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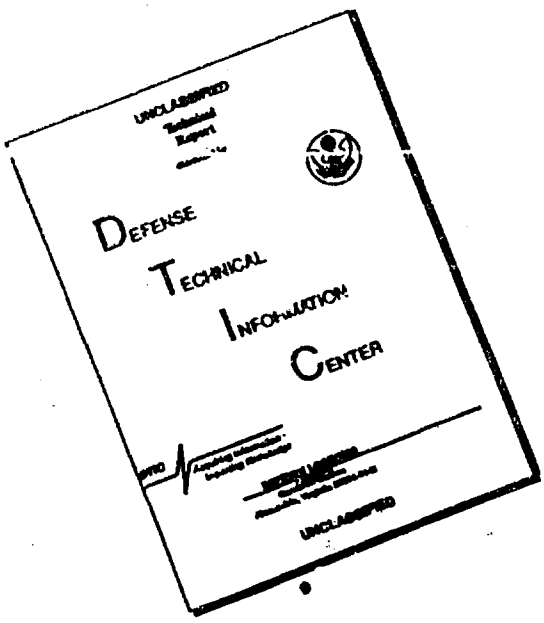

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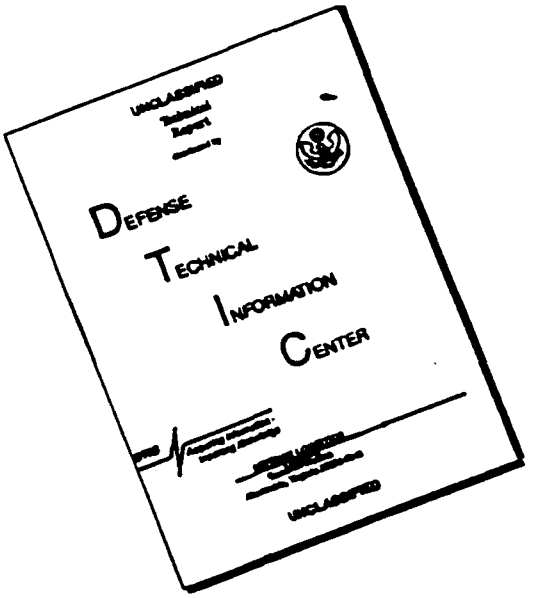

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TECHNOLOGY INSERTION ENGINEERING SERVICES
MASKING PROCESS EVALUATION
TASK ORDER NO. 7
(PHASE I)

CONTRACT SUMMARY REPORT
REVISION B
6 OCTOBER 1989

CONTRACT NO. F33600-88-D-0567
CDRL SEQUENCE NO. A009

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ACRONYMS AND ABBREVIATIONS

AFLC	AIR FORCE LOGISTICS COMMAND
AFLC/MA	AIR FORCE LOGISTICS COMMAND DIRECTORATE OF MAINTENANCE
ALC	AIR LOGISTICS CENTER
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
CBA	COST BENEFIT ANALYSIS
CNC	COMPUTER NUMERICAL CONTROLLED
CSR	CONTRACT SUMMARY REPORT
FIP	FACILITY IMPROVEMENT PLAN (WR-ALC BLDG. 142)
I.D.	INSIDE DIAMETER
IRR	INTERNAL RATE OF RETURN
MDC	MCDONNELL DOUGLAS CORPORATION
MDMSC	MCDONNELL DOUGLAS MISSILE SYSTEMS COMPANY
NPV	NET PRESENT VALUE
OC-ALC	OKLAHOMA CITY AIR LOGISTICS CENTER
OO-ALC	OGDEN AIR LOGISTICS CENTER
OSHA	OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
SA-ALC	SAN ANTONIO AIR LOGISTICS CENTER
SM-ALC	SACRAMENTO AIR LOGISTICS CENTER
TI	TECHNOLOGY INSERTION
TI-ES	TECHNOLOGY INSERTION-ENGINEERING SERVICES
TO	TASK ORDER
WR-ALC	WARNER ROBINS AIR LOGISTICS CENTER
VOC	VOLATILE ORGANIC COMPOUND

LIST OF APPENDICES

TASK ORDER NO. 7 (PHASE I) CONTRACT SUMMARY REPORT

1.0 EXECUTIVE SUMMARY (CONTRACT SUMMARY REPORT AND QUICK FIX PLAN)

This report presents activities performed by McDonnell Douglas Missile Systems Company (MDMSC) for the Air Force Logistics Command (AFLC) as part of the Technology Insertion Engineering Services (TI-ES) Program. Task Order (TO) No. 7 is composed of two phases. Phase I is a focus study on quality, time and cost improvements in masking methods currently used at the five Air Logistics Centers (ALCs). Phase II will address advanced technology maskants for implementation at the ALCs. This report addresses only Phase I.

The MDMSC TO No. 7 team has reached several conclusions as a result of our study of the masking processes at the five ALCs. These are addressed as recommendations, quick fixes and other observations in this report. Our general conclusions are stated as follows:

- The wax masking process at Oklahoma City Air Logistics Center (OC-ALC) is the most advanced of the ALC plating shops, and more advanced than at many job shops in the private sector.
- The plastic masking process at Ogden Air Logistics Center (OO-ALC) is costing much more than a wax masking process of comparable effectiveness. We have addressed this as a major recommendation in the Ogden section of this report.
- The wax masking processes at the other three ALCs are operating on par with private industry, but can be made more efficient and more productive by recommended small changes, which can be easily implemented, and by introduction of technologies developed in recent years since the shops were built or renovated. These are addressed in our report as quick fixes and other observations.

Our evaluation consisted of a review and analysis of the current operations. Recommendations, leading to improvement of these operations, were developed from the review and analysis.

Maskants are used in plating and chemical milling shops to protect portions of the surfaces from the chemical action. These maskants must be chemically resistant to the plating or milling chemicals, low in cost, reusable, and easily applied are removed. The three basic types of maskants used at the ALCs are wax, plastic, and organisols. The masking shop at OC-ALC uses an inexpensive and widely accepted wax maskant. They recycle the wax to minimize the material costs and impose quality control procedures which ensure maximum quality in masked and plated parts. Our observations indicate that this shop is a model to be emulated by the other ALCs. It is an operation equal to or surpassing the state of the art in private industry plating shops.

Of the five ALCs, four use melted microcrystalline wax and one (OO-ALC) uses a melted plastic for masking in their plating operations. Electroless nickel plating and chemical milling require a different maskant because of their higner processing temperatures. All five ALCs use organisol maskants in their operations.

The masking processes at all ALCs are operating with varying degrees of success. OC-ALC and OO-ALC have been used as representative models for wax and plastic maskants. OC-ALC represents what MDMSC believes is the best waxing system of the ALCs to compare against the plastic masking system. The rework and scrap-out data obtained from OO-ALC is the best historical data obtained from the five ALCs.

Using this data, we have developed a recommendation which will result in significant cost savings and quality improvements. It was determined the plastic masking process at OO-ALC is costing considerably more than a wax masking process of comparable effectiveness. Plastic is four and one half times more expensive than wax and has a limited useable life. Having analyzed this data and gained this knowledge, MDMSC recommends that OO-ALC change their maskant from hot melt plastic to wax when the existing masking equipment needs replacement. This will result in a first year savings of over $314,000 and recurring savings of over $375,000 annually, see paragraph 6.3.3.

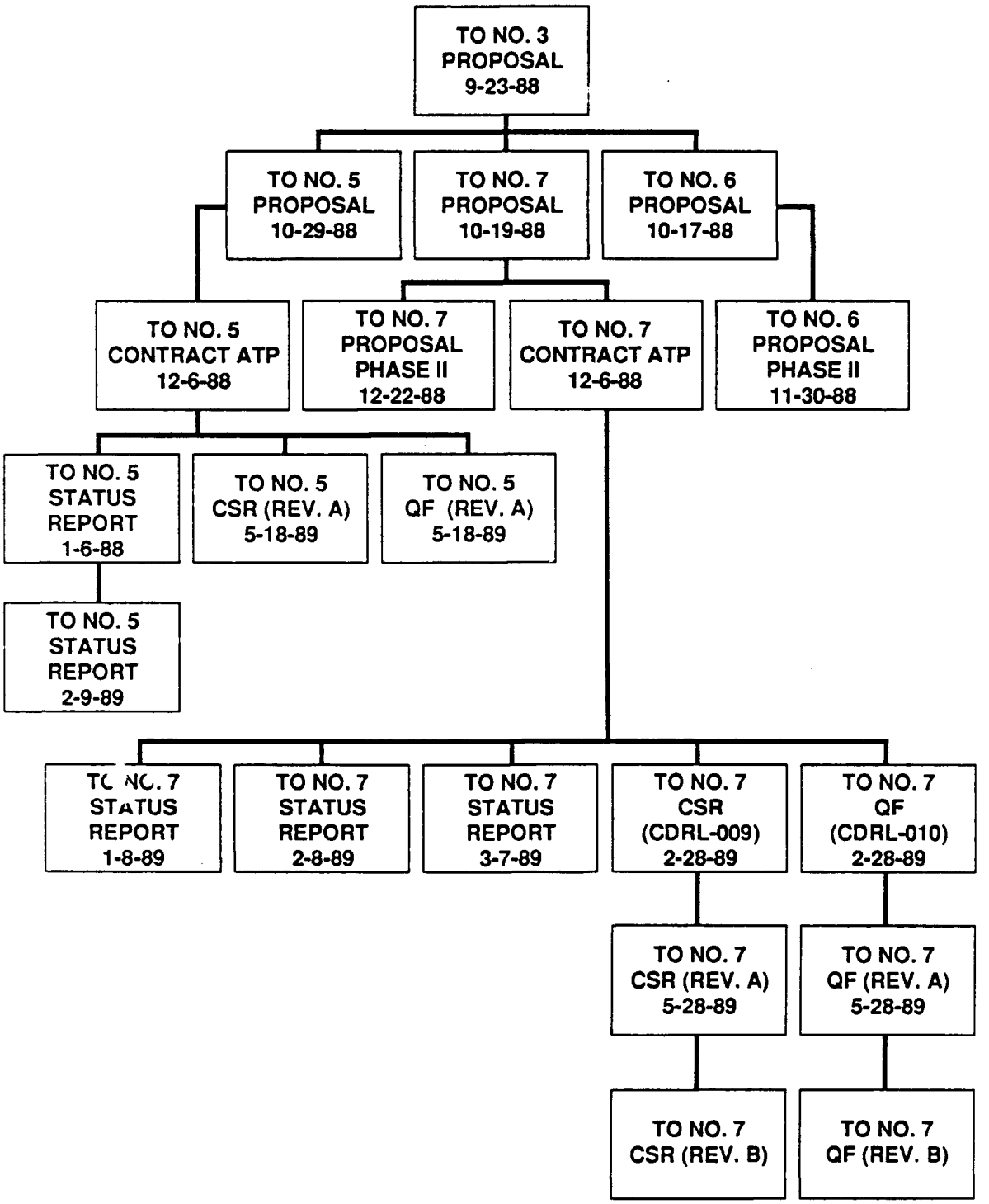
The costs to incorporate this recommendation include nonrecurring costs of $87,600 for processing tanks with mixers and heaters, $29,720 for the initial maskant to fill the tanks, $16,440 to install the equipment and $57,000 for storage carts. Although major changes are required to the present masking system, the savings are still significant.

Additional savings will accrue from improved quality of parts plated with the wax maskant. Plastic deteriorates with operating time, becomes less moisture resistant, and does not stay together. The deteriorated maskant provides less protection for the part and contaminates the chrome plating solution which does not occur with wax. Eliminating organic contamination due to the plastic byproducts should reduce the rework costs due to pitting or bond failures by as much as 200 parts per year.

2.0 INTRODUCTION

TO No. 7 was developed from the TI-ES TO No. 3 (Preliminary Plating Assessment), see Figure 2.0-1, which was performed in September 1988. TO No. 7 is a two-phase program. Phase I consists of evaluating the maskants currently used at the ALCs. MDMSC has completed the masking evaluations for all five ALCs. Phase II, which is a future effort, will evaluate maskants that are less hazardous to the environment, less toxic to the operating personnel and represent new technology to the metal finishing industry.

MDMSC has acquired a knowledge of the masking procedures, requirements, and masking technologies at all five facilities resulting in recommendations which could apply cross-command. The review of our accomplishments and recommendations will be addressed in detail in the ensuing sections. The recommendations made in this Contract Summary Report (CSR) should be considered an option that may require capital investment. Any recommendations requiring minimal capital investment which can be implemented within six months are considered quick fixes and are contained within the Quick Fix Plan (CDRL A010). Throughout MDMSC's performance of TO No. 7, many additional observations were made that did not qualify as a recommendation or quick fix due to their less significant impact in the areas of



TASK ORDER NO. 7 DEVELOPMENT
FIGURE 2.0-1

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time, quality, and cost. These are included as Other Observations in the sections for each appropriate ALC.

