THE DIRECTORATE OF MAINTENANCE
PLAN FOR RELIMINATING
OZONE DEPLETING SOLVENTS
FROM ITS INDUSTRIAL PROCESSING

Directorate of Maintenance
Aerospace (Guidance & Metrology Center
Newark Air Force Base, Ohio
United States of America

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Aerospace Guidance and Metrology Center
Newark Air Force Base, OH

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The plan included herein is adopted and approved as of the date set forth **below.**

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BACKGROUND:

The industrial operation within the Directorate of Maintenance at the Aerospace (Guidance and Metrology Center, (AGMC), Newark Air Force Base, Ohio, have historically consumed large quantities of Chloroflourocarbon (CFC) -113 (Freon 113) and 1,1,1 Trichloroethane. These two solvents have been classified AS "ozone depleting solvents" and, through the international "Montreal Protocol" agreement, have been slated to be out of production and eliminated from use by, or before, the year 2000 in the case of CFC-113 and 2005 in the case of 1,1,1 Trichloroethane. The international community expects the current Montreal Protocol targets to be moved to 1995 and 2000 respectively.

Strong legislative actions have been taken to enforce the provisions of the Montreal Protocol and to encourage expeditious transitions to alternative. These actions include a phased escalation of cost through imposed tax on the solvents at acquisition; emission control requirements that will be extraordinanily expensive to comply with; and criminal penaltiesfor non-compliance that are severe, enforceable, and do not differentiate between Department of Defense personnel and civilian industry.

The Directorate of Maintenance purchased 430,000 pounds of CFC-113 in 1990 at a total coat of over 8960,000. By 1993 that same quantity of CFC-113 will cost over #1,390,000. The 81,390,000 doea not include the exorbitant coat *of*forthcoming, imperative measures to control losses at <u>all</u> pointa 0! use.

The coat aspect of using the two solvents, the certain difficulty *of* acquiring adequate supplies in the future, and the impact continued use would have on AGMC's image and competitiveness in the future resulted in the Directorate of Maintenance taking aggressive action to find and implement alternative. A program of experimentation to investigate the use *of*aqueous processes as alternatives to the use of CFC-113 and 1,1,1 Trichloroethane for cleaning inertial system parts and assemblies was initiated in 1987.

By 1988, the effort had born fruit. Several parts composed of different materials had been thoroughly teated in aqueous processes. The testing and evaluation process had been extensive and thorough. Through a carefully coordinated effort from beginning to end, the cleaning *of*these parts waa completely converted from solvent to aqueous cleaning. This process and subsequent efforts have been carefully documented in various papers referenced in attachment 1.

Since that initial effort, other parts have been converted to aqueous cleaning. However, the total number of different parts now cleaned by aqueous based methods at AGMC are still only a minute fraction of the total number of parts cleaned with CFC-113 and 1,1,1 Trichloroethane.

During the intervening period from 1988 to now, considerable experience has been acquired at AGMC in the aqueous cleaning arena and the various part6 cleaned have had the scrutiny of time. An aqueous "Cleaning Center" has been constructed in the south end ofBuilding 4 and is now serving as the production cleaning function for those parts converted to aqueous cleaning. Most of the equipment has been acquired and the Directorate is awaiting certification of funding for the construction of a second, larger Cleaning Center at the north end of Building 4.

The processes converted to aqueous cleaning have performed well beyond original expectation. The parts are being cleaned better and faster than they were previously. Also, absolutely no known degradation has been observed in any of the various parts and assemblies that can be attributed to the aqueous processes used to clean them.

The materials from which the various parts now cleaned on a production basis by the aqueous process are constructed include ferrous alloys, stainless steel, aluminum, beryllium, copper, gold, pivot jewels, and certain epoxies and non metallic substance. Certain Beryllium parts, while not yet cleaned on a production basis, have been thoroughly tested and have been found capable of being cleaned satisfactorily with an aqueous oceaa.

Fundamental to the Directorate policy is the belief that a large majority of the Directorate's solvent baaed cleaning processes, be they general or precision in nature, can effectively be converted to aqueous processes. Those process, including cleaning, which require an alternative other than an aqueous process will have to be addressed when, and as, identified. The alternatives for this category of processes will be sought from among those being developed throughout the industrialized world.

To permit the Directorate of Maintenance to meet required targets for eliminating ozone depleting and other hazardous solvents from ita industrial processes, a formal, structured approach is deemed necessary. The structured approach or 'plan' must provide the necessary guidelines for decision making and provide for streamlining and coordinating the Center's resources to achieve such goals as shall be established.

That plan is set forth below.

