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APPLICATION NOTE

Repair of Flood-Damaged Electrics & Electronics using Stabilants

- *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, due to contamination by chemicals, pollutants, or particulate matter, a refurbished component may not be safe. The former is usually the case with hard-disk drives, and an example of the latter might be the floppy disk drives—both used in computers.

- *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. **Stabilants** can be used to prevent or solve these problems. We'll explain the use of this material 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'll 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 any event. While not all will be applicable to things such as automobiles, etc., let's go over some of these steps

- *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 reparability 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 uses 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 and if the film is too thick, can cause leakage currents at the impedances involved with some sensors. However, a small amount of anti-spotting agent (itself a surfactant) can be added to the second-to-last rinse if spotting is a problem.

- ***Removal and cleaning of circuit boards***

Disassembly can be somewhat tricky 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.

SIMMs should be removed from the mother-boards and here again, be sure to note which board went where. In the case of ICs you must remember that it may be difficult to pull an IC with a large number of pins—without damaging it or the circuit board.

Boards should be dried, preferentially without use of high-pressure air which may not only damage components, but which could drive particulate contaminants into inaccessible locations. A hair dryer set on low heat may be sufficient providing it is not directed at a heat-vulnerable component at close range. Try to 'ground-out' the circuit board by using one of the conductive rubber mats. Avoid touching any component or circuit board trace with any part of the dryer.

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

- ***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 attempt to turn-on a power supply without first drying this type of transformer, not only can they short-out, but an electric shock hazard could be created in the event that there is an electrical break-down between windings. Again, low heat, in the range of from 100 to 130°F, should work.

- ***Electrolytic-type filter capacitors***

Although electrolytic filter capacitors are metal cased, some have a small vent which might admit moisture. Since this vent is necessary to release any internal pressure which would occur in the case of an overload, some of these capacitors employ a sealing system designed only to prevent a build-up of internal gas pressure and should, therefore, not admit moisture. Often the only way to make 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 in the event that the capacitor has shorted out internally, for it might rupture its cases explosively.

Don't attempt to replace a fuse that blows with a larger one. If it blows it is usually better to assume a capacitor has shorted-out.

- ***Cooling fans.***

While on the subject of power-supplies, remember that many switching-mode power supplies contain cooling fans. These may be of the sealed-coil type; removal of the rotor can usually be accomplished by the use of a Circlip tool. If the fan doesn't turn freely, it may be packed with silt and require cleaning.

- ***Hard-disk drives as used on computers***

This is a tough one. While the cases are 'sealed' they are also vented, usually through a small filter. Depending on the depth to which the hard-disk 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. Follow their instructions as to packing and shipping to the letter as improperly packed drives may damage the internal storage media!

- ***Floppy-disk 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!

- ***CD, CD-ROM and other optical drives***

Contact the manufacturer or the manufacturer's service center.

- ***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***

The reparability can be dependent upon the type of microphone and/or handset used. If the rest of the phone can be refurbished, it might be cheaper to replace the handset.

- *Typewriters, laser-type printers, and printers*

In the case of most electric typewriters, the same procedure can be followed as is used for re-conditioning of older typewriters. Remove the case if possible. Remove any fuses, motors, print-heads, and circuit boards. Remove any rubber drive belts, platens and rollers. If cog-type timing-belts are present, mark their position with respect to the pulleys so that they can be replaced in the identical position. Clean these parts with warm water and a mild detergent, rinsing thoroughly. Clean the typewriter of silt and crud using hot water and a good detergent. A small amount of kerosene may be added to the wash water if grease, tar or oil contamination is hard to remove. Use proprietary de-greasing sprays with great caution as some of them are caustic agents which convert greases and oils to soap-like materials. These materials can also cause damage. Rinse and re-oil any mechanical mechanism using a penetrating oil (making sure that it does not get on any pulleys). Clean out the motor using a solvent-type cleaner such as isopropanol, using it in a well ventilated area. Let the motor dry. Do not expose it to hot heating elements or open flame when drying. Reassemble and test for mechanical hang-ups. Before re-connecting the drive motor belt or gear linkage, check to sure that the motor runs properly.

Laser-type 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 don't have a technical manual, we suggest you contact the manufacturer.

Dot-matrix and daisy-wheel printers can be treated much the same way as typewriters. In the case of the former, you may have to replace the print-head.