3.0 AFLC ASSESSMENT

The evaluation trip provided an excellent opportunity for the TO No. 7 team to obtain a close look at the masking processes and procedures at each ALC. Currently, the ALCs use three basic types of maskants (wax, plastic, and organisols) which are compared in Table 3.0-1 for their advantages and disadvantages. Table 3.0-2 shows the plating, masking, finishing, and chemical milling operations identified at each ALC.

The organisols are used in higher temperature processes which do not require extended immersion time, such as chemical milling and electroless nickel. Wax is used at four of the five ALCs for general electroplating. The only exception is OO-ALC, which uses hot dip plastic resin instead of the wax. OC-ALC was the only ALC to use process control procedures for the maskant operations. The trimming operations varied considerably with no apparent standard practice established. Masking processes containing solvent-based plastics/organisols are used at all five ALCs for electroless nickel and/or chemical milling. Procedures for this process are similar and without much difference in material and practices. The waxes are not suitable for these processes because of their low melting points and elevated temperatures of the chemical solutions.

San Antonio Air Logistics Center (SA-ALC) and Sacramento Air Logistics Center (SM-ALC) both have normal waxing operations that are adequate for the type and quantity of work being done. Both have established methods of removing wax from plated parts that are functional.

The wax operation at Warner Robins Air Logistics Center (WR-ALC) is less than standard for the work being performed there. This wax is not the best selection for protecting the parts because it is less tolerant of abuse than other waxes. The wax tank is contaminated with used wax causing frequent masking problems attributable to defective wax. They have plans to redesign and improve their facility which will help with the existing waxing problems.

	ADVANTAGES	DISADVANTAGES
PLASTIC (HOT MELT)	1. HIGH MECHANICAL TOUGHNESS 2. TRANSPARENT 3. ADEQUATE TEMPERATURE RESISTANCE FOR ELECTROLESS NICKEL 4. EASILY REMOVED * 5. LOW VOC EMISSIONS 6. FEWER TANKS REQUIRED 7. SIMPLE SHOP ORGANIZATION 9. SIMPLE TO USE 10. RAW MATERIAL EASY TO DISPOSE	* 1. NOT RECYCLED 2. MAY RELEASE (LIFT) AT EDGES 3. DEGRADES WITH AGE 4. ENERGY INTENSIVE HEATING 5. FIRE HAZARD 6. EXPENSIVE MATERIAL 7. OBNOXIOUS ODOR 8. CAN CAUSE SEVERE BURNS 9. LIMITED CROSS COMMAND APPLICABILITY 10. LIMITED AVAILABILITY
WAXES	* 1. RECYCLABLE 2. LOW COST MATERIAL * 3. LOW VOC EMISSIONS 4. LOW VOLUME OF WASTE (WHEN RECYCLED) 5. ECONOMICAL TO HEAT 6. APPLICABLE ACROSS THE COMMAND 7. LOW INVENTORY COSTS 8. NO OBNOXIOUS ODORS 9. EASILY AVAILABLE	1. LOW RESISTANCE TO PENETRATION 2. LOW TEMPERATURE RESISTANCE * 3. LABOR INTENSIVE CLEANING BEFORE PLATING 4. SOME ODOR NOTICED 5. REQUIRES MORE TANKS 6. REQUIRES MORE SHOP ORGANIZATION 7. REQUIRES MORE SKILL TO USE 8. MORE DIFFICULT TO REMOVE
ORGANISOLS	1. HIGH TEMPERATURE RESISTANCE 2. EASILY (MANUAL PEELING) TRIMMED, CLEANED AND STRIPPED 3. QUICK TO APPLY	* 1. HIGH VOC EMISSIONS 2. EXPENSIVE * 3. PRESENCE OF FLAMMABLE SOLVENTS * 4. NOT RECYCLABLE 5. STRONG ODOR SOLVENT 6. FIRE HAZARD

VOC = VOLATILE ORGANIC COMPOUND
*INDICATES A MAJOR ISSUE

ASSESSMENT OF THREE CURRENT MASKING PROCESSES USED AT AFLC DEPOTS (ALCs)

TABLE 3.0-1

LSC-20042D

		SA-ALC	SM-ALC	OC-ALC	OO-ALC	WR-ALC
PLATING/FINISHING	ANODIZE					
	TYPE I	X	X	X	X	X
	TYPE II	X	X	X	X	X
	TYPE III	X	X		X	X
	CONVERSION COAT	X	X	X	X	X
	HARD CHROME PLATE	X	X	X	X	X
	CADMIUM	X	X	X	X	X
	VACUUM CADMIUM				X	
	NICKEL	X	X	X	X	X
	ELECTROLESS NICKEL	X	X	X	X (NEW)	
	SILVER	X	X	X	X	X
	COPPER	X	X	X	X	X
	TIN		X	X	X	X
MASKING	PLASTIC				X	
	WAX	X	X	X		X
	ORGANISOL	X	X	X	X	X
	MOLDED PLASTIC FIXTURES	X				
CHEMICAL MILLING	CHEM MILL					
	OF ALUMINUM		X		X	X
	OF TITANIUM					X
IVD	IVD	X	X (NEGOTIATING)	X	X	X

PLATING/MASKING/FINISHING/CHEMICAL MILLING OPERATIONS PERFORMED AT EACH ALC

TABLE 3.0-2

Neither SA-ALC nor WR-ALC recycle their wax. Wax has successfully been proven recyclable at two of the ALCs. SA-ALC and WR-ALC could realize the same cost savings by recycling their wax.

MDMSC's observation was that wax is the most universal masking material that is adaptable for all of the ALCs for general electroplating, except as previously noted. Table 3.0-3 rates the ALCs using wax on their current wax process. The highest degree of control over the process was exhibited by OC-ALC. OC-ALC has implemented a wax control system which is more sophisticated than that at many private sector job shops. At this installation, the Process Control Laboratory takes an active role in controlling the properties and composition of the masking wax, in much the same manner as they do the plating baths. They have instituted melting point determination and acidity determination to control the masking wax per Military Specification MIL-W-12465C and American Society for Testing and Materials (ASTM) D-127.

Record keeping which is essential to monitor the effectiveness of the plating operations is virtually non existent except for OO-ALC. Their computer record keeping system, which is being further improved, has helped the OO-ALC and the Technology Insertion (TI) program team to identify plating problems.

Emphasis for the Phase I study was placed on a comparison of the wax and plastic maskants. Phase II will emphasize a replacement for the organisol maskants which MDMSC believes needs to be examined.

The TI team identified one major recommendation, two quick fixes, and five other observations for AFLC. The major recommendation and other observations are shown with their applicability at each of the ALCs in Table 3.0-4. The two quick fixes are discussed in the Quick Fix Plan. The major recommendation and other observations are discussed in paragraphs 3.1 and 3.2.

	SM-ALC	OC-ALC	SA-ALC	WR-ALC
RECYCLING STRATEGY	4	4	2	1[1]
CONTAMINATION CONTROL	2	4	2	2[1]
ACIDITY CONTROL	3	4	2	1
BRITTLENESS CONTROL	3	4	3	1
TRIMMING/CLEANING PROCEDURE	4	2	3	2
APPLICATION PROCEDURE	3	4	3	2
OVERALL SCORE	19	22	15	9

(4 = MOST DESIRABLE, 1 = LEAST DESIRABLE)

NOTE: OGDEN IS NOT INCLUDED (SINCE IT DOES NOT USE WAX PROCESSING)

[1]CURRENTLY RUNNING TESTS FOR RECYCLING AND CONTAMINATION IMPACT

WAX MASKING RATING AT FOUR ALCs
TABLE 3.0-3

	AFFECTED ALC				
	OC-ALC	OO-ALC	SA-ALC	SM-ALC	WR-ALC
RECOMMENDATION					
Change Maskant.		X			
OBSERVATIONS					
1. Preparation of Aluminum for Chemical Milling.		X		X	X
2. Replacement of Organisol Maskant.	X	X	X	X	X
3. Use of Molded Plastic Masking Fixtures.	X			X	X
4. Track Rework and Rework Causes.	X		X	X	X
5. Wax Recycling and Cross-Contamination Control.			X		X

LSC-20153B

RECOMMENDATION AND ENGINEERING OBSERVATIONS

TABLE 3.0-4

3.1 OVERVIEW OF RECOMMENDATIONS

One major recommendation was identified for the masking operations. This recommendation is for OO-ALC to change from a plastic maskant to a wax maskant with a recycling system. The wax is more economical, and by recycling, it will help reduce material costs and minimize the additional load that would be placed on the vapor degreaser. After evaluating the masking operations for the general plating processes it was determined that the wax was the best overall maskant. By changing from plastic to wax, OO-ALC will realize improved plating quality, improved masking quality and reduced masking costs, see paragraphs 6.3 through 6.3.3. Although masking time will increase, the benefits outweigh this disadvantage.

3.2 OVERVIEW OF OTHER OBSERVATIONS

The following observations were not considered as recommendations or quick fixes because they had a less significant impact on the areas of time, quality, or cost. These observations were recorded to assist the ALCs in developing ideas that will further enhance the masking operations. These observations will be expounded on in the sections for each appropriate ALC.

3.2.1 Preparation of Aluminum For Chemical Milling

The organisol maskant will not adhere to the marking ink, applied to the sheet metal by the rolling mill, to show alloy designation and temper. This is allowing the maskant to lift in certain areas resulting in poor etching quality. A solvent, such as acetone or methylethylketone, should be applied with a handwipe to remove the ink prior to chemical cleaning and subsequent organisol masking. For detailed information for OO-ALC, SM-ALC, and WR-ALC, see paragraphs 6.4.1, 8.4.1, and 9.4.1, respectively.

3.2.2 Replacement of Organisol Maskants

Organisols currently in use by the ALCs contain either toxic and/or flammable organic solvents. It is recommended that the use of a newly-developed water-based maskant be considered as a replacement. Full evaluation of this maskant system will be deferred until the execution of Phase II. For detailed information for each ALC, see paragraphs 5.4.1, 6.4.2, 7.4.1, 8.4.2, and 9.4.2.

3.2.3 Use of Molded Plastic Masking Fixtures

Certain repetitive parts can be masked with compression molded masking fixtures to reduce or eliminate labor-intensive manual masking operations. An evaluation to determine when and where to implement the fixtures for cost effectiveness is highly recommended. For detailed information for OC-ALC, SM-ALC, and WR-ALC, see paragraphs 5.4.2, 8.4.3, and 9.4.3, respectively.

3.2.4 Record Plating Rework Causes and Rework Quantities

The availability of rework data which concisely identifies plating process problems, such as that maintained by OO-ALC, would enable the ALCs to pinpoint causes of increasing rework rates and initiate corrective actions. For detailed information for OC-ALC, SA-ALC, SM-ALC, and WR-ALC, see paragraphs 5.4.3, 7.4.2, 8.4.4, and 9.4.4, respectively.

3.2.5 Wax Recycling and Cross Contamination Control

OC-ALC and SM-ALC both have facilities for recycling wax. Recycling wax at SA-ALC and WR-ALC would reduce material and disposal costs for wax. When recycling wax, the chromium masking tanks should be separate from the other masking tanks to avoid cross contamination in the wax. For detailed information for SA-ALC and WR-ALC, see paragraphs 7.4.3 and 9.4.5, respectively.

3.3 MASKANT EVALUATION

Suppliers of masking products have been identified and contacted for technical information on their materials. Additionally, some companies known to be in similar lines of business were contacted to determine whether they were either engaged in or interested in development of maskants. This was done to identify additional efforts in work which might mature in the next four to eight years.

Upon completing our five ALC visits, our database was further expanded by contacts and conferences with individuals representing the maskant vendors listed in Appendix A. Technical data on their products was received. These are included in the Masking Process Database, see Appendix F.

The primary maskants used at the ALCs are organisols, waxes, and plastics. Each maskant has its own particular limited usefulness. Since there is no one maskant that is inexpensive, will withstand wide temperature ranges, and is resistant to strong acids or strong alkalies, one maskant can not be used for all applications.

3.3.1 Wax Maskant Material Evaluation

Microcrystalline waxes are the most universal, inexpensive maskants for plating operations today. They do not pose a contamination problem to any of the plating solutions. None of the ALCs using wax report deposit problems associated with the wax. The greatest problem with wax maskant is having loose particles float on the surface of the solutions. These particles of wax can get on the plating area when the part is put into the bath. The particles of wax usually come from the masked parts that have overheated due to inadequate electrical connections or overheated plating solutions. This problem is easily cured by making better electrical contacts and skimming the surface of the solution.

The lower melting Petrolite BE-Square 175 wax and Tolber's C-562 Miccrowax are the same type of product. They are compatible with one another and the control procedures in Appendix A of the Quick Fix Plan are applicable to both waxes. The only distinguishing difference is in the cost. The BE-Square 175 is more cost effective and is used at OC-ALC and SA-ALC. The Tolber C-562 Miccrowax is used at SM-ALC.

