

# COMMLINE

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# "100% or ZERO SPARE PARTS?"

## (A Maintenance Engineering Method)

*This is the conclusion of a two-part article discussing the pros and cons of zero spare parts inventory. The first article was published in the Sept/Oct 1986 issue of COMMLINE.*

By Howard C. Cooper

**METHODS WHICH INCREASE MTBF**  
Maintenance Engineering efforts and expense should be focused FIRST on methods and means to eliminate the stresses which cause malfunctions and failures rather than fighting fires and stocking expensive spares, some of which may never be used.

Although elimination of these above stresses from your systems may require technical assistance, we will list basic methods for eliminating them.

### ELIMINATE POWER SURGES AND TRANSIENTS

Transients are generated by nature and by man. Power company grid switching to regulate power distribution will cause irregular but frequent disruptions and contamination to A.C. power. Transients at a 120 V.A.C. wall outlet can rise to 6,000 Volts within a few nano seconds (X10-9th), do its damage and be gone within 10 to 50 microseconds (X10-6th). This is so fast they can not be seen on the average oscilloscope. Since this same A.C. power must now feed computers and electronic equipment, which are sensitive to and react negatively to these power disturbances we must condition "commercial grade power" to get "computer grade power".

There are several devices on the market, each conditioning power in different ways: transient suppression devices, regulators, isolation transformers, generators (isolation and sustaining), voltage synthesizers, LC filters, RC filters, dedicated lines, special grounding, and uninterruptable power supplies (U.P.S.). When purchasing or

considering the many types of power conditioning equipment, the erroneous and disastrous assumption is often made that, "The more money I spend on a device the more assured I will be of eliminating my computer and electronic equipment problems". Not so. Power conditioning device costs range from \$100.00 to \$300,000.00. No single device can be considered a "cure all." In general, the above mentioned devices were designed, each, to solve a specific problem. While each being partially or completely effective at solving a specific problem, they will have little effect on other types of power disruptions. No matter what the cost, if your problem is not the right one for the applied power conditioning device, it will be a wasted effort. However, in typical computers, computer numerical controls, robotics, automation controllers, etc., power conditioning devices such as regulators, filters and isolation transformers are most often already built in. The most frequent missing link is effective TVSS (Transient Voltage Surge Suppression) devices.

Voltage "spikes", current surges and voltage transients, are the most frequent power disturbances, occurring hundreds of times per month. TVSS is a new and progressing corner of the power conditioning industry. Properly engineered TVSS network devices (many on the market are not properly engineered) have shown themselves to be the most cost effective way to eliminate most computer malfunctions and failures. TVSS networks are rarely built in because the technology is new and because of price competition in the small computer industry. Most National and International Engineering Societies and governing bodies have written Transient Suppression testing and application standards, such as: I.E.E.E.-587, UL-1449, CSA, FCC Transient Standard, National Bureau of Standards, etc. IBM's PC Magazine pointed out recently that 90% of Personal Computer problems can be avoided (eliminated) by applying well designed TVSS plug strips. The IBM-PC, however, has no TVSS built-in, nor do most other PCs,

except for the IBM-PC industrial hardened version which costs some \$2,000 more than the regular PC. A good TVSS plug strip costs about \$100.00.

Whereas individual suppression components each have limitations and strengths, this writer has been most successful by applying EFI Corporation TVSS networks which combine advantages of high-speed and high energy suppression with voltage filtering and RF trapping.

### DEDICATED LINE AND GROUNDING

A dedicated line is not a power conditioning device but should be mentioned here because it is so widely used and often expected to perform as a "cure all" for computer and electronic equipment problems. A dedicated line is nothing more than a separate power line brought directly from the main distribution power panel to the electronic system in question. What this does is avoid the possibility of power disruptions caused by other pieces of equipment on that same line. It does not stop disruptions coming from the utility company lines, mother nature, or other equipment fed by the same main distribution panel. One of the best effects of putting in a dedicated line is it provides also a dedicated ground from service entrance (source) to the computer system (load). By providing improved grounding, common mode problems can be avoided and suppression equipment will operate more effectively.

