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**Number 41**

## **APPLICATION NOTE**

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### **Repair of Flood-damaged Electrical/Electronic Gear using Stabilant 22**

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#### **Introducing Stabilant 22**

Stabilant 22 is an initially non-conductive block polymer that when used in a thin film within contacts switches to a conductive state under the effect of the electrical field. The field gradient at which this occurs is set such that the material will remain non-conductive between adjacent contacts in a multiple pin connector environment.

*Thus, Stabilant 22 provides the connection reliability of a soldered joint without bonding the contacting surfaces together!*

Contacts are generally the weakest link in any piece of electrical/electronic equipment whether it be in low current devices found in computers or higher current circuits found in automotive and aviation applications, to name only a few. The use of Stabilant 22 or its isopropanol-diluted form, Stabilant 22A, will make contacts from 10 to 100 times more reliable, eliminating costly service call-backs and ensuring customer satisfaction.

#### **Background**

Many pieces of electrical or electronic equipment can be repaired after being immersed in flood waters. The basic work is not difficult, although there will be components within the equipment which may not be repairable except by experts, or where contamination by chemicals, pollutants, or particulate matter, may render a refurbished component unsafe. The former is usually the case with hard disk drives, and an example of the latter might be the removable disk drive types used in computers. In this note, we introduce Stabilant 22 and considerations for equipment that can be restored after a flooding event.

#### **Precautions regarding sewage contamination**

Equipment that has been submerged in flood waters should be considered contaminated, including with harmful micro-organisms from sewage. Salt water flooding is in most cases more problematic than fresh water, adding corrosion to the sanitary concerns.

A precautionary rinsing with isopropyl alcohol will generally disinfect circuit boards from electronic equipment without damaging components although semi-sealed items such as potentiometers may have to be replaced. Isopropyl alcohol can also be used on metal parts and cases, although with some finishes and paints a test should be made to make sure that the alcohol won't damage the finish. In some instances, one of the home disinfectant sprays may be used, but again, test for possible damage to finished surfaces.

For the same reasons, precautions should be taken when handling such equipment to avoid infection – sharp edges can be dangerous when coliform bacteria are present, and all such infections should be taken seriously - a tetanus shot might be required!

## **Connector problems**

These may be present from the moment the equipment is re-assembled or they may not show up until later. But in any event, they may often be of an intermittent nature and thus difficult to trace. Stabilant 22 can be used to prevent or solve these problems. The following sections explain the use of this product in some detail.

## **Other problems**

Most electronic equipment, including that used on cars, trucks, farm machinery, communications, and in home entertainment can be successfully repaired providing certain procedures are followed. When in doubt, contact the manufacturer.

We begin with refurbishment of the more complex electronic equipment. As you'll understand, many of the techniques relating to the electronics will be similar in multiple situations. Here we outline the steps required for many of the systems and equipment one may encounter.

## **Metal components including electronic chassis and cases**

Here the enemy is corrosion and exposure to air of water-soaked equipment can increase this problem. Often a consideration as to repairability is the ease with which the electronics can be removed from their enclosures.

Where equipment housings contain accumulated silt, the use of warm water and detergent might be needed to free-up the electronic components. Remember though that the detergent will also remove any oily film from the metal parts which could be protecting them against rusting.

Therefore, it may be necessary to spray the metal parts, housings, cases etc. with a good water-displacing penetrating oil to protect them while the electronic components are being treated.

Avoid the use of oils containing silicones. While these could be effective in displacement of moisture, they can cause problems with connectors and could interfere with repainting any metal components.

## **General comments on cleaning circuit boards and connectors**

Whenever detergent and water is used to clean circuit boards or connectors, these should be rinsed off thoroughly such that no detergent residue is left. Make sure that any card-edge connectors or other connectors are not at the bottom of the board (where they will accumulate any material dissolved in the rinse water).

This is necessary as some detergents will leave a hygroscopic (water-attractive) film on the surface of the circuit board or connector. If such a film is too thick, can cause leakage currents at the impedances involved with some sensors. However, a small amount of anti-spotting agent (itself usually a surfactant) can be added to the second-to-last rinse is spotting is a problem.

## **Removal and cleaning of circuit boards**

Disassembly must be done carefully because of the potential for damage of components by static electricity. Often silt will have penetrated under ICs especially if they are socketed (as may be the case with microprocessors). The use of running warm water and detergent (or surfactant) might be needed to remove these deposits.

Obviously, any plug-in boards will have to be removed from the mother-board. It is advisable to make a note of the name (part # or serial #) for each board as they are removed. What might seem obvious at the time may not be so easy to remember later. This caution also applies to any wiring-harness connectors in the system. Wires can be tagged using surgical tape until such time as a listing can be made. A rough sketch of each connector location can often save hours of work later on.

Memory modules (SIMM's, DIMM's, etc.) should be removed from the motherboards and here again, be sure to note which socket each belongs in. When removing socketed IC's, remember that it may be difficult to pull those with a large number of pins; an insertion/extraction tool should be used to avoid damage to the IC or the circuit board.