Petrolite's BE-Square 195 wax, used at WR-ALC, is more brittle and less resilient. Although it will withstand higher operating temperatures, it will not tolerate physical abuse as well as the lower melting point waxes. The ductility of this wax is more adversely affected by overheating and by contamination from the chromium plating solution.

All of the microcrystalline waxes are free from solvents and pose little safety or fire hazards at operating temperatures. The operating temperature is 180°F to

250°F. The difference between the 560°F flash point and the maximum operating temperature is 310°F, so the possibility of fire is limited.

Masking waxes are easily recycled. To recycle wax most effectively, plating solutions which contaminate the wax need to be rinsed off after plating. After neutralizing and rinsing, most of the wax is removed in a hot wax tank for reuse. The recommended recycling process is detailed in paragraph 6.3.1.

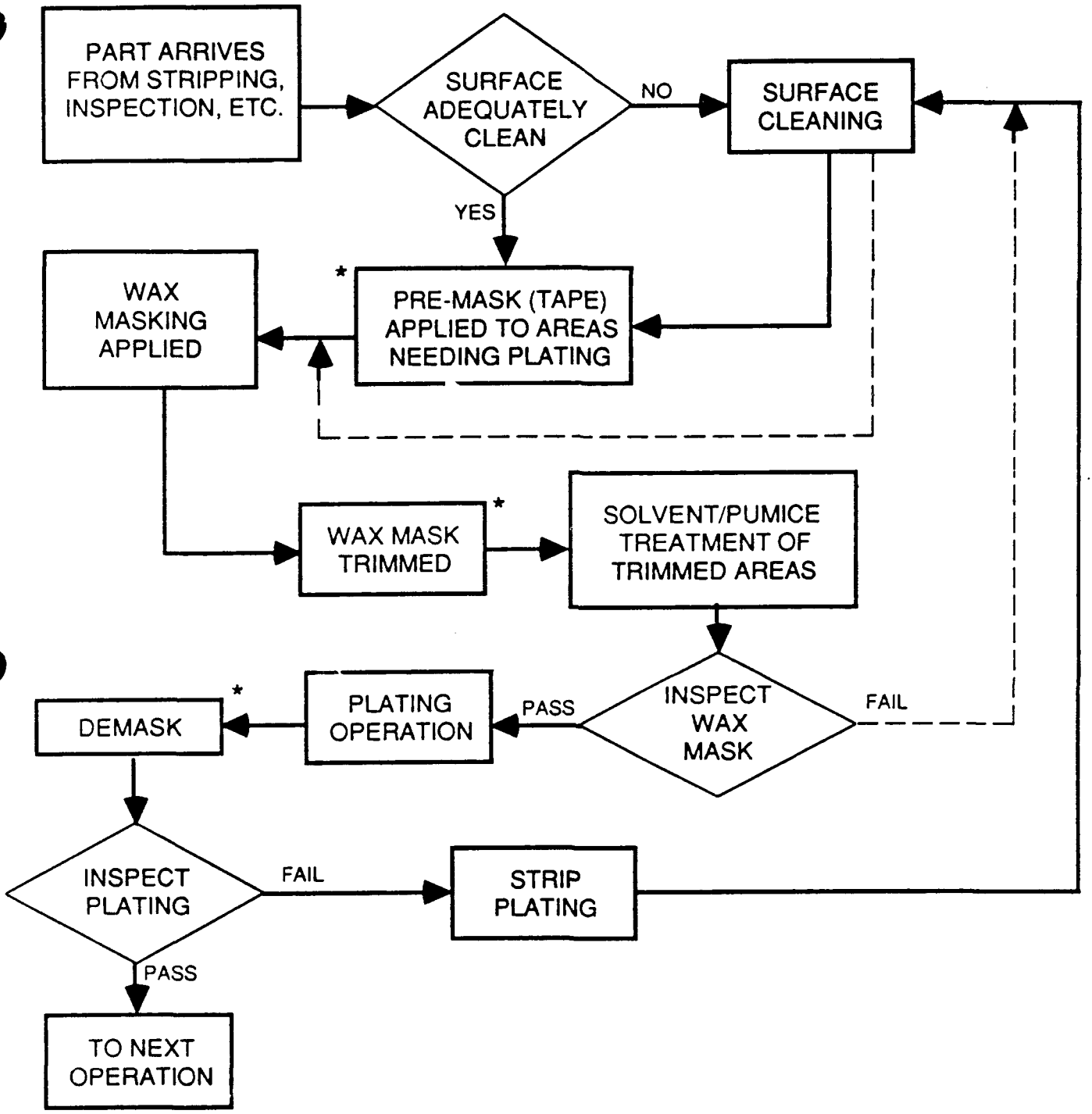
Detailed information on wax and its parameters is in Petrolite's vendor sheets in Appendix F. The general work flow in the wax masking process is presented in Figure 3.3-1.

3.3.2 Plastic Maskant Material Evaluation

There are many types of plastic maskants used to mask parts for chemical processing. They are in the form of tapes, paints, and hot dip liquids. Vinyl tape is the most widely used plastic maskant at the ALCs. It is inexpensive and an effective limited stop off for chemical processing. It is used primarily to stop off cylindrical shaped parts or as an addition to hot dip maskants. It is labor intensive and not economical to use on larger areas. It should not be used under wax unless absolutely necessary as the wax will not adhere to the tape as well as the metal.

The Evans' B-100 plastic material is used in the greatest volume to mask large areas. The only plastic maskant evaluated in this study was the hot melt plastic used at OO-ALC. OO-ALC uses this material to mask all plated parts requiring masking. This maskant is the easiest and least time consuming of all the masking materials to apply and remove. Plastic is also harder and more ductile than the waxes, therefore, it is more resistant to mechanical damage.

The supplier states that it was designed to be used on smaller parts and not to be used for extended lengths of time in some plating baths. The material is not waterproof, but it is water resistant. It does not completely repel liquids, but absorbs it very slowly. During a longer plating time, for example 36 hours, the plating solutions will begin to penetrate the maskant.



*INDICATES OPERATIONAL BOTTLENECKS OR LABOR/TIME INTENSIVE OPERATIONS.

GENERALIZED MASKING WORK FLOW (WAX PROCESS)
FIGURE 3.3-1

One of the more serious problems with this material is that it is attacked by chromium plating solutions which in turn can contaminates the plating solution. If enough of the organic material is dissolved in the solution the resultant trivalents can cause poor bonding and pitting in the chromium deposit. Another safety hazard that this material poses is its fire hazard, since it operates within 105°F of its flash point. OO-ALC has already experienced a fire because of this.

3.3.3 Organisol Maskant Material Evaluation

Organisol maskants are most frequently used in higher temperature processes, such as electroless nickel and chemical milling. It is generally used in alkaline or weak acid solutions. If it is used in strong acids, especially oxidizing acids, the immersion time must be kept relatively short. Longer immersion time in these solutions will contaminate them with organics. This can cause serious problems in chrome plating operations.

Organisol maskants are recyclable if the plating solution does not discolor the surface. If the maskant is discolored it indicates the maskant has been chemically altered. Repeated recycling of adulterated material will cause adherence problems, therefore recycling of organisol maskants is not normally recommended.

The organisol maskants used at the ALCs are solvent reduced elastomers. Table 3.3-1 compares the different organisol maskants at each ALC. They contain the same basic solid components with one or more of the following solvents: toluene, xylene, naptha, or perchloroethylene. These solvents vary due to requirements for evaporation rates or environmental or safety restrictions. The percentage of solvents may be adjusted to regulate evaporation rate due to difference in the evaporation rate at different room temperatures. Toluene and xylene are flammable materials. Naphtha is combustible. Occupational Safety and Health Administration (OSHA) requirements for worker exposure to these chemicals is more stringent for perchloroethylene than for the others because it is more toxic. Currently, the ALCs restrictions for either perchloroethylene or the flammable solvents are not

ALC	Maskant	Vendor	Solvent System: As Manufactured	Solvent System: Recommended Thinners	Solvent System: Actual Thinners	Operation
OC-ALC	Coverlac A-2114	Spraylat	Toluene	Toluene or Xylene	Perchloroethylene or Toluene	Electroless Nickel
OO-ALC	Turcoform Mask 522	Turco	Toluene Xylene and Naphtha	Turcoform Thinner #4 or Toluene or Xylene	Toluene	Aluminum Chemical Milling
SA-ALC	Turcoform Mask 5580-G	Turco	Perchloroethylene Toluene and Xylene	Turcoform Thinner #4 or Toluene	Perchloroethylene	Electroless Nickel
SM-ALC	Blue Mask 15	Crest	Perchloroethylene and Xylene	Blue Mask #15 Thinner	Blue Mask #15	Aluminum Chemical Milling and Electroless Nickel
WR-ALC	Turcoform Mask -540R	Turco	Perchloroethylene and Naphtha	Perchloroethylene	Toluene	Aluminum and Titanium Chemical Milling

ORGANISOL MASKANTS COMPARISON AT EACH ALC

TABLE 3.3-1

consistent. They are addressing the issues for stricter regulations differently but they are proceeding towards a goal to minimize the use of hazardous chemicals. With the regulations for air toxics, the emissions of these solvents will have more stringent regulations. It is recommended that the ALCs continue the study for maskants in TO 7 Phase II, to study the feasibility of alternate, environmentally safe maskants to eliminate the use of solvents in the chemical milling maskants, see paragraph 3.2.2.

Because possible organisol replacements are to be studied in Phase II, the MDMSC TO No. 7 team has not concentrated its efforts on them during Phase I evaluations. Appendix G provides more detailed cost information on the different organisol maskants that are used.

4.0 REVIEW OF ACCOMPLISHMENTS

MDMSC has had a staff of engineers concentrating their efforts on evaluating the metal finishing shop masking operations. Efforts began by familiarizing our TO No. 7 assessment members with the TI-ES Program in general. Simultaneously the team developed a masking and masking related chemical database.

The site team visited the five ALCs on one trip. OC-ALC and OO-ALC were visited on subsequent trips. Because OC-ALC and OO-ALC best represent the different masking systems, they were used as models to develop the recommendations for improvement.

At the request of Air Force Logistics Command Directorate of Maintenance (AFLC/MA), the writing and submittal of the Phase II proposal was moved to the beginning of the TO No. 7 schedule to allow concurrent efforts with respect to optimizing current processes and introducing new technologies to ALC masking operations. This would then result in a single set of consistent recommendations. Advanced technology masking processes which are commercially available were reviewed and the two most favorably assessed candidate types (water-borne systems and decal-type systems) were chosen and developed as the basis of the proposal. However, authority to proceed with

Phase II was not received; therefore, recommendations developed during the current effort which are contingent upon combined results of the two studies may result in some Phase I recommendations being modified or rescinded at the completion of Phase II.

The two quick fixes applicable to the ALCs are summarized below with their respective cost savings.

- Institute Wax Properties Control Procedure at All ALCs.
  MDMSC proposes that written wax properties control procedures be used assure the quality of wax maskant. This procedure will track the melting point and acidity of the material. This procedure is to be used whether the wax is recycled or not. Yearly savings of $21,600 may be realized.
- Change Pumice Cleaning Methods at OC-ALC.
  MDMSC recommends that OC-ALC use a biodegradable citrus solvent, (if approved at OC-ALC), soap and pumice mixture to scrub parts with instead of perchloroethylene and pumice. This mixture will speed the cleaning time and give the surface a water break free and active surface. Yearly savings of $164,285 may be realized.

AFLC may realize an estimated $560,888 in recurring savings if all the recommendations and quick fixes are incorporated.

5.0 OKLAHOMA CITY AIR LOGISTICS CENTER

The masking shop at OC-ALC is operating with technical expertise which reflects the understanding of the wax process used. The OC-ALC operation was the most advanced of the ALCs. Because of this, no major recommendations are made for this ALC, but three other observations are noted in paragraphs 5.4 - 5.4.4.

5.1 WAX MASKING OVERVIEW

OC-ALC uses wax for masking parts for all plating processes other than electroless nickel plating. The wax masking areas are located in Building 3001 which also houses the plating processes. The three wax areas are segregated according to their plating use, which is masking parts for nickel, chrome, and silver plating. The nickel and chrome wax areas are in the same vicinity. The nickel and chrome wax tanks are in separate areas from the nickel and chrome plating lines. The silver wax area is near the silver plating process which is located away from the other processes.

The wax procedures at OC-ALC are the most refined and advanced of all the ALCs. Their recycling and control procedures have made the masking processes the most cost effective system. MDMSC bases this assessment on: the cost of the maskant for the number of parts masked, the cost of the maskant, the volume of maskant replacement required, the longevity of the masking material, and the consistent throughput of quality parts.

5.1.1 Wax Masking Facility

Three separate wax and dewax facilities are at OC-ALC. The area dedicated to chromium plating consists of three wax tanks with three adjacent dewax tanks and a vapor degreaser charged with perchloroethylene. The nickel plating masking area consists of three wax tanks with two dewax tanks and a perchloroethylene vapor degreaser. The masking area dedicated to silver plating and some cadmium plating, consists of a wax tank with a separate dewax tank.

