

[Back to Index of Technical Papers](#)

## Archive of Technical Articles

# U.S., Mexico Pressure Maquiladora Companies to Implement Ozone-Safe Circuit Cleaning

by Michael Jones  
Micro Care Corporation, New Britain, CT USA

First Published: October 1991

As the Free Trade Agreement between Mexico and the United States edges closer to implementation, there is pressure on both sides of the border to insure that the environmental problems within both the U.S. and Mexico are being resolved. The rejuvenated and reinvigorated SEDUE, long a sleeping giant in Mexico, recently has become a vigorous defender of environmental and natural resources. This new emphasis is most obvious in the huge, multinational effort to protect the ozone layer by eliminating ozone depleting chemicals, and SEDUE and the Maquiladora electronics industry are playing an important part in this program.

The good news is that the alternatives are starting to come to market. Within the past two years materials finally have been proven to meet the standards of the electronics industry. This report summarizes recent developments in electronics cleaning with an eye towards a critical area that is too often ignored: benchtop cleaning after rework.

## Choosing a Cleaning Process for the Rework Area

The problem benchtop cleaning has two dimensions: the cleaning chemical and the cleaning process. Selecting the correct process is the more important decision, but the one most often ignored. Happily, there are three general guidelines upon which production engineers can rely when selecting a benchtop cleaning system.



The first suggestion is to find systems which minimize waste, which can be summarized as "sloppy housekeeping." Used sloppily, these chemicals are expensive and potentially dangerous, plus inefficient systems inflict hidden labor costs. They also tend to increase solvent consumption through waste, spills and

evaporation. If they can be eliminated then overall costs will be reduced.

Engineers should scrutinize processes which--

- Require workers carry, mix, pour or pump chemicals,
- Require employees to unavoidably touch or immerse their hands in the cleaning solvent.
- Create unwarranted fumes, such as in high-speed spray operations or open open-top pans, tanks or jars of solvents.

Another reasonable rule is to select the same material for benchtop cleaning that is used in the bulk cleaning process. This simplifies management throughout the entire organization. For example, using one type of material eliminates incompatibility problems with components. It minimizes inconsistencies in the cleaning results caused by the different chemistries. It allows buyers to save money by purchasing in greater quantities. It even helps minimize the housekeeping chores of waste disposal and worker safety programs. Find one cleaner and stick with it.

Search for processes which allow the technicians to perform all of their tasks -- especially cleaning -- at their workbenches. In many factories, workers routinely leave their benches to clean their assemblies. Workers enjoy these unofficial coffee breaks, but these breaks pulverize productivity. Enormous savings can come from systems that keep people at their workstations, doing what they are paid to do.

## Benchtop Cleaning Systems

Despite all the hype, there are only four methods for cleaning electronics at the workbench. These have been in use for a dozen years or more. Each choice has [certain advantages](#) and should be considered for certain applications.



**Automated Bulk Cleaning.** The best choice is to run all the boards back through the bulk cleaners. Bulk cleaning systems are usually small, benchtop cleaning machines with limited capacity. No other method which will provide such a high degree of consistent cleaning. Properly installed and maintained, every board will be cleaned to exactly the same degree. The obvious drawbacks include the number of machines required, plus the wasted labor costs, waste disposal costs, energy costs, fume handling costs and the cost of the solvent itself. But if the company can afford it, this is the best way to go.

**Dip-and-Brush Cleaning.** The "dip-and-brush" process is the cheapest method of circuit cleaning. This involves two simple parts: a small jar to hold the solvent and a brush with which to scrub. This method's main advantage is the low installation cost. Training costs are minimized,



too, because most technicians have learned dip-and-brush cleaning at one job or another. But the system is flawed because it hides the contamination on the board and does not remove it. In addition, the solvent quickly becomes contaminated, so the boards are cleaned even less thoroughly. With today's dense circuits and delicate components, the dip-and-brush method is obsolete.



**High-pressure aerosols.** High-pressure aerosols are a reasonable advance from dip-and-brush cleaning. These aerosols are packaged at 70 psi or more and the solvent flows faster than 3 milliliters per second. With pressures of this magnitude, the impact of the spray substitutes for the mechanical scrubbing action of a brush. Clean, uncontaminated solvent rinses the contamination from the board. The main negative to high-pressure aerosols is the cost. The prodigious use of solvent is expensive, messy and generates high levels of exposures to potentially toxic chemicals.

Because the chemicals are atomized in the spray, the use of combustible or flammable liquids is unwise, restricting aerosols to "safety solvents" containing chlorine -- that is, the ozone depleters.

**Controlled Dispensing.** Low-pressure aerosols with remote dispensing systems are a reasonable compromise for benchtop cleaning. They combine the scrubbing action of dip-and-brush with the convenient rinsing action of the aerosol sprays. By themselves, they lack the internal pressure to scrub the boards clean, so most manufacturers market specialized dispensers to provide the mechanical scrubbing action. This makes these systems slightly more expensive than plain aerosols but they offer reduced solvent consumption, faster cleaning (more boards per unit of labor) and the ability to use non-ozone depleting chemicals. The two remote dispensers on the market today are the Cobra Brush from Miller-Stephenson and the Trigger Grip from Micro Care. They differ in price, brush tips, ESD compliance and ergonomics, but both are a substantial improvement over crude, high-pressure aerosols.