THE DIRECTORATE OF MAINTENANCE PLAN TO ELIMINATE OZONE DEPLETING AND OTHER HAZARDOUS SOLVEBTS FROM ITS INDUSTRIAL PROCESSES:

A Hazardous Solvent Alternatives Working Group (Working Group) is hereby created by the Directorate of Maintenance to consist of the Deputy Division Chiefs from each of the three Divisions that form the Directorate of Maintenance, i.e. the Aircraft Product Division (MB), the Engineering Division (MAE), and the Missile Product Division (MAK). The Working Group will be chaired by the MAE Deputy and will have as ad hoc members, as a minimum, the MAE Division Chief, the Civil Engineering Facilities Branch Chief and the Environmental Management Chief. The ad hoc members will be available when needed to work issues in their respective areas of responsibility and expertise. The three Deputy Division Chiefs repellent, and rightfully so, the corporate oversight for the respective Divisions' interests and, in that respect, the interest of the Director o! Maintenance.

The purpose of the working Group is to provide the management direction, guidance, and oversight required to assure the Directorate of Maintenance will meet deadlines for phasing ozone depleting solvents out of its industrial process.

The Working Group is responsible for assuring that all actions in the effort to eliminate ozone depleting chemicals from Directorate of Maintenance processes will be initiated and/or reviewed and then concurred with unanimously by the Working Group before they are released as being completed and before they are implemental. (The initiation of an effort may take place, however, without the unanimous consent of the Working Group.) The Working Group has the latitude to establish its own procedures to assure It complies with its responsibilities.

The process of implementation from initiation into test to subsequent production aqueous cleaning for each and every part or assembly selected will be the joint responsibility of a team consisting of the following as a minimum:

Project Engineer/MAEL (team leader)
Product Engineer/MA_N
Process Engineer/MA_E
Training Leader or pertinent technician/MA_P

Of course, the Product Engineer, the Process Engineer, and the Training Leader or technician are to be from, or in support of, the production area responsible for the part or assembly in question. The product engineer, the process engineer, and the training leader/technician will not devote full time to the team effort; however, they will input to team decisions and will participate as required to do so. It will be the responsibility of the team to innovatively teat and evaluate the part or assembly for both degradation and cleanliness and to perfect the process to obtain acceptable results. To assist them in discharging this responsibility are the following guidelines.

GUIDELINE 1: The final cleaning process accepted as a suitable alternative for an existing process shall result in no damage or degradation to the part or assembly being cleaned that will impact its function, and it shall render the part or assembly, as` a minimum, as clean as the existing process as verified by the current methods employed for that purpose in the part or assembly's cost center.

This is a statement of final quality requirements. The words "impact its function" are deliberate. Their purpose is to address and make acceptable the fact that any cleaning process does some 'damage' or "degradation" to the item being cleaned, even if only a few atoms of the item's surface are removed. This guideline provides a working definition of the words damage and degradation for purposes of this effort by relating damage and degradation to "function".

There is a risk in employing Guideline 1. The risk is that a part may be "damaged" unacceptably relative to function without being detected by the tests used to evaluate degradation.

A control for this risk is provided by the fact that the team members are the parties with fundamental responsibility for the item being cleaned and for the functionality of the final assembly of which it is a part. The team must unanimously agree on an approach and its results; if they cannot, the issue is elevated to the Working Group for resolution. The next higher review is the Division Chiefs and, finally the Director of Maintenance.

GUIDELINE 2: All solvent based cleaning processes with the possible exception of "flushing" operations will be evaluated for conversion to an aqueous based process.

This guideline is an obvious assumption. Everyone *knows* that an aqueous process may not be a panacea for all processes. The guideline is important, however, because it sets the tone of the implementation process. It mandates the investigators set out to find the aqueous process that can work. It also provides the direction to be taken in planning for the equipment and facilities required for alternative processes.

GUIDELINE 3: It is preferable to assume some risk in part damage or some lost test time from contamination than it is to delay subsequent implementation through exercising excessive care at the beginning of testing; this is conditional upon the understanding that the cause of such damage or contamination is to be corrected through process adjustment before a final process is accepted for implementation.

This guideline provides a risk acceptance philosophy. It is based upon the fact that cost benefits to be obtained through ultimate implementation of process changes are very much greater than the small coat that may be incurred through the assumed risk, i.e. the savings in CFC-113 use and acquisition cost as opposed to the cost of a single part or assembly damaged during the implementation process.

GUIDELINE 4: If a part consists of one or more materials which have previously been subject to thorough degradation testing in a similar part or assembly relative to the aqueous process, and the results of that testing have been accepted as satisfactorily indicating no degradation concerns, that part may not be required to undergo any degradation testing on its own behalf; instead degradation testing may be inferred by reference. This decision will be made by the team assigned to that part.

GUIDELINE 5: Providing satiafactory degradation teat results exist, if a part has been tested and evaluated for the degree of cleanliness achieved via a proposed aqueous process, and the results indicate the part is clean using the verification process for cleanliness established in the applicable Technical Order (T.O.) or shop practice, then further testing of any kind may not be required to justify converting the process from solvent baaed to aqueous baaed cleaning. This decision will be made by the team assigned to that part.

The purpose of Guidelines 4 and 5 is simply to permit expediting the flow from teat initiation to process implementation. There is a risk involved in both guidelines. The risk is that an item may be damaged unacceptably in the case of Guideline 4 or will not be cleaned adequately in the case of Guideline 5. However, there are a number of controls which reduce the scope of this risk in addition to the conditional statement incorporated in Guideline 3 and in the explanation of that guideline. Those controls include the following:

1. The team members are the parties with fundamental responsibility for the item being cleaned and its functionality in the final assembly of which it is a part.