The tanks for preheating and waxing parts are heated to operating temperatures with steam. The steam flows through pipe heat exchangers hanging inside the wax tanks.

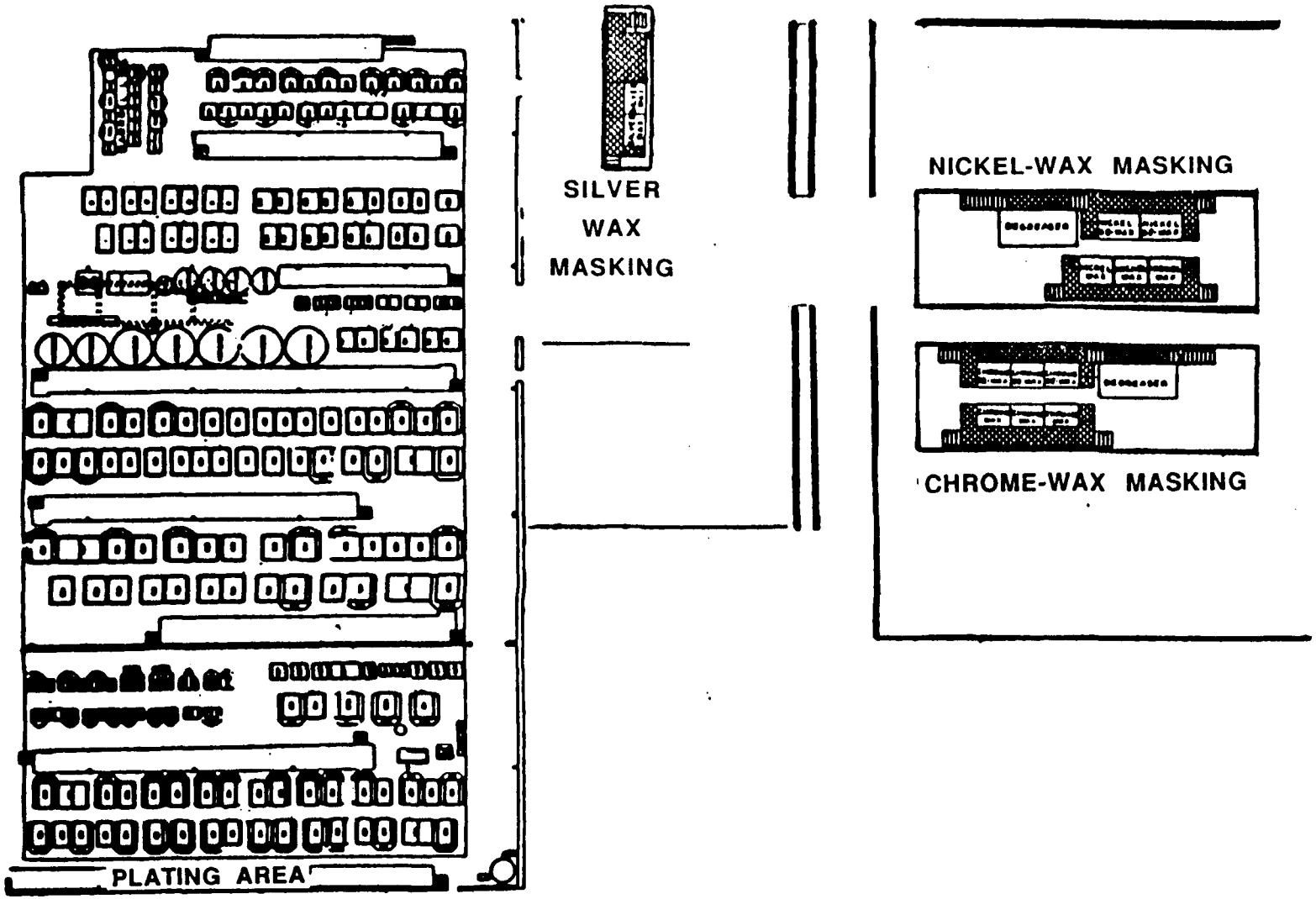
The locations of the masking lines with respect to the plating shop are shown in Figure 5.1-1. The individual masking lines for hard chrome, nickel, silver, and nickel-cadmium plating are further shown in Figures 5.1-2, 5.1-3 and 5.1-4.

The hard chrome plate process flow, see Appendix C, also shows how the masking operation is integrated into the plating process flow. Hard chrome is used as an example of the waxing procedure as it represents the most difficult process. The other masking lines operate in a much similar manner.

The segregation of the wax systems reflects concern for avoiding cross contamination of metals from one plating tank to another, especially from the chrome salts. The wax maskant is recycled from each of the elevated dewax tanks back to its appropriate affiliated wax coat tanks through insulated pipes that fill when the dewax tank fills to their level. The level of the wax tanks are constantly maintained in this manner.

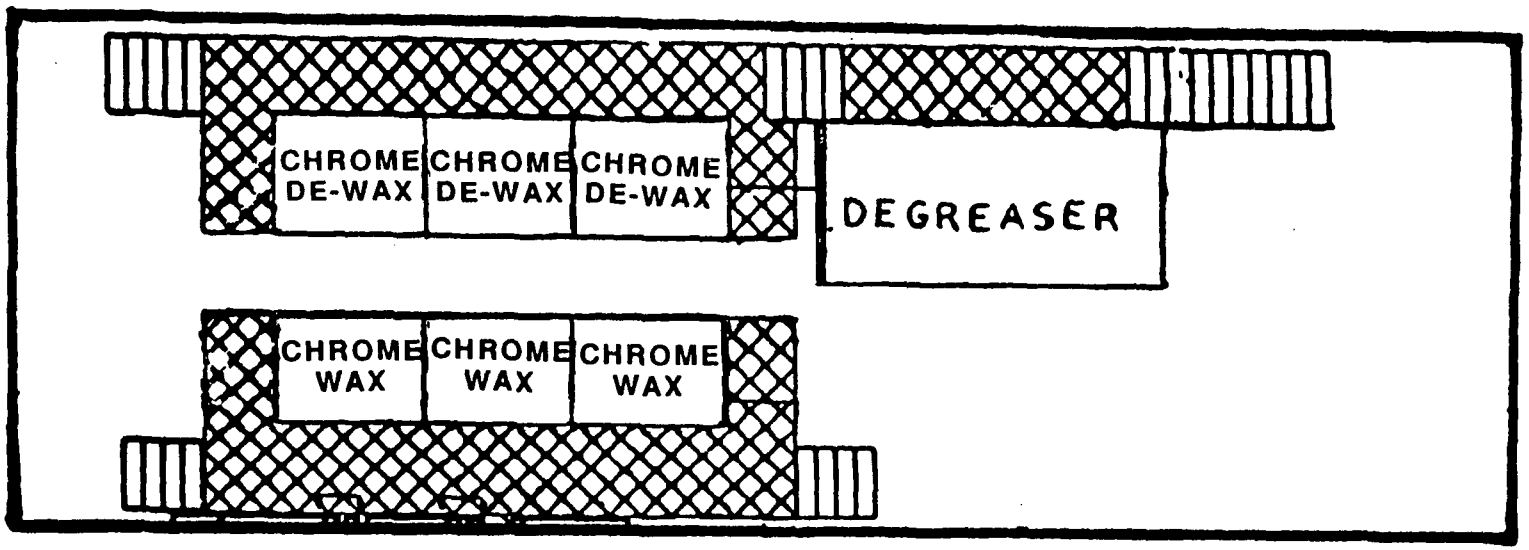
The vapor degreasers have side stream solvent recovery systems, and a distillation reservoir with a pump that forces the solvent through a hand spray nozzle to wash the parts. The degreasers are covered and are in line with the dewax tanks.

The existing facilities for hot-dip wax masking of parts prior to plating operations are good and the analytical controls of the wax maskant have been in practice for such a significant time that few production problems occur.



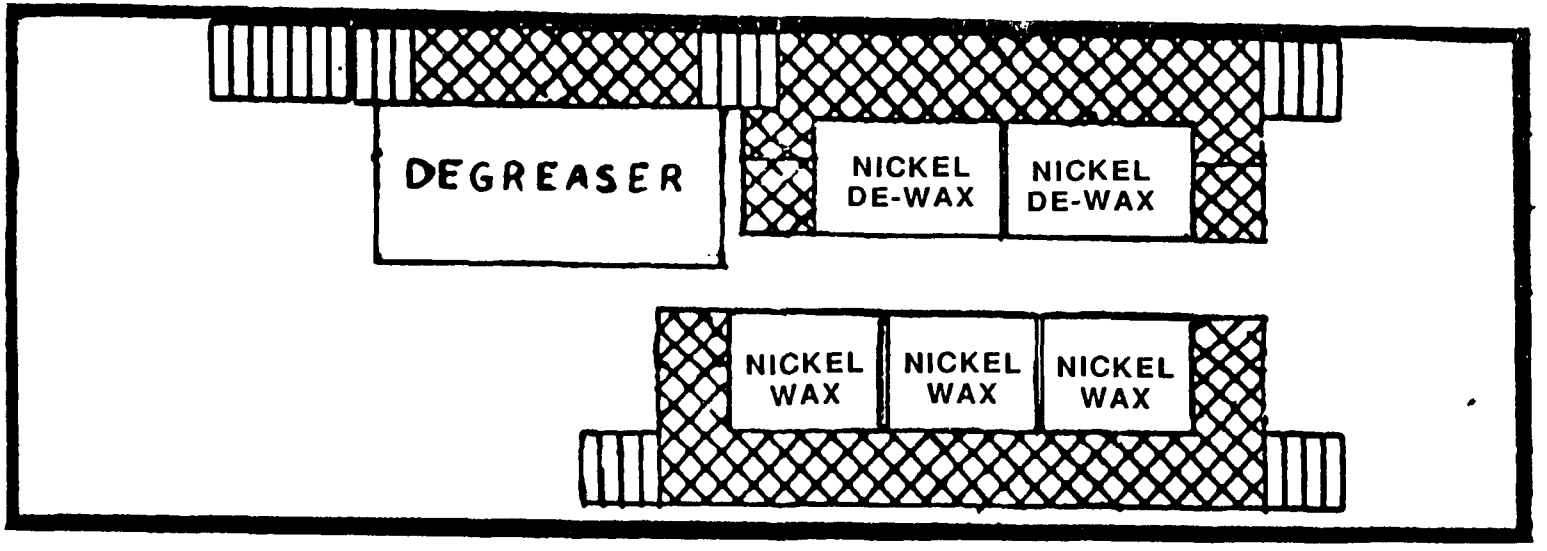
LOCATION OF MASKING LINES WITH RESPECT TO THE OVERALL PLATING SHOP (OC-ALC)

FIGURE 5.1-1



FLOOR LAYOUT OF HARD CHROME WAX MASKING LINE (OC-ALC)

FIGURE 5.1-2



FLOOR LAYOUT OF NICKEL ELECTROPLATE WAX MASKING LINE (OC-ALC)

FIGURE 5.1-3

FLOOR LAYOUT OF SILVER/CADMIUM WAX MASKING LINE (OC-ALC)

FIGURE 5.1-4

5.1.2 Wax Masking Process

In each of the three wax areas, the dewax tanks are maintained at a temperature of 250°F. Technical Orders 42C2-1-7 and 2-1-111 require the wax temperature range to be 210°F to 240°F. The adjacent wax tanks are maintained at 170°F - 190°F to build wax to a proper protective thickness, per Technical Order 42C2-1-7.

Application of pressure-sensitive tapes (lead-foil tape for hard chromium and nickel plating plus the use of plastic and paper tapes) prior to the application of the hot dip wax is similar to that used by the other ALCs. Red Miccromask lacquer is applied onto the lead tape when plating. This is done to help define the area to be trimmed. Glycerin and zinc oxide paste is also used per the Technical Orders to fill threaded and blind holes to facilitate the complete removal of wax during the dewax operation.

After wax is applied, the wax is trimmed to expose the paste mixture or the paper masking tape. The wax over the metal foil tape is scored with a knife. Then the wax is lifted manually from the paste or the tape is unwound removing the wax. Either way the plating area is free from wax. After this, any glycerin and zinc oxide paste is then washed off. This process is also explained in the Technical Order.

Cleaning unmasked areas, after the total masking operation and prior to plating, is accomplished by wiping the specific surfaces with a perchloroethylene wetted pad. The area is then scrubbed with a pumice filled scouring pad to remove any soil and wax. The parts are rinsed until the dried film of pumice is completely removed. This may take some time as the dried pumice is rather adherent and difficult to see. Approximately twenty seven percent of the plating preparation time is spent pumice cleaning. All parts can be pumice cleaned faster by using the method described in Quick Fix Plan paragraph 6.0. Soaking the scrubbed masked parts in a warm alkaline soak cleaner is the last procedure before plating. The part is then rinsed and put into the plating bath.