### ELIMINATE HEAT

In any given electronic controller there is a mix of integrated circuits, transistors, diodes, and other components, all of which have varying heat tolerances. Therefore, the cabinet temperature must be controlled to satisfy the components with LOWEST temperature failure limits. A marked increase in operating stability and a decrease in maintenance downtime can be achieved if ambient temperature inside control cabinets is held

between 75 to 100 degrees F. When electronic cabinets exceed 110 DEGREES F. malfunctions start to occur. 115 to 120 degrees starts to bring about hardware failures. Additional air conditioning or destratifying fans will cure these problems. During AMEMCO surveys small \$25.00 Wahl Corporation thermometers, with magnetic mount base and peak holding needle, are mounted in electronic cabinets to detect cabinets with temperature problems. Care should be taken not to over rate B.T.U. capacity of air conditioners and not to mount so cold air blows directly on circuit boards.

## ELIMINATE DIRT BUILD-UP

Many electronic control cabinets, even recent models, are insufficiently sealed against contamination. This weakness can be detected by a rapid buildup of oily dirt or black dust on circuit boards. Contamination can enter through wire ducts, vent panels, around switches and around door edges if improperly sealed. Contamination buildup will cause resistive paths, shorting between wires and board traces, intermittent disruptive failures and finally permanent hardware failures.

Often times (even among name brand manufacturers) cooling is achieved by circulating shop air through the cabinet. This practice may get you through the new equipment warranty period, but it is not adequate in many environments for long term reliability. Dirt packs around and over components preventing them from eliminating heat. Dirt also contributes to corrosion problems. After sealing cabinets it may be necessary to aid circulating fans or an air conditioner to keep temperatures below 100 degrees F. Foam rubber strips with adhesive backing are readily available for sealing around doors and panel edges. Duct Seal or any non-flammable flexible material should be used to seal around cable holes and knockout holes in the bottom or top of the cabinets.

## ELIMINATE VIBRATION AND OXIDATION

Electronic controllers and computers suffer when subjected to excessive physical vibration. The results are three-fold:

1. Circuit boards gradually vibrate out of their sockets, resulting in intermittent or lost connection,

which can cause machine crashes, jumping or runaways.

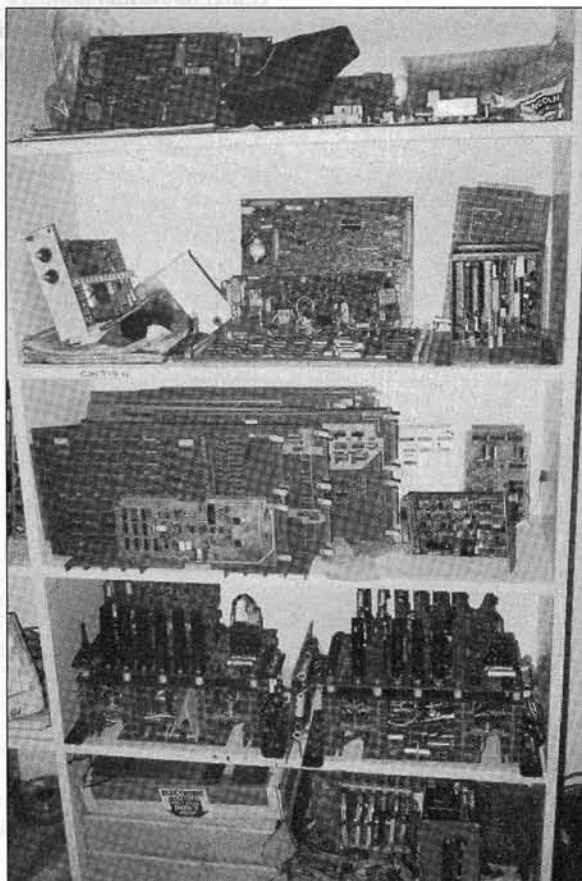
2. Continued vibration can actually shear component and lead connections.
3. Vibration causes slight movement on all friction connections, such as circuit board socket connections and plug socket connections. This slight movement can cause the friction connection to move from an area of low resistance (good connection) to an area of oxidized high resistance (bad connection).

Numbers 1 and 2 can be solved by placing shock mount pads under the control cabinet or using rubber center vibration isolating bolt mounts. This writer has seen several instances in the field where both of these problems were occurring on brake presses, shears and numerical control machines. The maintenance personnel had grown accustomed to repetitive failures and accepted them as "normal maintenance". However, when proper shock mounting was installed, the electronic maintenance dropped to zero.