Boards should be dried, preferentially without use of high-pressure air which could drive particulate contaminants into inaccessible locations. A hair dryer with a low heat setting may be sufficient, but it should not be directed at a heat-vulnerable component at close range. Avoid touching any component or circuit board trace with any part of the dryer. While drying, PCB's should be on an anti-static mat.

Wiring harnesses will often hold moisture and must be dried out before being reconnected. Where, as in the case of computer power supplies, the wiring may be soldered to a board (inside the supply's case) it's rarely necessary to disconnect it.

## **Power supplies - transformers and inductors**

Both switching-mode and conventional power supplies may contain transformers. Some transformers have windings which are not impregnated with a sealant during manufacture. If you turn on a power supply without first drying this type of transformer, an electric shock hazard could be created by an electrical breakdown between windings. Again, low heat (100 to 130°F), should work.

## **Electrolytic-type filter capacitors**

Although electrolytic filter capacitors are metal cased, most have a small vent (to prevent pressure buildup in case of overload) which might admit moisture. Some of these capacitors' seals are designed only to prevent a build-up of internal pressure and should not admit moisture. Often the only practical way to be sure that a capacitor has survived immersion is by testing, or by actually applying power to the supply.

In this case, be sure that you won't be exposed to flying debris, should a bad capacitor rupture its case explosively.

## **Fuses**

In every case, don't attempt to replace a fuse that blows with a larger one, whether in power circuits or smaller ones. This is especially likely to be due to a short circuit in the equipment when flood damage has occurred, including possibly the large capacitors just mentioned.

## **Cooling fans**

While on the subject of power-supplies, remember that many power supplies contain their own cooling fans. Many styles of motors have been used over the years and the type determines the action to be taken. Some sealed units should be replaced, while others can be serviceable. If the fan doesn't turn freely, it may be packed with silt and require cleaning. Again, depending on the type of bearings used, replacement of a fan assembly may be the more cost-effective solution.

## **Hard disk drives in computers**

HDD cases are sealed, with only a tiny vent, usually via a small filter. Depending on the depth to which the drive was submerged, the sealed cases could have become contaminated with water or particulate material. Your best bet is to contact the manufacturer of the hard-disk drive to obtain the name of a reputable data-recovery service. Drive platters may need to be removed in a clean room to avoid damage from grit, etc. It is important to avoid any attempt to power up the drive until this possible need is determined.

## **Removable media (floppy/CD/DVD) drives**

The cost of these is such that you may be far better off replacing them rather than risk damage to a disk because of residual contamination. It only takes one bit of grit to ruin a floppy disk or to scratch a DVD. The manufacturer may provide information specific to a drive if you wish to restore it.

## **Keyboards**

Depending on the type of key-switches used, these may be repairable. However, the cost of a typical PC-clone keyboard is low enough that refurbishment may not be worth the time involved. If in doubt, call the manufacturer.

## **Telephones and smart phones**

In the case of land-line telephones, repairability can be dependent upon the type of microphone and/or handset used; most of these are modular and it might be cheaper to replace the handset.

Smart phones and other cellular phones vary in their potential to be restored, according to model and brand. Even “user-replaceable” batteries are being phased out by many manufacturers. The specifics of non-factory repair of smart phones are beyond the scope of this note.

## **Electric typewriters**

In the case of most electric typewriters, the same procedure can be followed for mechanical parts as is used for re-conditioning of older typewriters. Remove the cover to access any fuses, motors, print-heads, and circuit boards. Remove any rubber drive belts, platens and rollers. If cog-type belts are present, mark these and their pulleys so that they can be replaced in the identical position. Some rubber components can become brittle and should be replaced; otherwise, clean these with warm water and a mild detergent, rinsing thoroughly.

Clean the mechanisms as needed (hot water and detergent may suffice). A small amount of solvent may be used if tar, grease or oil contamination is hard to remove. Use great caution with proprietary de-greasing sprays, as some of them contain caustic agents (which convert oils to soap-like materials) can damage electronic and mechanical parts. Rinse and re-oil mechanical parts using a penetrating oil (avoiding belts and pulley edges).

Clean out the motor with a solvent such as isopropanol. Let the motor air-dry, avoiding open flames and ensuring good ventilation during this process. Reassemble and test the motor before reconnecting any drive belt or gear linkage.

## **Computer printers**

Laser printers are much more difficult to repair. The order in which they are disassembled is often quite important, and it is not unusual to find that special jigs and fixtures must be used to insure proper alignment of certain components. If you don't have these and the technical manuals, we suggest you contact the manufacturer.

Dot-matrix and daisy-wheel printers can be treated much the same way as electric typewriters. Print-head replacement may be needed for a dot-matrix unit.

Inkjet printers will require replacement of water damaged ink cartridges, along with print heads, for printers in which these are separate from the ink tanks. After removal of any electrical components or circuit boards, clean the mechanical components and re-oil as necessary. Optical encoders used in some printers should be checked and carefully cleaned if needed. Replace the dried electrical components and install new cartridges. As before, when in doubt, call the manufacturer!