Masking for some of the engine parts for chromium plating could be reduced by incorporating a compression-molded plastic fixture as currently performed at SA-ALC, see paragraph 5.4.2.

Although no official records were kept or available on plating reject history, plating rejects are reported minimal. This can be partially attributed to the cleaning procedure. Rejects are so low that keeping records of them are considered an unnecessary burden. There is no evidence or history of any pitting in the deposits caused by the masking material or a non activated surface.

Following plating, the waxed parts are rinsed well, neutralized in an alkaline solution (if plated in an acid solution), rinsed again, and then dried. The parts are then put in the appropriate segregated hot wax dewax tank until the wax is melted off. The part is then drained of any wax in trapped areas by rotating the part to allow the trapped wax to escape. While the part is still hot, any remaining tape used is removed.

Finally, the part is allowed to cool then put into a vapor degreaser containing perchloroethylene and washed with the solvent to remove all of the remaining wax and adhesive residues.

5.1.3 Wax Maskant Material

All waxing tanks at OC-ALC are charged with BE-Square 175 wax, supplied by Petrolite Specialty Polymers Group, which is a ductile, microcrystalline wax with a nominal melting point of 182°F. It is also called 180-185 Wax which is the melting temperature range of BE-Square 175. The wax is maintained and adjusted by the Process Control Laboratory to maintain the ductility and melting point of the wax and control acidity. The ductility and melting point is maintained by additions of Victory wax, supplied by Petrolite, and the acidity is controlled by addition of triethanolamine in both the chrome and the nickel wax tank areas, see Appendix A of the Quick Fix Plan.

The wax has no evidence of breaking down or causing any detrimental effects to the plating solutions or to the plating deposits. The supervisors and personnel contacted state that they have not experienced any unusual problems that could be associated with the wax such as bond failure or pitting.

All of the microcrystalline waxes are free from solvents and pose little safety or fire hazards at operating temperatures. The operating temperature is 180°F to 250°F. The difference between the 560°F flash point and the maximum operating temperature is 310°F, so the possibility of fire is limited.

5.2 ORGANISOL MASKING OVERVIEW

The organisol masking operation at OC-ALC is a simple one. Only one small tank of masking material is used. The tank is located in the electroless nickel area which is the only process at OC-ALC requiring this type of maskant. OC-ALC does not do any chemical milling.

The maskant is a readily available commercial product that is suitable for protecting parts to be electroless nickel plated. Its cost is comparable to other organisol maskants, see Appendix G.

5.2.1 Organisol Masking Facility

Since no chemical milling is done at OC-ALC, minimal organisol equipment is required. It simply consists of a ducted tank located at the end of the electroless nickel line.

5.2.2 Organisol Masking Process

Because the organisol masking installation is small, the process is not complicated. Parts are simply immersed in the material until a satisfactory coating is achieved. This may take one to two dips depending on the humidity and viscosity. Lower the humidity, decreases the organisol drying time and prevents excessive dripping. Parts not requiring dipping can be masked by painting the organisol onto selected areas needing masking.

The parts are air dried thoroughly, up to twenty four hours, before being trimmed. Trimming too soon damages the bond of maskant to the part. It also makes a rough uneven line which affects the plating smoothness at the edges. The area to be plated is carefully scored at its boundaries to avoid scratching the metal. The maskant is then manually peeled from the area to be processed.

After plating, the maskant is physically pulled from the part. Sometimes the maskant is so adherent or the part has such a complicated shape that the maskant can not be easily removed.

5.2.3 Organisol Maskant Material

The organisol currently used is Spraylat Corporation's Coverlac A-2114. Like all organisol maskants this material is a solvent soluble rubber based material (butadiene polymer) mixed with solvent soluble plastic materials such as styrenes.

The solvent used in this maskant is toluene which is a flammable solvent with a flash point of 45°F. Perchloroethylene and/or toluene is the thinner. Perchloroethylene is nonflammable, but it is more toxic than toluene. With the more stringent safety and environmental regulations, the feasibility of using alternate maskants should be studied in TO 7 Phase II, see Paragraph 5.4.1.

5.3 RECOMMENDED IMPROVEMENT

Because this masking shop is operating in a manner which reflects a great deal of technical expertise and understanding of the process they are using, we did not identify any major recommendations. We did identify areas for improvement which are discussed in the Quick Fix Plan, paragraph 5.2.

5.4 OTHER OBSERVATIONS

The following observations were not considered as recommendations or quick fixes because they had a less significant impact on the areas of time, quality, or cost. These observations were recorded to assist the ALCs in developing ideas that will further enhance the masking operations.

5.4.1 Replacement of Organisol Maskants

The masking processes at OC-ALC for the high temperature processes (electroless nickel) utilize Spraylat Corporation's Coverlac A-2114 a solvent reduced elastomer. This maskant is used for electroless nickel plating as shown in Appendix G.

This masking process is a significant source of solvent emissions in the plating shop. The maskant contains toluene, a flammable solvent, and it is thinned with toluene and/or perchloroethylene. It is technically sound to look to the issue of eliminating solvents before the expected regulations sharply reducing Volatile Organic Compound (VOC) emissions become effective. The proposed air toxics regulation calls for a reduction in both toluene and perchloroethylene emissions.

During our familiarization work at MDC facilities and assembly of our masking technology database, we identified a water based maskant system. Full evaluation of this system will be deferred until the execution of Phase II, but we feel that we should mention its existence here. This technology has been developing over the past 15 years and only within the past four years has it attained the necessary technical performance to compete with solvent based systems. The water based system chosen for implementation at MDC St. Louis, see Appendix B produces a quality advantage based upon increased environmental compliance. Preliminary cost estimates, see Appendix G, show that it presents higher material costs than the presently used solvent based systems, but it will reduce a need for future air pollution control equipment.

5.4.2 Use of Molded Plastic Masking Fixtures

Certain high repetitive rate parts lend themselves to the design and use of plastic compression molded masking fixtures because of the relative complexity of the masking when done by hand. An analysis to determine when and where to use these fixtures would be beneficial for OC-ALC.

At SA-ALC, plastic compression molded masking fixtures are being used to mask areas on the I.D. of cylindrical parts. This strategy can be useful if applied

correctly. SA-ALC has found the method useful enough after experimentation that they have a vendor working with them on site to develop more fixtures. This method would be most useful in hard chromium plating, perhaps in conjunction with conforming anodes, to limit the amount of surface cleaning and demasking labor effort.

The masking fixtures which we saw at SA-ALC were used where the end or bore I.D. and a small portion of the external cylindrical surface were masked. The advantages available over the labor intensive wax removal processes are easily seen. No negative comments were volunteered by SA-ALC personnel other than those relative to judicious selection of parts and geometric constraints.

Because experience is needed in determining where these fixtures can be best utilized, we recommend that an experienced vendor such as Acme Masking Company of Indianapolis, Indiana be contacted to work with shop floor and process engineering personnel to develop fixtures with high pay back potential.

5.4.3 Record Plating Rework Causes and Quantities

Currently, OO-ALC is the only ALC plating shop that keeps good records of the quantity or cause of rework. With these records, plating problems and their remedies can and have been successfully diagnosed. The availability of rework data which identifies the cause of the rework would enable AFLC and the ALCs to pinpoint rising rework rates from their processes and begin formulating corrective action as at OO-ALC.

The MDMSC TO No. 7 team believes this observation should not be confined to plating and masking operations, but should be implemented in other shops.

6.0 OGDEN AIR LOGISTICS CENTER

The major recommendation identified for OO-ALC is the change from plastic to wax maskant. Recycling the wax maskant from the chromium plating line is only a part of this recommendation, and it is the source of the associated initial capital costs. The wax is a much less expensive material than the currently used plastic and does not need to be changed out because it has a much longer pot-life. Also, recycling of this wax will help reduce material costs and minimize the additional load that would be placed on the vapor degreaser by the wax system. A full rationale and cost benefit analysis of this recommendation is found in paragraphs 6.3.2 and 6.3.3. This recommendation will result in first year savings of over $314,000 and recurring of $375,000.

The significant elements of this recommendation are discussed below, after a concise summary of the present operation. In the description of the current operation, the majority of the data was gathered from the masking questionnaire, see Appendix E. The remainder of the data, except where noted, came from MDMSC TO No. 7 observations, telephone conferences and information received from the ALCs especially OO-ALCs MANEP engineering personnel. Several recommendations are made but because they have a less significant impact, they are listed in the other observations paragraphs 6.4 - 6.4.3.

6.1 PLASTIC MASKING OVERVIEW

OO-ALC uses a plastic maskant to protect all parts to be selectively plated except for electroless nickel. The plastic masking area and plating tanks are located in Building 505. There is only one plastic masking tank and it is ten years old.

The plastic masking procedure is the simplest and most time efficient of any plating masking procedure of all the ALCs. The parts are taped, and dipped only once in the plastic maskant before being trimmed.

The masking material is four and one half times more expensive than any other plating maskants used by the ALCs. The plastic is short lived and must be

disposed of regularly because it deteriorates with heat. If it is not changed out often enough, it not only contaminates itself, but also some of the plating solutions. Old material does not provide adequate protection to the parts and contamination contributes to plating rejects.

6.1.1 Plastic Masking Facility

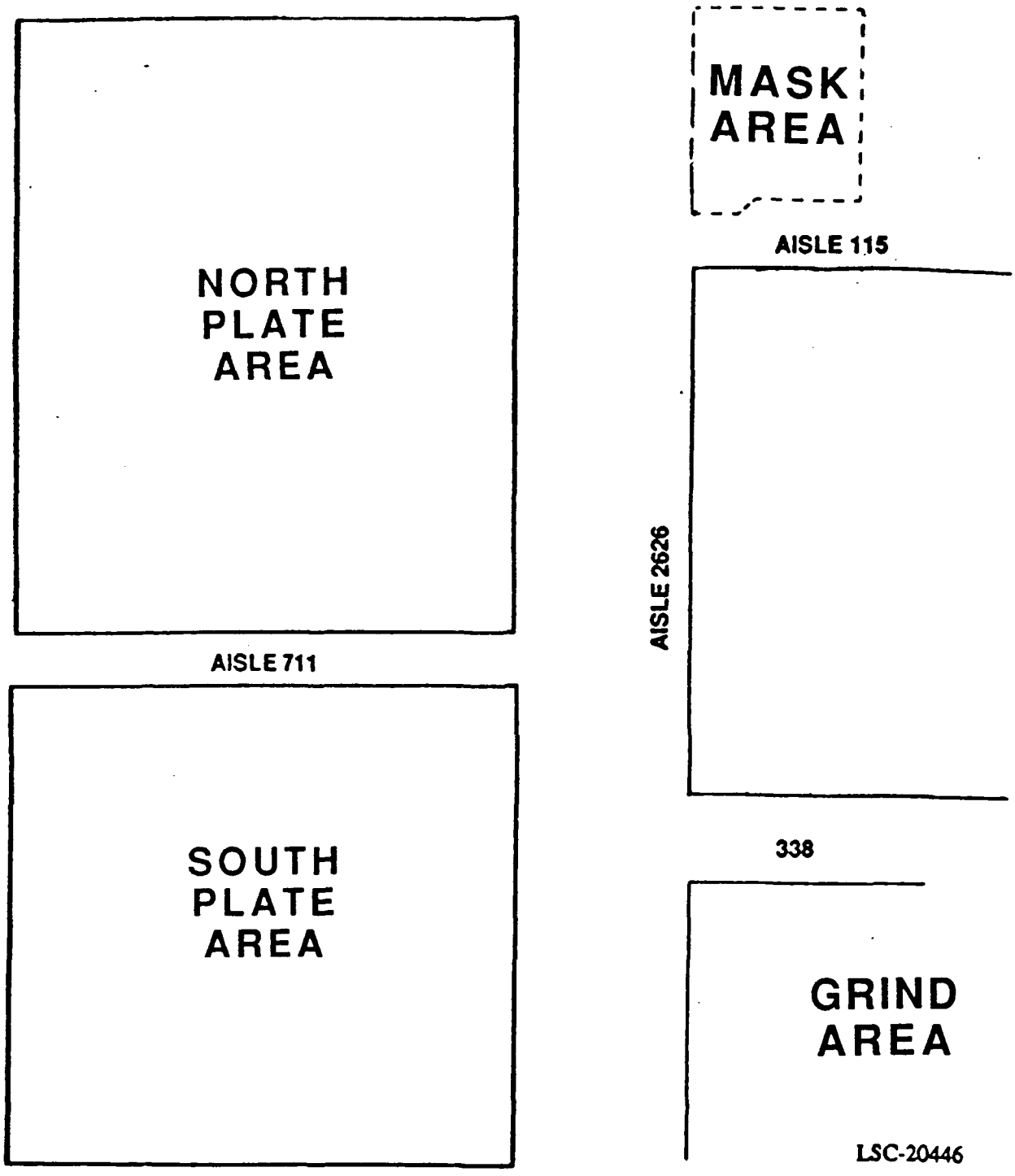
The hot melt plastic masking line is located in a separate area, close to the chrome plating lines, within the plating shop, as shown in Figure 6.1-1. The location is convenient since most of the masked parts are chrome plated. The floor layout of the present masking area, indicating tank positions, is shown in Figure 6.1-2.