Fluid-ink-jet printers. Obviously you'll throw away any ink cartridges. After removal of any electrical components or circuit boards, clean the mechanical components and re-oil as necessary. Replace the dried electrical components and use a new set of cartridges. As before, when in doubt, call the manufacturer!

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

Stabilants have been used in the manufacture and maintenance of these types of equipment for several years. Contact us if you have any questions.

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

Again, **Stabilants** have been used for several years in the repair and maintenance of this type of equipment.

- *Automobile, Truck and Farm Machinery electrical problems*

We'll confine our suggestions to the electrical and electronic areas of this equipment. Most of the problems will be related to either immediate or delayed-action connector malfunctions, especially with equipment that relies on computer-control modules connected, as they are, with numerous sensors. On the assumption that any small sensor ports (to intake vacuum and the like) are free of obstructions, that the wiring harness itself is reasonably dry and that the engine, transmission, differential(s), steering gear, brakes and wheel bearings 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 problems can be considered to be the fault of the control modules themselves.

In addition to the sensors, all electrical contacts on the wiring harness should be treated; everything from head-light connectors, fuse holders, dashboard connectors (such as for dashboard lights, gauges, etc.) to turn-signal switches. (Remember, switches can be subject to corrosion too). Screw terminals too should be treated with a drop of **Stabilant 22A**.

In fact most of the electrical-connection problems can be fixed or prevented by using **Stabilants**.

- **Other types of equipment**

The **Stabilants** can also be used on connectors and switches in home appliances such as on the 'program' contacts on electric dishwashers, washers and dryers. This applies to connectors in general, irrespective of whether they are screw terminals, tab connectors or other types.

- **What is Stabilant 22?**

Stabilant 22 is an *initially non-conductive* 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 *non-conductive* 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** can provide the connection reliability of a soldered joint without bonding the contact surfaces.*

- **Where can Stabilant 22 be used?**

Stabilant 22 can be used in all types of connectors, at frequencies from DC to several gigahertz, on faders or potentiometers, or in non-inductive (non-arcing) power-interrupt switches. The number of uses are almost limitless.

- **Is Stabilant 22 just another contact cleaner?**

No, **Stabilant 22** is a *resident* potentially *electrically-active* material which through a synergistic combination of effects 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.

- **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 re-manufacturing. 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; as well as requiring service personnel of exceptional caliber. In many cases the use of **Stabilants** can thus increase the efficiency of existing staff as well as allowing many connector harness related problems to be

handled at a much lower cost. How can Stabilants correct electrical contact problems?

In many electronic applications demodulation (detection) of RF signals in connectors exhibiting thin-film rectification effects can either reduce the signal-to-noise ratio or introduce artifacts which can disrupt data flow. **Stabilants** can cure these.

While **Stabilants** have demonstrated that they can cut the cost of both shop and field maintenance; their use in the manufacturing of electronic systems can speed up production as well as reducing rejections.

- *How does Stabilant 22 work?*

Contact failure is rarely caused by a single factor. Thus, treatments that solve only one problem don't necessarily offer a reliable long term solution. For example, cleaners do not prevent the re-entry of contaminants or the reformation of contaminant films; nor do they offer any lubrication. They must be used each time a connector gets dirty. Lubricants in themselves are rarely cleaners. Corrosion inhibitors are neither cleaners nor lubricants and are often specific to one type of metal or plating. Unsaturated oils used as contact treatments can cross-link under the influence of elastomer or thermoset plastic curing agents and accelerants.

While resident in the connector, **Stabilant 22** performs several concurrent functions. Its very presence in the contact gap will prevent the entry of outside contaminants. It has sufficient surfactant action to lift surface contaminants and hold them in suspension. In cases where corrosion products are present **Stabilant 22** will penetrate them and prevent rectification effects. Due to its high dielectric constant it will act to form a capacitive layer which is in parallel with whatever residual resistance exists in the contact increasing the passage of AC signals. Given sufficient DC bias within the gaps of the contact the thin film of **Stabilant** will "switch", conducting by quantum tunneling and thus limit the resistance of the contact to a serviceable level.

- *In what forms is Stabilant available?*

The **Stabilants** are available in two forms; as a concentrate (**Stabilant 22**) and as an isopropyl alcohol-diluted form (**Stabilant 22A**). Because of the 4:1 dilution, a given size container of **Stabilant 22A** will cost about one-fifth the amount of a container of **Stabilant 22** as it contains only one-fifth the amount of the concentrate.