Number 3 may exist when No. 1 and 2 are not noticeable. It may result from slight vibration, but can also result from simple aging of friction connectors. This can be cured by using the proper deoxidizing agent on friction connectors. Again, several field case instances have been observed where oxidation buildup on older controls had become so troublesome that a control retrofit was being considered. With the proper application of a contact cleaning solution and deoxidation treatment, however, complete reliability was restored to the controls. Normally, application of any solution to circuit board connectors or plug pins is prohibited or discouraged for the following reasons:

1. Some solutions may clean the contact, but cause faster oxidation in the future.
2. Other solutions may prevent further oxidation buildup, but will not remove existing oxidation and will leave a thin film which will attract dirt and iron-dust buildup.

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Near 100% spare electronics for a Cincinnati Milacron, Cinturn<sup>TM</sup> CNC Lathe. If solid state boards never fail, why stock spare parts? If boards have a history of failing, something should be done to eliminate the stresses causing the failures.

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3. The common use of an eraser to remove dirt and oxidation from pins and circuit board edge pins is discouraged, as the friction of the eraser will rapidly wear through thin layers of gold or silver plating, thus ruining the conductive surface.

There is, however, one solution which has been proven effective in field application to remove oxidation and prevent future oxidation buildup and which does not wear away or corrode material. If used according to the manufacturer's recommendation, it should not leave a film to attract dirt. This solution is Cramolin Red from Caig Laboratories Inc. Cramolin should be used rather than an eraser when reseating, replacing and cleaning circuit board edge connectors, cable connectors, jumper pin contacts, etc.

## POTENTIAL RESULTS

Cost containment and increasing productivity without increasing personnel count is today's goal of every

company. As more and more automation equipment is installed, the key to achieving this goal is to increase reliability and productivity of automation equipment, not people. AMEMCO has helped many companies achieve this goal.

If stresses are eliminated—frustration goes down while reliability and productivity go up. Over the past twelve years this writer (maintenance engineer) has come full circle from believing 100% spare parts were a maintenance necessity to now recommending near ZERO spare parts inventories. As one of the early NC maintenance engineers for the fifth largest manufacturing company in the U.S.A. this maintenance engineer established the practice of purchasing spare CNC and PC controllers to allow 100% spares, off line troubleshooting training aids and fewer maintenance delays. These costs were quickly justified based on frequency of use of spare modules and boards. Downtime dropped dramatically and positive corporate recognition was given to these methods. Today this same engineer shows many companies, as a consultant, how they can and should buy no initial spare part inventory. At the same time your facility can enjoy longer MTBF supported by fewer maintenance personnel and while suffering fewer maintenance

frustrations. This is done by paying more attention to good "fire prevention" techniques rather than paying total attention to "fire fighting" techniques. It is always better to build a "road-guard rail at the top of a cliff" than to place "an ambulance at the bottom of the cliff". Although maintenance engineers may assist maintenance technicians, their first priority should be reducing downtime and increasing MTBF of computers and automation equipment.

Howard Cooper has a BS degree in Electronic Technology from Southern Utah State, graduating Magna Cum Laude and has done graduate work at BYU. He has worked the past twelve years in Manufacturing Industries specializing in Industrial Electronics. Mr. Cooper worked five years for John Deere Company pioneering their Numerical Control Maintenance Engineering program, and four years for Baker EIMCO-PEC as Electronic Engineer. He has enjoyed consulting, nation-wide, since January 1981. He has been honorary member of the National Advisory Board for "Electronics" Magazine, has presented papers at national conventions for the Society of Manufacturing Engineers and in Trade Magazines on "Maintenance and Reliability of Electronic Controls". He presently is participating on IEEE committees to establish guides for application and testing of transient surge protective devices.

ELIMINATE DOWNTIME

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Maintenance Engineering Products & Service

AMEMCO in-plant, seminar, equipment survey and the resulting program to eliminate stresses which cause malfunctions and failure should become first priority toward increasing equipment reliability and permanently cutting maintenance costs. You can hereby cut maintenance downtime and losses in half within 30 days for less than \$2,000 per NC or CNC machine tool, and less than \$1,000 per PC (Programmable Controlled) machine, Robot, etc.. This program is proven to net larger immediate and on-going savings with less effort than programs to initiate Predictive Maintenance, PM Programs, Training or Maintenance Management Computer Systems. Why? Because this is the only program that stops failures from occurring. A thousand spent on "fire prevention" always saves millions in "fire fighting" costs and fire losses. It is always better to place a guardrail at the top of a cliff than to place an ambulance at the bottom of the cliff. AMEMCO stands ready to help! Call Us Today.