The masking line consists of one hot melt plastic tank custom built in 1979. It has a 160" long by 32" wide by 76" deep working space with approximately 4" of insulation. It has adjustable overflow weirs at each end of the tank that allows a constant overflow of melted plastic to be agitated within the tank. Without this movement the plastic would overheat, so automatic heat operated shutoffs are incorporated for safety. The heat required to melt the plastic is provided by special electric heaters secured to the outer surface of the tank bottom. There are hot spots in the tank where the plastic can overheat so the importance of periodic maintenance on this integrated system to prevent fires cannot be overstressed. This is emphasized by the fact that a fire has occurred with this material.

The process flow for masking and hard chrome plating is shown in Appendix C. The hard chrome plating is emphasized in this discussion because it represents the largest volume of any of the plating processes at OO-ALC requiring masking.

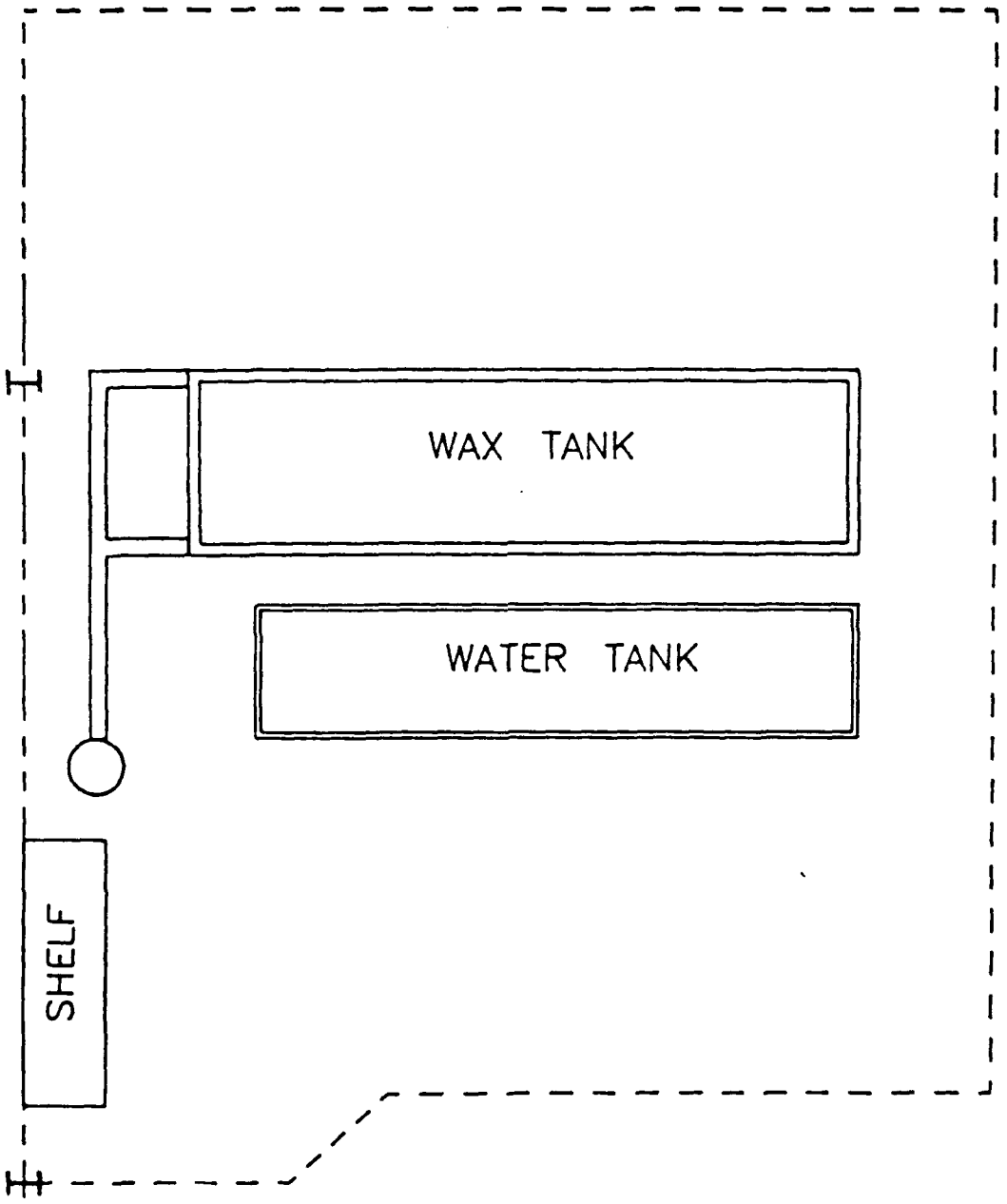
6.1.2 Plastic Masking Process

Parts to be plated are vapor degreased using 1,1,1-trichloroethane and then dry pressure blasted with aluminum oxide grit and/or glass beads. Initial masking is accomplished with any or all three different masking tapes. Lead-foil tape is applied at the border lines of the areas to be selectively plated and is used as



LOCATION OF HOT MELT PLASTIC MASKING TANKS WITH RESPECT TO OVERALL PLATING SHOP FLOOR LAYOUT (OO-ALC)

FIGURE 6.1-1



FLOOR LAYOUT OF PRESENT MASKING AREA (OO-ALC)

FIGURE 6.1-2

an electrical robber to decrease roughness on the edges. Plastic tape is used to provide additional protection against undesired plated deposits. This tape is also used instead of the hot plastic maskant for parts that have small journals.

The masked parts are dipped once in the hot melt plastic masking tank and then quenched in cold water to solidify the plastic. The plastic bordering the areas of the part to be selectively plated are scribed with a sharp knife and the plastic is manually peeled from the part. Plastic removed in the trimming operation is often returned to the plastic tank and remelted. After plating, the maskant is scored with a knife and peeled from the part. Only a few parts are vapor degreased to remove any adhesive residues transferred from the masking tapes.

The masking of parts for selective plating of nickel and silver is similar to the procedure for chromium plating except that no lead-foil tape is utilized.

6.1.3 Plastic Maskant Material

The masking operations at OO-ALC preparatory to the plating of chromium, nickel and silver, currently incorporate the use of a hot melt plastic (cellulose acetate butyrate in accordance with MIL-P-23242B, Type II), supplied by Evans Manufacturing Company as B-100 Mask Peel, see Appendix F. This material has the shortest life span and is the most expensive maskant used other than the organisols. The vendor rates the pot life of the hot dip plastic maskants at 500 to 700 hours at 350°F which is less than a calendar month.

The manufacturer states that the maskant material is recyclable, but he recommends not mixing used material in the tank with unused material. A separate tank is recommended for the recycled plastic maskant and then used only for non critical parts. With these parameters it is not economically feasible to recycle. OO-ALC has chosen not to recycle the maskant except for the trimmings. OO-ALC is now extending the use of the plastic by reducing the temperature and using the maskant for approximately three months. The maskant will deteriorate slower at lower temperatures but the plating quality is being sacrificed by extending the use for this length of time. The tank contents,

of material that has exceeded its useful life, are discarded due to thermal degradation which causes objectionable odors in addition to a tacky, overly adherent, opaque coating when solidified.

The maskant exhibits excellent resistance to mechanical damage during handling and transporting of the masked parts. The OO-ALC process engineering staff believes the plastic maskant is best for the parts they process (large and heavy parts associated with aircraft landing gear fabricated of high strength steels). It is also more time efficient than wax maskants. OO-ALC feels comfortable with the hot melt plastic maskant for these reasons in spite of some major drawbacks. These include high material costs and short life span. The plastic maskant is four and one half times more expensive than common hot dip waxes. It is replaced an average of 4.3 times per year due to deterioration.

The plastic maskant is disposed of with the sanitary trash after rinsing. Three week old, used maskant was tested for toxicity by the Extraction Procedure Toxicity (EPT) test for chrome at OO-ALC. Three samples were tested: one after a room temperature quick rinse, one after rinsing for twenty minutes in hot water, and one after soaking in ferrous sulfate solution for one hour with a final quick rinse in hot water. The maskant rinsed with a quick dip of room temperature water failed the EPT test with 19.3 ppm of chrome. Both of the other samples indicated the chromium level was less than 5 ppm. This is below the limits to be classified as a hazardous waste. This test needs to be carried out on regular intervals during the lifetime of each new addition of maskant. At some point the deteriorating maskant may absorb more chromium salts than can be removed with the present rinsing methods.

6.2 ORGANISOL MASKING OVERVIEW

The organisol maskant at OO-ALC is used primarily for the chemical milling process. One tank of maskant is located in the chemical milling area. It is a simple process which includes dipping the part in the maskant tank, air drying, and then scribing before milling.

The maskant is a readily available commercial product that is suitable for protecting parts to be chemically milled or electroless nickel plated. Its cost is comparable to other organisol maskants, see Appendix D.

6.2.1 Organisol Masking Facility

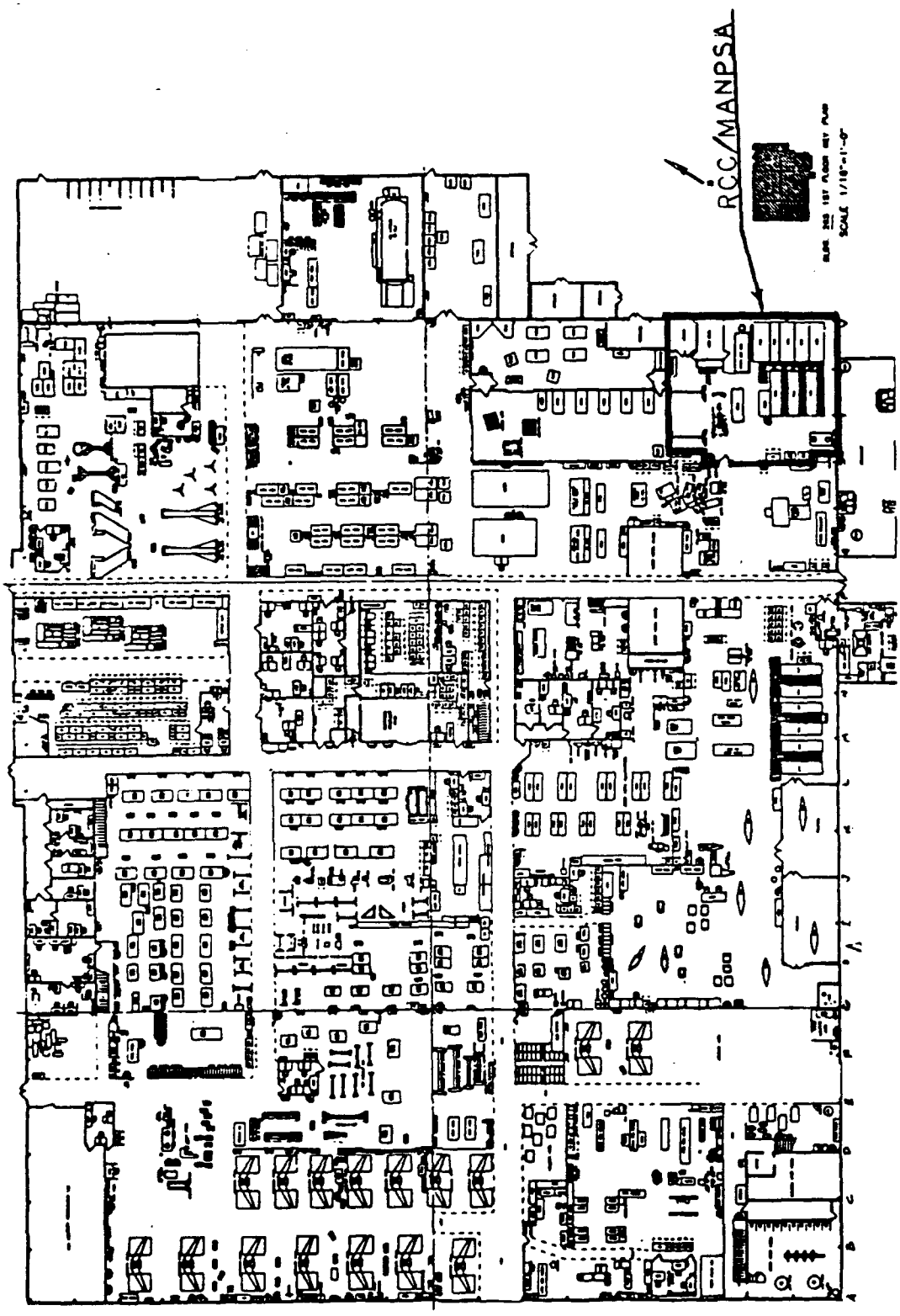
The chemical milling process is located in Building 265, see Figure 6.2-1. It contains a chemical milling line with cleaning solutions, chemical milling solutions, a vapor degreaser and an oven. A table and workbench is located in an open area adjacent to the maskant tank enclosure and the chemical milling area. This is for scribing and removing the maskant, see Figure 6.2-2.