### Ozone-Safe Cleaning Chemistries Are Becoming More Affordable



There are now a wide variety of proven solvents that can be used to clean PC assemblies and systems. This is a dramatic change from as recently as two years ago, when many new products were announced but unproven. Here's a run-down on the full array of choices, as seen from the perspective of benchtop cleaning. The results are

summarized in Table 2:

***CFC-113 and Blends:*** These are the baddest of the ozone-depleting chemicals; CFC-113 is serious environmental problem with an "Ozone Depletion Potential" (ODP) of 0.80. It is available in more than thirty blends and marketed under the brand names of Freon®, Genesolv® and others. Benchtop technicians like CFC-113 because it is non-toxic, non-flammable and static safe. The cleaners evaporate quickly, are mil-spec approved and are generally safe for components. However, their deleterious environmental impact and increasing price requires them to be phased out as quickly as possible. Plants using CFC-113 should plan on making the change in 1992 if at all possible; 1993 at the latest.

***1,1,1-Trichloroethane and Blends:*** With an ODP of 0.10, trichloroethane (also called 1,1,1-tri or TCA) is an imperfect improvement over the CFC-113 blends. Cheap and mil-spec approved, 1,1,1-tri is easy to handle and evaporates quickly. It cleans most rosin-based fluxes and easily ionics as well as organic contamination. On the negative side, it has a strong chemical odor and frequently attacks plastic components. Overall, the use of 1,1,1-tri should be minimized and phased out whenever possible.

***Alcohol:*** Alcohols were the original defluxers and they are enjoying a resurgence in popularity today. They are cheap and ozone safe, but they are flammable and overexposures can be hazardous. Alcohols clean rosin fluxes, grease and oils. Plus there are many different types of alcohols, so different materials can be selected for different tasks. Isopropanol is the least expensive cleaner. Methanol is a health hazard but one of the most aggressive defluxers. Ethanol is a mild cleaner and is safe enough to drink. Nonlinear alcohols, such as those marketed by Kyzen Corp., are a new approach to defluxing and are not yet suitable for benchtop cleaning because of the need to rinse the cleaners from the boards. Micro Care offers a number of different [alcohol-based products](#).

***Terpenes:*** Terpenes are produced by every living green plant -- trillions of tons every year. They are biodegradable and ozone safe. Widely used in household cleaning (PineSol, Mr. Clean) terpenes are safe enough to be used as a food additive (chewing gum, orange juice) and powerful enough to be used as a defluxer at over 400 locations around the world (AT&T, Motorola, Raytheon). They are the only type of cleaner that works on all types of fluxes -- RA, RMA, SA, OA and even some no-clean fluxes. Two types of terpenes are currently used as defluxers: citrus products and pine products. Chemtronics has announced a pine-based product that will be inexpensive and mild. [Bioact® EC7M](#), from Petroferm, is powerful citrus-based product and is suitable for use on the workbench without rinsing.

***Aliphatic Hydrocarbons:*** These products are new, updated versions of well-known cleaners such as mineral spirits. The most common product in this class is [Axarel®](#) from Petroferm. With an ODP of zero, Axarel® is environmentally acceptable. However to date its cleaning performance has been reported as irregular and only about a dozen locations are using it in North America.

***HCFC Solvents:*** This new family of compounds was created to replace CFCs. Some

HCFCs are finding homes in the refrigeration and blowing agent industries. For defluxing, [HCFC-141b](#) appears to be a good choice because it evaporates very quickly, is ESD safe, non-flammable and relatively non-toxic. It can be reclaimed and recycled. With an ODP similar to 1,1,1-tri, it is most useful only in niches that the other cleaners cannot serve.

**Water:** Aqueous-based bulk cleaning systems have enjoyed a resurgence of popularity in recent years, and with good reason. The raw material is cheap, the cleaning results are good, and the cleaner is ozone safe. However, water-based bulk cleaning systems use deionized water (D-I water) for cleaning. This is water from which all impurities have been removed, and it is this purity that makes D-I water an extremely aggressive cleaner. But unlike the other chemicals, even a little bit of contamination will undermine the cleaning potency of D-I water, literally within seconds. So D-I water only can be used on a workbench in a hermetically sealed container, and very few manufacturers packaging D-I water in this manner.

## Manual Cleaning Needs Safe, Affordable Cleaning Choices

Over the long run, there is no "Holy Grail" for benchtop cleaning, only a choice that combines the best features of cost, safety and environmental concerns and minimizes the negative problems. Variations in technologies, budgets or customer needs may cause different engineers to recommend very different benchtop systems and solvents. The only absolute fact which everyone must resolve is the awareness that we only have one planet, and it has only one ozone layer. We all must start to protect it now before it is too late. Fortunately, there are now enough options available that production engineers can make reasonable decisions among qualified choices, and need not trust to luck to produce quality products in 1992.

---

### About the Author

Michael D. Jones is a Vice President at Micro Care Corporation in New Britain, Connecticut. Micro Care provides environmentally improved cleaning alternatives to the electronics industry. Mr. Jones spends an average of 110 days each year on the road, helping electronics plants in every part of the world migrate from CFCs to more acceptable and cost-effective cleaners.

---

### Related Information:

- For additional information about the ozone-safe DuPont HFC solvents, check out the [Vertrel® solvents web site](#).
- For other information about the Bromothane™ brand of nPB solvents, check out the [Bromothane™ web site](#).

- For additional help, use the [Solvent Selection Guide](#) in this Site to help determine the optimal recommendation.
- A simplified PDF version of the same [Selection Guide](#) also is available.

---

[Back to Technical Articles index](#)

---

[Solvent Guide](#)

[Hotlinks](#)

[Cleaning Costs](#)

[Contact Us](#)

[Search This Site](#)

---

Revised October 29, 2004  
Copyright © 2004 Micro Care Corporation, All Rights Reserved