- *What is the difference in use of these materials?*

Stabilant 22 is most useful where the connections are out in the open - such as card-edge connectors or where the lubricating properties of the material are useful - such as an aid to installing microprocessor IC's or on switches. 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**). The isopropyl alcohol diluant serves ONLY to carry the concentrate into the connector.

The **Stabilants** have proven to be very effective in improving the reliability of connectors in general and are developing a reputation for ease and speed of use under field conditions. Not only are many OEM's pre-treating sensor connectors during manufacture, many are providing the **Stabilants** to their service technicians either as Standard-Store items, or recommending them for field procurement.

The **Stabilants** are presently used in applications ranging from Avionics through Process control, including such critical fields as Bio-medical electronics, Air-Traffic Control, Police & Emergency communications and the like.

- **How are the Stabilants applied?**

The application of the **Stabilants** is exceptionally easy. Just use a drop of two of **Stabilant 22A** on one of the electrical or electronic sensor connectors, including any other in-signal-path connector in the wiring harness, and reconnect the system.

- **What packaging is available?**

We can supply the concentrate (**Stabilant 22**) in 15mL, 50mL, 100mL, 250mL, 500mL and 1 Liter bottles. The dilute (**Stabilant 22A**) is available in 50mL, 100mL, 250mL and 500mL containers. We do not have a 1 liter container of the dilute as 500 mL is the largest size bottle that can be shipped by air (in single or multiple packages) without additional restrictions. We maintain our stock in depth and ship most orders the same day they are received. The 15 mL sizes are in dropper bottles, and these are available on request for the 50 mL sizes as well.

- **Is it available in a spray can?**

No. Why waste the material? We would like to think we are environmentally responsible and safety conscious. We use no CFCs, HCFCs or any other ODC (Ozone Depleting Chemical) either in or in the manufacture of **Stabilants**.

*In addition even **Stabilant 22A** has only about 1/200th the solvent impact as conventional contact cleaning solvents over a three year time span. As **Stabilant 22** contains no solvent it has absolutely minimal environmental impact and is, therefore, becoming the treatment of choice for many service organizations!*

- **Just how much should be used?**

Normally, a final film thickness of from 1/2 to 2 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. When using **Stabilant 22A**, use enough so that once the isopropyl alcohol evaporates the desired 1/2 to 2 mil film of **Stabilant 22** remains.

In applications to moving surfaces, such as in slip-rings or potentiometers, film thickness should be minimized to the point where "hydroplaning" won't occur.

- **What is the 15mL service kit?**

This was made up at the request of several manufacturers who wanted a standard kit that they could issue to their service personnel. It consists of a 15ml dropper bottle of **Stabilant 22A** and some applicators, all in a small capped cardboard tube that can be tossed into a tool box without damage.

- **Does the action of Stabilant deteriorate with age?**

In some field trial applications lasting over ten years **Stabilant 22** has shown no sign of reduced effectiveness. With a high molecular weight and a very low vapor pressure, almost none of the material will be lost by evaporation. Unlike some other contact protection oils, **Stabilant 22** will not cross-link when exposed to free-machining materials such as high-sulphur brass, or when used on contacts where agents used to promote cross-linking of thermosets or elastomers are present in the environment or in the actual connector components. Thus **Stabilant 22** does not form a scum or "varnish".

- **CAUTION — SEWAGE CONTAMINATION!**

Quite frequently equipment that has been submerged in flood waters will have become contaminated with fecal or other harmful bacteria. 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 on the metal parts, but again, test for possible damage to finished surfaces.

For the same reasons, precautions should be taken when handling such equipment to avoid infection! And all such infections should be taken seriously as tetanus shots might be required!

D.W. Electrochemicals Ltd. has NSCM - Cage Code / NATO Supplier Code 38948
15 mL of Stabilant 22a (isopropanol-diluted) has NATO Part # 5999-21-900-6937
15 mL of Stabilant 22 (concentrate) has NATO Part # 5999-21-909-9981

The Stabilants are patented in Canada - 1987; US Patent number 4696832. World-wide patents applied for. Because the patents cover contacts treated with the material, a Point-of-sale License is granted with each sale of the material.

MATERIAL SAFETY DATA SHEETS ARE AVAILABLE ON REQUEST

NOTICE

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