The fumes from the solvents in the tank are removed by vents around the top edge of the tank. No ventilation is provided for solvents emitted from the drying parts over this tank. A manually operated fire extinguishing system has been installed for the maskant tanks since the solvent is flammable. Manual fire extinguishers are also available.

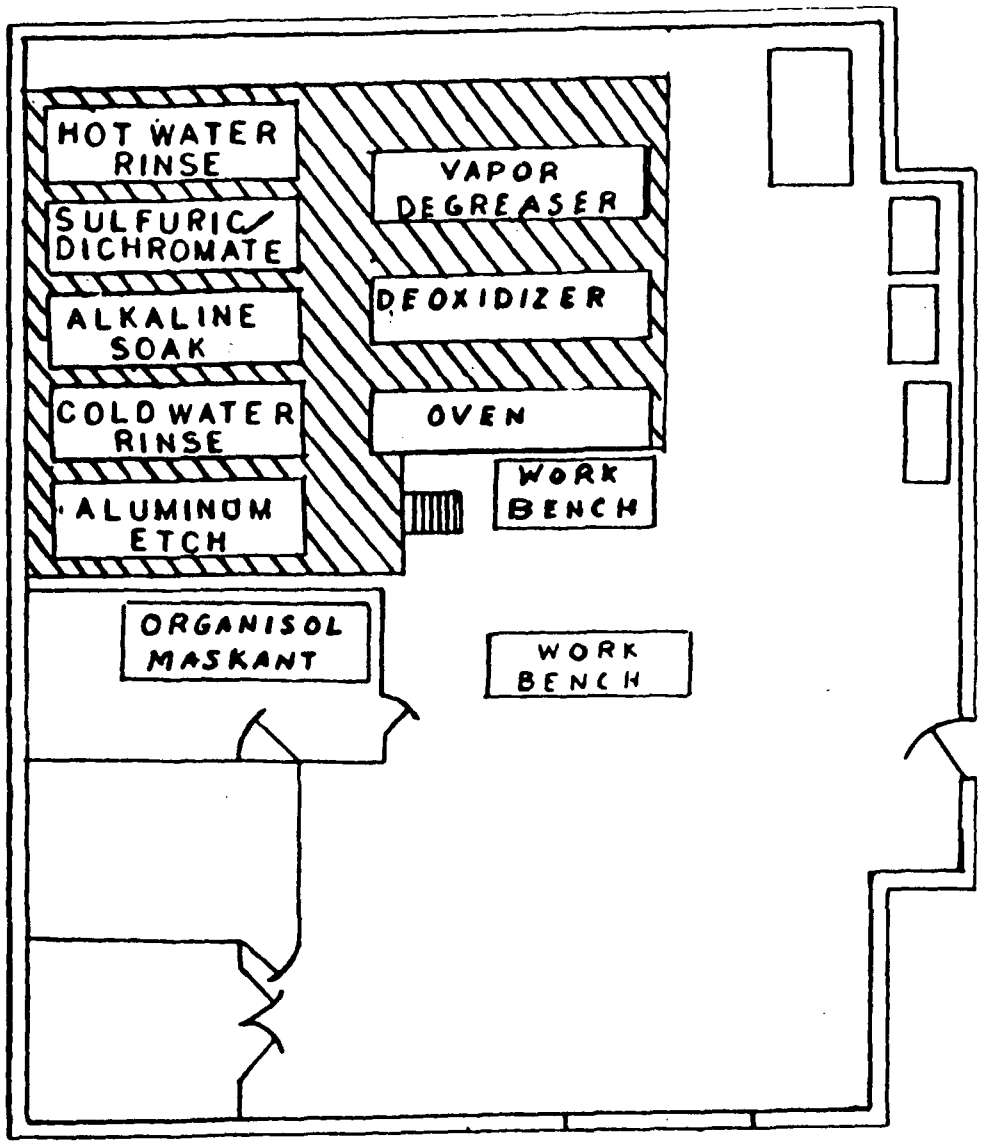
The ducting is constructed from galvanized sheet metal which is acceptable for the solvent fumes but will corrode from exposure to the milling chemicals. Therefore the vents are in poor condition. It was noted that the ventilation is inadequate for employee exposure to the chemical solutions, see Appendix G for a copy of air sampling performed by OO-ALC. The chemical fumes have also resulted in damage to parts and metal stock that were stored in the chemical milling room. The organisol maskant tank is located in a segregated area between the chemical milling line and a paint booth. There are two electric mixers to stir the organisol maskant. Paper air deflectors are attached to the motors to keep the air from drying the surface of the maskant. The mixers need to be changed to air motors with the air vented upward so drying problems in the maskant tank will not result.

6.2.2 Organisol Masking Process

The organisol masking installation is not complicated. Degreased parts are immersed in the material until a coating of approximately twenty mils thick is achieved. This may take two to three dips depending on the viscosity, humidity,



LOCATION OF CHEMICAL MILLING AREA WITH RESPECT TO OVERALL BONDING SHOP - BUILDING 265 (OO-ALC)
FIGURE 6.2-1



LOCATION OF ORGANISOL MASKANT TANK IN CHEMICAL MILLING FACILITY (OO-ALC)

FIGURE 6.2-2

and room temperature. The parts are rotated 180 degrees to get the coating uniform. The parts are air dried thoroughly, up to twenty four hours, before being trimmed. Fiberglass and metal templates are used to score and trim the area to be etched. Trimming too soon damages the bond of maskant to the part. It also makes a rough uneven line which affects the etching smoothness at the edges. The maskant adjacent to the area to be milled is carefully scored at its boundaries to avoid scratching the metal, and is manually peeled from the part.

After chemical milling, the maskant is pulled off of the part. Sometimes the maskant is so adherent or the part has such a complicated shape the maskant can not be easily pulled loose. Small parts can be put into thinner which will slowly dissolve the material. The larger parts must be laboriously peeled and scraped with a soft tool.

6.2.3 Organisol Maskant Material

The organisol currently used is Turcoform Mask 522. Like all organisol maskants this material is a solvent soluble rubber based material (butadiene polymers) mixed with solvent soluble plastic materials such as styrenes. The maskant contains toluene, xylene, and naphtha, and is thinned with toluene. The solvent is flammable, so OO-ALC has installed a manually operated fire extinguishing system. Environmental regulations for these solvents are becoming more stringent, so the feasibility of using alternate, less hazardous materials should be studied, see paragraph 6.4.2.

6.3 RECOMMENDATION TO REPLACE PLASTIC MASKANT

MDMSC recommends the following major improvement for the masking area of the Building 505 plating facility. The recommendation is to change the maskant from Evans B-100 plastic maskant to Petrolite BE-Square 175 wax maskant as soon as the existing masking tank needs replacing. This recommendation would result in a substantial material cost savings. The Petrolite BE-Square 175 wax maskant would permit recycling of the majority of the maskant resulting in further cost savings.

Figure 6.3-1 shows preliminary floor plan of the proposed wax system. This plan is to show the feasibility of our recommendation fitting into the existing space. Any detailed plan would be included in an implementation plan.

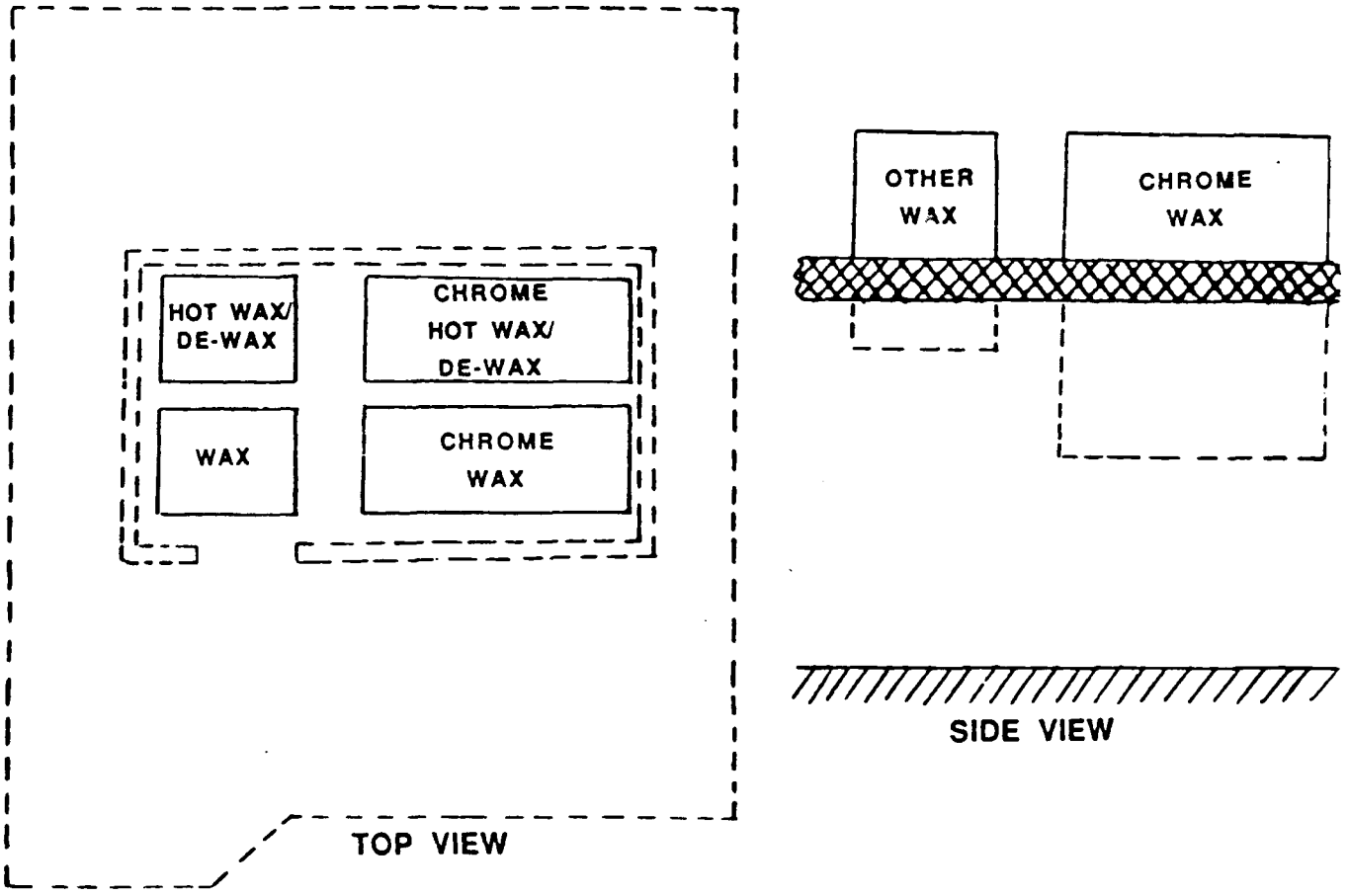
The change from plastic to wax maskant is estimated to save over $388,500 per year after implementation costs, see paragraph 6.3.3.

6.3.1 Proposed Wax Maskant Process

The significant elements to accomplish this recommendation are:

- Install the new system as soon as the existing custom built masking tank requires repairs that will keep the system out of production for the same length of time it takes to install the new system.
- Install steam lines for new tanks.
- Purchase and install four new insulated stainless steel tanks with drains to remove any water or plating solutions.
- Purchase and install steel plate coil steam heat exchangers for each tank.
- Install air mixers on the wax and first coat/dewax tanks.
- Fill all new tanks with a wax maskant (Petrolite BE-Square 175).
- Recycle used wax maskant from the hard chromium plating line by neutralizing, rinsing and drying the wax after plating.
- Perform final cleaning of plated parts in the vapor degreaser after most of the wax is melted off in the hot wax/dewax tank. (CR33 can be repaired for this use.)
- Train personnel on the wax masking system.
- Implement wax property controls according to the procedure in the Quick Fix Plan, paragraph 5.1.

The four tanks in our recommendation are insulated stainless steel with girth members made of steel square tubing. The design is similar to those used commercially and available from most tank vendors, see Appendix G. The dimensions of the chrome masking tanks are proposed to be 84"x36"x108". The nickel masking tanks would be 48"x36"x72". These sizes are based on the parts measured on visits to OO-ALC. The same type of stainless steel tanks



PRELIMINARY FLOOR PLAN OF PROPOSED WAX SYSTEM

FIGURE 6.3-1

recommended in TO No. 5 for WR-ALC is recommended. Any moisture or water introduced in the tank is heavier than the wax, therefore the water settles to the bottom of the tank. Stainless steel will prevent any rusting failures which in turn should give almost infinite service. A bottom drain will eliminate any of the unwanted liquids trapped under the wax.

