some metal plating can micro-crack when they and the materials on which they are plated are formed during the process of manufacturing the connector. A good example of this would be tin-plating, which during temperature changes, undergoes a crystalline-lattice-modification which actually alters the dimension of the material, leading to enlargement of the cracks and, as a parallel problem, "spalling" of the plated surface from the substrate. In this situation, potential corrosive materials can accumulate under the plating; leading to premature failure of the connector. We have encountered cases where storage and shipment of these types of connectors in corrugated cartons (without a sealed plastic protective bag) can cause failures due to the migration of sulfate and sulfides present in the cardboard itself!

We don't think we have to dwell on the effects of the salts used to melt ice on the highways, or salt contamination in ocean-side areas, but people forget that various salts such as calcium chloride, are also used to hold moisture in gravel roads and road foundations.

The third class of contaminants are those, such as low saturation oils, which while they themselves don't cause problems in their original state, can be cross-linked into polymer films because of the presence of other contaminants. For example, many plastics used in connectors are thermosetting resins and contain catalysts or curing agents which can act on unsaturated oils or partially saturated oils to make them cross link into gummy varnish-like films. The same sort of thing can be caused by some of the rubber materials encountered in connectors or even in automobiles. Where connector materials use the so-called free- machining alloys, the presence of the sulfur which gives these alloys their machinability can cause cross-linking of oils and subsequent connector failure.

The final class is that of galvanic corrosion. This occurs where two dissimilar metals are used in contact in the connector. Not normally found in connectors supplied as mating pairs by reputable manufactures, they are most often found where the male and female connector parts are obtained from different sources. One of the worst matches of this type would be the use of a good gold-plated connector mated to an aluminum bodied connector. More typical are die cast connector shells (forming the ground circuit) which are mated with silver plated components.

The dissimilarity of the metal itself will generate a potential between the connector components which can result of disintegration of the donor metal and or plating of the donor metal onto the other component.

What are Stabilants uses in mobile radio equipment?

Stabilant 22 can be used wherever electrical contacts are Used, whether this is in connectors, or in switches. Whether the application is ground, marine, or airborn based the number of places where **Stabilant 22, Stabilant 22A** or **Stabilant 22E**, can be employed, are almost too numerous to list.

Whether the radio installation is a small compact unit as carried by personnel, a car or truck mounted unit, or even a large base station, it will usually have bee designed in a series of modular units interconnected using a variety of connectors. It is on these connectors, as well as the various switches and integrated circuit contacts, that the Stabilants can be used to increase reliability. With many circuits designed to use minimum of power, such as CMOS frequency synthesizer modules, the power level in the individual contacts are often so low that even a very small amount of contaminant film will either prevent the units from functioning, or lead to false frequency information being entered. With the increasing sophistication of mobile equipment, it is not unusual to find this power-conservation type of design excepting in the final power-amplifier itself. This is done in order to conserve power and/or minimize heat-dissipation requirements.

Many portable units are more likely to fail under severe usage and environments conditions, which is often when they are needed most. A good example of this might be a severe storm when radio communications are imperative because of power outages. The very weather conditions encountered, together with the intensive usage of the equipment can often combine to knock it out of service, just when it is desperately needed.

When connections are less than perfect, thin-film-rectification or oxide-film-rectification effects may occur, making the system more susceptible to the electromagnet pulses caused by lightning. These may also cause side-band spatter or reduce side-band rejection as well as leading to lowered signal to-noise ratios by making the system more susceptible to RF interference from many from other sources. The result is often a jamming of the unit when it is used near high-power sources of RF such as AM, FM or TV transmitters.

The number of connections in most systems has also increased substantially. And while microprocessor control is now making it easier to perform self-checks on some of the new equipment, it has made the same equipment much more sensitive to connector problems, whether they be card-edge connectors or those in socketed IC's.

While the material was designed to substantially increase the reliability of all forms of contacts, **Stabilant 22** is also finding increased use as an insertion lubricant for multi-pin IC's. Here it almost eliminates the possibility of bending-under a pin on a IC.