## **Communications equipment, including avionics, CATV, mobile, etc.**

Stabilant products have been used in the manufacture and maintenance of these types of equipment for many years. Please contact us if you have any questions. Also refer to our other application notes that cover particular situations and equipment.

## **Electrical dispatch, switching and process control equipment.**

Again, Stabilant 22 has been used in the repair and maintenance of these types of equipment for many years.

## **Automobile, Truck and Farm Machinery electrical problems**

Most electrical/electronic problems will be related to either immediate or delayed connector malfunctions, especially with equipment that relies on computer-control modules and the numerous connected sensors. One must check that any small sensor ports (to intake vacuum and the like) are free of obstructions, that wiring harnesses are reasonably dry and that the mechanical assemblies are free of contamination and properly lubricated, and that any control modules have not been damaged physically. A systematic cleaning and treatment of the electrical and electronic connectors may have to be done before considering faults to originate in the control modules themselves.

In addition to the sensors, all electrical contacts on wiring harnesses should be treated. Headlight connectors, fuse holders, dashboard connectors (for dashboard lights, gauges, etc.), turn-signal switches and screw terminals should be treated with a drop of Stabilant 22A. In short, most electrical connection problems can be fixed or prevented by applying Stabilant 22 or 22A.

## **Other types of equipment**

Stabilant products can also be used on connectors and switches in home appliances. This includes safety interlock switches and program selectors' contacts on electric dishwashers, washers and dryers. This applies to connectors in general, and particularly screw terminals and tab connectors. The appliances mentioned are not only prone to flood damage, but normally 'live' in a humid environment.

Stabilant products have proven very effective in improving the reliability of connectors in general and have developed a reputation for ease and speed of use under field conditions. Some OEM's are pre-treating sensor connectors during manufacture, and many are providing the Stabilant Service Kits to their service technicians either as Standard Store items, or recommending them for field procurement.

Stabilant 22 is presently used in applications ranging from avionics through process control, including such critical fields as biomedical electronics, air traffic control, police/emergency communications and the like.

## **How does Stabilant 22 work?**

Since contact failure is rarely caused by a single factor, Stabilant 22 was designed to prevent corrosion, reduce mechanical wear on contacts and to lower total contact resistance. Treatments that solve only one problem don't necessarily offer a reliable long term solution. For a product that is only a cleaner, only a lubricant or only a corrosion inhibitor will not address all of the issues. For example, corrosion inhibitors are neither cleaners nor lubricants and are often specific to one type of metal or plating.

Some products also introduce long term problems; unsaturated oils used as contact treatments can cross-link under the influence of elastomer or thermoset plastic curing agents. Stabilant 22 does not varnish or evaporate, remaining stable for many years in service to prevent the entry of outside contaminants and moisture due to temperature cycles and vibration.

Small amounts of corrosion products can even be lifted and suspended due to the surfactant property of Stabilant 22. Its lubricating property prevents fretting of contact surfaces given those same stresses. Finally, a brief description of Stabilant's effect of lowering contact resistance is in order.

On a microscopic level each contact face has a peaks-and-valleys appearance which allows a multitude of metal-to-metal contact zones – an array of parallel low-resistance contacts. The thin film of Stabilant 22 allows these to be undisturbed. In the 'valleys', due to its high dielectric constant, it will act to form a capacitive layer in parallel with whatever residual resistance exists, improving the passage of AC signals.

In the narrowest spaces (near metal-to-metal contact zones), Stabilant offers additional conduction due to surface effects and quantum tunneling and thus limit the overall resistance of the contact pair to its best serviceable level.

## **In what forms is Stabilant available?**

Stabilant 22 is available in several forms and sizes. As a concentrate it is simply called "Stabilant 22". Alcohol-diluted formulations are Stabilant 22A (25% concentrate and 75% isopropanol) and Stabilant 22E (as with 22A, but diluted with ethanol). 5mL, 15mL, 50mL, 100mL, 250mL, 500mL and 1 litre sizes of the concentrate are available. One of our most popular products is the 15mL Stabilant 22A Service Kit - this also includes micro-brush applicators and an instruction sheet, in a capped tube for convenient stocking, bench and toolbox use. For industrial/bulk users we offer Stabilant 22S. This provides a bottle one-fifth filled with concentrate (usually a 50mL bottle); the user can add isopropanol (to get the equivalent of Stabilant 22A) or any desirable choice of a diluent. The smaller sizes (5mL, 15mL and 50mL) are in dropper bottles for easy dispensing. A 0.5mL sample size and other sizes are available on request.

## **Is Stabilant 22 cost effective?**

As Stabilant 22 can be quickly applied to all contacts and connectors in a system, the often difficult diagnostic determination as to which one of many contacts are erratic can often be eliminated. This can significantly reduce service time in the field and in many cases eliminates the need to return boards for shop service or remanufacturing.

As any service manager knows, the diagnosis of electronic problems, especially where intermittent failures are concerned, is often much more difficult than the actual part replacement, requiring service personnel of exceptional caliber. In many cases the use of Stabilant 22 can improve the efficient use of staff time, allowing many connector-related problems to be handled at a much lower cost.

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**

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