2. The team must unanimously agree on an approach and its results; if they can not, the issue is elevated to the Working Group for resolution. The next higher review is the Director of Maintenance.

3. Any observation at any time may cause the team to elect to do more thorough testing of any type; the guidelines do not prohibit more extensive testing, they merely give the basis to waive it initially in seemingly obvious situation.

The Working Group shall establish the priority of the items and existing processes to be subjected to the effort to find and implement an alternative.

Each item selected must have a thorough written report to justify process conversion. That report will be prepared by the Project Engineer from the Engineering Division. It must be concurred with, and signed accordingly, by all team members to be considered complete. The report must then be formally approved by the Working Group.

While each item selected must have a report written for that part, it will be acceptable to group items for inclusion in the report which are of like composition, which have the same Item Manager or technical order, and which have been proven to be cleanable with the same process.

Before an alternative process may be implemented, it is imperative that the request to do so must be approved via the appropriate Item Manager. In the case of the Oklahoma Air Logistics Center (OC-ALC), a single point of contact (POC) for all such ozone depleting solvent alternative requests was established in April, 1991. (This action was a result of the OC-ALC/AGMC Executive Conference held in April 1991.) Similar POC identifications will be solicited from the Sacramento Air Logistics Center (SM-ALC) and the Ogden Air Logistics Center (OO-ALC). All requests for permission to implement will be prepared by product engineering and forwarded to the Item Manager's POC through the AGMC Poc . The AGMC POC will be the Hazardous Solvent Alternatives Project Engineer from the Engineering Division. The significance of the POCs in this effort is the ability they provide to work issues affecting Item Manager approval of process changes immediately, by phone, with priority attention and, thereby, to avoid administrative delays at both ends and delays through the mail system.

An alternative to the above process where, and if, it can be arranged, is for the item managers to delegate process approval authority for those proceses which require ozone depleting or other hazardous solvents to AGMC's product engineers. If such arrangements are forthcoming, they will permit process change approval to be accomplished at AGMC.

The actual implementation will be done only after receipt of the Item Manager's approval or, in the case(s) where local approval authority is granted, after local product engineering approval. The formal implementation will then be initiated by a letter from the Working Group Chairman to the product engineering organization. Product engineering will provide the necessary documentation and approval authority to the appropriate production organization for implementation.

A team may evaluate more than one item at a time and there may be more than one team functioning.

All items which are converted to aqueous based cleaning must ultimately be built into a repaired component or system and sold via a full range of functional testing. This testing process provides a final level of control over risk. Further, the repaired components and systems are subject to the continuing scrutiny of the reliability data systems maintained by AGMC that monitor their performance in actual use.

In addition to alternate process development via an aqueous process, the Working Group will be responsible for the full gamut ofissues which must be resolved and/or integrated to make it possible to phase out ozone depleting solvents from Directorate of Maintenance industrial processes within required time limits. These include, but are not limited to, such issues as seeking alternative where an aqueous process for cleaning proves unacceptable, providing the planning for the facilities and equipment required to implement alternatives on a production basis, and developing comprehensive milestonea for the effort.

Finally, this is a plan based upon need and experience. Need and experience are dynamic, and, hence, can change. Similarly, this plan may be changed to adapt if, and as, required through the corporate approval process.

The structure recommended above will permit decisive action by the evaluation teams while at the same time providing confidence that the final results will acceptably address everyone's concerns. This will enable the effort to gain and maintain momentum and, ultimately, to meet the Directorate of Maintenance policy target8 for the removal of ozone depleting solvents from ots industrial processes.

REFERENCES

Note: All **of** the references listed below were written at and are available **from** the Aerospace Guidance and Metrology Center, **Newark AFB, Ohio; Phone (614) 522-7220, (DSN: 346-7220).**

1. **The Cyl-Sonic Cleaner: Aqueous Ultrasonic Cleaning Using Biodegradable Detergent. by Kenneth B. Patterson and Don E. Hunt; July 13, 1988.**

2. **Aqueou8 Cleaning of Instrumentation Bearing Assemblies" by Gene W.** Ott; January 16, 1990.

3. **"Centralized Precision Cleaning of Inertial System Components with Aqueous Processes Improves Quality and Reduces Use of CFC's. by Don E. Hunt, Gene W. Ott, and Roger N. Johnson; April 3, 1990.**

4. **GIT-1-B SG and TG (Beryllium) End Housing Aqueous Cleaning Project Summary to Date" by Thomas L. Ciupak; July 5, 1990.**

9. **A U.S. Air Force Repair Center's Policy and Progre in Eliminating CFC's' by Don E. Hunt; September 17, 1990.**

6. Implementing Alternatives to Ozone Depleting Solvents - Some Considerations' **by Don E. Hunt; March 12, 1991.**

Attachment 1