The **Stabilants** function from DC up through several Gigahertz, at current densities covering the complete range of available connectors. They are used from -70'C up t 210' C and even higher when under pressure.

Why should we use Stabilant over less expensive alternatives?

We grant that the material itself is expensive. However it is unique in having a very-long useful life once in place. And it is very important to remember that**Stabilants** are a *resident* treatment; that is, they stay on the contacts!. Thus they are only used once in the lifetime of the equipment, unlike cleaners which will have to be used every time the connector becomes contaminated. And unlike other so-called contact treatments Stabilant 22 will not cross-link (becoming varnish-like) under the action of sulfur-based curing agents in elastomers, cutting-oil residues, or the sulfur-bearing free-machining metal alloys used in some contacts. In most types of service work, *the cost of the time involved in removing and replacing a module just once will be many times greater than the cost of the* Stabilant *used to treat the connectors.* Here, what is important is that not only will proper connector treatment cure existing contact problems, it will prevent others problems from occurring in the future, thus eliminating the necessity of repeating the treatment at a later date!

In other words, why should you have the expense of doing a job more than once?

In what forms is Stabilant available?

Stabilant 22 is packaged in 15mL, 5OmL, lOOmL, 25OmL, 5OOmL and 1 Liter containers. The Stabilants are available in several forms; such as a concentrate called **Stabilant 22**, and as an isopropyl alcohol diluted form called **Stabilant 22A**. Another is **Stabilant 22E** where the diluant is ethyl alcohol.. Because of the diluants are added in 4:1 ratio, a given size container of **Stabilant 22A** (or example) will cost about one fifth the amount of a container of Stabilant 22 for it contains only one-fifth the amount of the concentrate. A third packaging is available for industrial bulk users. **Stabilant 22S** packages the concentrate such that it occupies one-fifth the volume of an otherwise empty container. This allows the end- user to add his own diluant and saves the added costs of shipping alcohol, as well as allowing the end-user to use an alternate diluant such as one of the other solvents used in electronics.

What is the difference in use of the Stabilants?

The concentrate, **Stabilant 22** is most useful where the connections are out in the open such as exposed RF connectors. Where the connections are not too easy to get at or where the user wishes to apply the material to something such as a socketed IC (without removing the IC from its socket) it is easier to use the alcohol diluted form, **Stabilant 22A** or , **Stabilant 22E.** In either case, alcohol diluant serves only to carry the concentrate into the connector.

Is Stabilant available in a spray can?

No! Not only would this be wasteful, but the alternative propellants to the chlorofluorocarbons or the hydrochlorofluorocarbons are generally highly inflammable, and this flammability represents a serious hazard in itself. We have found that customers prefer the dropper bottles used in the smaller sizes, and when purchasing larger quantities, we are happy to provide empty dropper bottles, or advise customers of sources for specialty applicators so that they can use our materials most efficiently!

Is Stabilant just another contact cleaner?

No, it is important to remember that **Stabilant 22** is an *electrically active* material which enhances conductivity within a contact without causing leakage between adjacent contacts. Thus large quantities of the material do not have to be "hosed" on as is the case with cleaners.

Just how much should be used?

Normally, a final film thickness of from 0.5 to 1 mils of the concentrate is all that is necessary. In other words you want just enough to fill up the interstices between the contact's faces. Where you're using **Stabilant 22A** (or **Stabilant 22E**), you'll have to use enough s that once the alcohol evaporates the desired 0.5 to 1 mil film of Stabilant 22 remains.

What is the 15mL service kit?

This was made up at the request of several manufacturers and electronics equipment service organizations who wanted a standard kit of reasonable dimensions that they could purchase and stock in quantity, issuing it to their field service personnel as required. The service kit consists of a 15mL container of**Stabilant 22A** and some soft tipped swabs as applicators, all in a small capped tube. The applicators are reusable. To quantify your requirements, a 15 mL Service Kit bottle contains about 900 drops of the material.

How can I be sure that the material works?

Quite apart from the fact that **Stabilant 22** has passed a number of stringent field tests before being issued a NATO/CAGE supply code number as well as a NATO Part number, we could cite the fact that **Stabilant 22** is used both by computer companies and is used by many hospitals on their biomedical electronics to improve reliability of the equipment where lives are in the balance, we could cite the use of **Stabilant 22** by many broadcasting networks to achieve the last measure of reliability in critical network switching applications, we could cite its use in navigational aids, or we could cite the years of use in the audio field where even consumers found the material easy to use and its results impressive; but we still feel that the best way to find out just how well it works is to try it out! That's why we have samples available. Almost every service shop or manufacturer has equipment available where the switches or connectors have become erratic over the years. Use **Stabilant 22A** on them for quick turnaround test, or use the material in field service and satisfy yourself.

Can we use Stabilant 22 in other equipment?

It can be used in computers, test equipment, cameras, just about everywhere there' a low voltage signal or control connection. For example, the effect of**Stabilant 22** in Computers is to reduce the number of times the system locks-up or crashes, some times it even eliminates non-software crashes completely.

When used on socketed IC's, photo-couplers/isolators, rotary, push button, or slide switches, or even on BNC connectors, the net effect is usually to make the proper operation of the equipment less erratic, and in the case of IEEE-488 buss- controlled equipment, to cut down on the potential for system lock-ups.

The Stabilants are bring used in such diverse applications as flight simulators and railroad control equipment. They are TSO'D for Avionics, and are standard store items in a growing number of major OEM's, hospitals, and research institutions a well as being used in a number of U.S., State, Canadian, and Provincial Government agencies, and police forces.

Is the material hazardous?

No, **Stabilant 22** has caused no skin reactions in tests, and is, in the undiluted form, non-flammable. Stabilant 22 has an LD50 of about 5 grams per kilogram body weight, primarily due to dehydration of untreated specimens or due to its action as a laxative.

The **Stabilants** are considered extremely safe environmentally, because of their exceptionally low toxicity they are replacing a broad spectrum of solvent systems in electronic servicing and production. In the US they are not subject to the TSCA (The Toxic Substance Control Act) nor are they reportable under SARA Title 111.

What is the best way to apply it to a contact?

The 15mL and 50 mL containers have "dropper" type caps that allows **Stabilant 22A** or Stabilant 22E to be applied directly to such components as socketed IC's, switches, connectors, etc. Some end users prefer to buy larger quantities and use industrial syrettes to apply the material onto connections. Camel's hair or sable brushes can be used to brush it on card-edge connectors. Cards can also have their edge connectors dipped into the dilute material.

When using **Stabilant 22** as an IC insertion lubricant and large quantities of IC's are involved, we would suggest that an applicator be made up. This consists of a rectangle of conductive foam (of the type used to prevent static-charge damage of IC's) be epoxied to the bottom of a flat tin. Flood the foam with **Stabilant 22**. The IC can then be pushed down on the foam thus applying **Stabilant 22** to its pins.

Does the action of Stabilant 22/22A/ 22E deteriorate with age?

Stabilants have been in some field trial applications for over fifteen years now without showing any sign of reduced effectiveness. The material has a high molecular weight and a very low vapor pressure, thus it is not prone to evaporation. Unless removed by cleaning, it will probably outlast the service life of the electronic equipment on which it is used. The **Stabilants** do not affect elastomers save for some slight swelling on some materials. We don't recommend the use of **Stabilants** on deposited-carbon-film or resistive-paint-film type potentiometers, or on power switches where there is enough inductance in the load to cause a spark when the contact opens. The **Stabilants** do not contain any silicones.

Revision 3

Stabilants are a product of Dayton Wright research & development and are made in Canada

NSCM/Cage Code - NATO Supply Code 38948

15 mL of S22A has NATO Part # 5999-21-900-6937

MATERIAL SAFETY DATA SHEETS ARE AVAILABLE ON REQUEST