The steam heat exchangers are also commercially available in many different configurations, see Appendix F. Since they are only exposed to the protective wax maskant they can be made of steel which has much better heat transfer characteristics than stainless steel.

Either the hot wax/dewax tanks or the nickel wax tank can be used for their respective purposes for parts from any plating tank. The chrome wax tank can only be used to coat parts for the chrome tank.

The BE-Square 175 wax temperature should be controlled between 210°F and 240°F per Technical Order 42C2-1-7 in the hot wax/dewax tank. The maskant from the hot wax/dewax tank should be used for all first coats of wax. The cooler wax tanks are used for all subsequent coats and the temperatures should be maintained at 180°F to 200°F. This is also called out in the Technical Order.

The parts will be dipped in the hot wax tank first to warm the part and apply a thin coat of wax as a base for the next coat. Then the parts will be dipped in the wax tank at 180°F three to four times to build up a wax coating. Then the wax is cooled to room temperature. The wax is then removed from the area to be plated. The trimming operation must be followed with a solvent wipe to eliminate wax residue as well as adhesive tape residue.

The recycling procedures have two separate process flows, one for chromium plated parts and one for all other plated parts. Chromium salts are serious and detrimental contaminants to all other plating solutions even in small quantities. The materials from the other plating solutions are not as detrimental as chromium salts in the same small quantities if introduced into the chrome plating solutions. Furthermore chromic acid, which is a strong oxidizer, has a

deteriorating effect on all maskants to varying degrees. The other plating solutions do not affect the maskants this way. Proper rinsing is all that is needed to eliminate wax contamination problems.

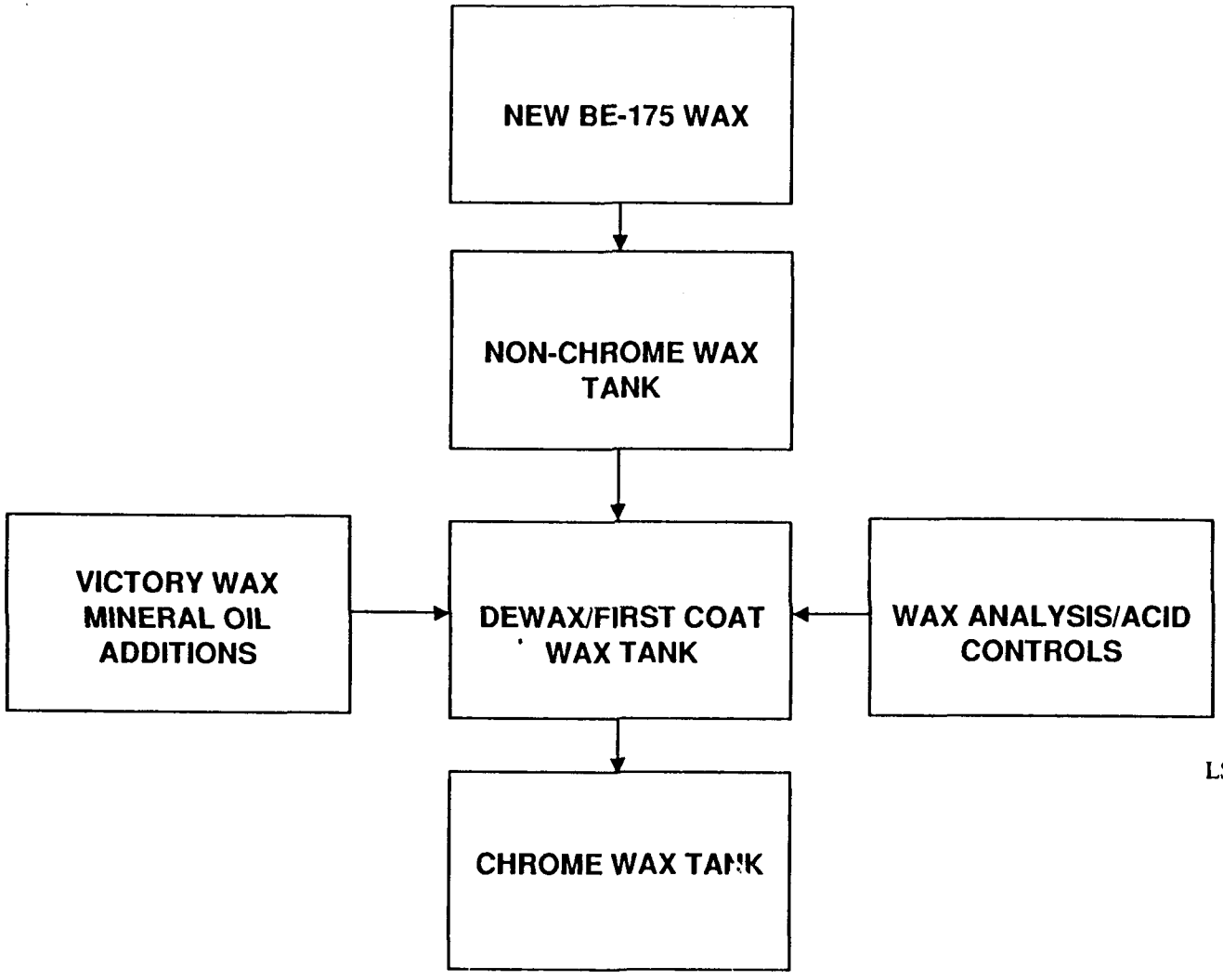
With this in mind, the wax removed after the chromium plating process should be rinsed thoroughly in agitated rinse water. Next, it should be neutralized in an alkaline solution, such as the chrome strip, then rinsed again in air agitated hot (150°F to 170°F) water. This final rinse of hot water is not to remove wax, but to clean any final chromate film from the surface and facilitate drying. The part then needs to be dried before dipping it into the hot wax/dewax tank.

The hot wax tank should have same BE-Square 175 wax as the wax tanks but the temperature needs to be higher to melt the wax quicker. The temperature should be closely controlled because high temperatures drive off petroleum products, which keeps it ductile, from the wax.

The parts from the other plating operations also need to be cleaned in agitated rinse water. If the waxed parts were in acid solutions, they should be neutralized as the chrome plated parts explained previously. The masked parts from the alkaline solutions need only to be rinsed well. All parts should be rinsed in hot water to accelerate drying.

The dried parts should then be dewaxed in the hot wax/dewax tank. This wax will then replenish the chrome wax tank. Since this is the tank used the most for masking, it will require the most replenishing. The parts for the other plating operations can be dewaxed in the non-chrome wax tank as well as the hot wax tank if necessary, although it will take longer. All additions of wax to replenish dragout losses should be made to the non-chrome wax tanks. By doing this virtually all of the wax controls should be done in the hot wax/dewax tank, see Figure 6.3-2.

Parts that have been thoroughly dewaxed can have the last film of wax removed in the vapor degreaser. The amount of wax removed should require the vapor degreaser to be cleaned every two weeks. This can be accomplished in the



WAX REPLENISHMENT CYCLE
FIGURE 6.3-2

existing vapor degreaser (CR 33). It would be even more advantageous to the wax system if the degreaser is moved back to the other end of the existing line. This is now being discussed at OO-ALC to help eliminate the problem of water getting into it. A flow diagram is in Appendix C showing the parts flow for this proposed wax system.

Although our recommendation is based on installing new tanks, the existing plastic maskant tank may be determined useable when an implementation plan is developed. The electric heaters should be deactivated and the steam heat plate coils used to heat the wax. It is important that the plastic be completely removed from the sump area of the plastic tank to avoid mixing and contamination of the wax.

The maintenance of wax properties is significant in maintaining first time quality. The wax control procedure, is included in the Quick Fix Plan.

6.3.2 Rationale Leading to Change

MDMSC recommends that OO-ALC replace the plastic maskant with wax, based on quality improvements and reduced costs. The wax is a less expensive material than the plastic and has lower operating costs. The wax provides better protection for the base metal from the plating solutions.

The recommended wax (Petrolite BE-Square 175) is a relatively hard but ductile wax used at many plating shops in industry with good results. The material cost of this wax is $0.72/lb., considerably less than the $3.27/lb. for the plastic. When used with proper wax property control procedures, its wax life is estimated to be at least seven years. With a high use, the wax life may never be exceeded because of losses estimated at 96 pounds per week and the continual makeup additions with new BE-Square 175 and with Victory Wax as indicated in the wax property control procedure, see Quick Fix Plan, paragraph 5.0.

The equipment and operating costs are economical compared to the present custom fabricated equipment costs, see paragraph 6.3.3. The recommended

steam is less expensive than the electric heat currently used. Electric heat is the most expensive type of energy available, see Appendix D. Steam heat can not be used for heating the plastic maskant because of the higher temperature plastic maskant requires.

The hot melt plastic coating tank was custom built for OO-ALC. There is no spare backup tank and the tank is not a stock item that can be easily replaced. If there are any problems with the tank, production would have to halt until it is repaired or replaced. Any replacement tank would require a lengthy lead time for construction. The original cost of this complex tank was $59,550 which is equivalent to $104,200 FY89 dollars. The wax system recommended could be installed for about the same cost but the four tank system would assure continued production if any one of the wax tanks had to be shut down.

The wax maskant can be recycled to minimize waste disposal and material costs. The wax will be rinsed, removed in a hot wax tank, and the remaining wax removed in the vapor degreaser. This procedure will save most of the wax for reuse.

The wax removed in the vapor degreaser will be a thin coating. The existing vapor degreaser in the chrome plate lines was not working, but is scheduled to be repaired. This vapor degreaser will handle the parts to be degreased. Although there will be an increased load on the vapor degreasers, recycling wax will minimize this additional burden.

OO-ALC will realize improvements in the quality of plating and masking as well as a reduction in cost. The plastic maskant deteriorates with heat in conjunction with time which contaminates itself and the chromium plating baths and reduces protection for the plated parts.

The plastic is cellulose acetate butyrate, which is a source of organic and particulate contamination. If used, it should be maintained within the guidelines of Military Specification MIL-P-23242B(AS), see Appendix G. The procedures noted in this Mil Spec for testing the material are applicable not only for

procurement but for use as well. This specification includes testing criteria to determine the deterioration and contamination factors throughout the maskant's use.

Several important criteria of the Mil Spec include:

- Paragraph 4.7.4. lists odor as a determining factor of whether the material is good. If it has an obnoxious odor it is a sign of deterioration.
- Contamination determined per paragraph 4.7.10 stipulates no scum or contaminants appear on the surface of water after boiling and cooling.
- For any reuse, follow paragraph 4.7.11 to keep from contaminating plating solutions.
- Because of its known hazards of breaking down and absorbing chromic acid, paragraph 6.3 dictates plastic maskant not be reused after being exposed to chromic acid.

The samples obtained in our second visit would not pass most of the tests described in the Mil Specs. The maskant was over three months old and was scheduled to be replaced. A sample of the material taken at that time was not flexible, had a very strong sour butyrate odor, and when the sample was boiled in water a noticeable quantity of degraded material was on the water when cooled. The maskant also had leached out enough chromium salts to color the water a distinct yellow.

By using the material over three months (2160 hours), the maskant was already two months (1400 hours) past the vendor and military specification recommended maximum operating time. OO-ALC operates the maskant at a lower temperature trying to make the maskant last longer. The plastic maskant tank is operated at 315°F, 35°F lower than the standard temperature of 350°F. Although this change in temperature may increase the life of the maskant, it deteriorates beyond productive use before the three month change out time. Contamination and decreased part protection caused by the deteriorated maskant are the reasons for the existing military specifications outlining its use.

This contamination can cause pitting and poor bonding. Some steels with high percentages of alloys such as manganese and silicon are more sensitive to contamination as noted by airline plating facilities. Rework and scrap data provided by OO-ALC show that 14% of the journals plated on the KC135 aft axles require rework due to pitting. This is also substantiated by information developed by the grinding department. All of these defects may not be completely attributable to these organic contaminants, but the contaminant is a contributing factor to all pitting at OO-ALC.

Many items made of 300 M alloy steel, such as in many landing gear components, have a high frequency of pitting when the hot melt plastic is used at OO-ALC. Shop personnel have noted that the pitting gets worse as the maskant ages. Excessive pitting is one of the criteria used at OO-ALC to change the maskant. This, in itself, demonstrates their knowledge of the known contaminating effects. The personnel have evaluated the problem and now mask 300M steel parts, such as the KC135 aft axles, with vinyl tape. When tape is used, the deposits stop pitting. Using tape for parts such as axles is now standard practice.

Wax masking materials have no history in private industry or at any of the other ALCs of causing the problem that has been noted with this maskant. Testing for contaminants is not a criteria for its use as noted in the military specifications for masking waxes, see Appendix G.

The wax maskant is softer and not as tough as the plastic maskant. In the past, wax was used in a small production tank. OO-ALC had problems with damage of the wax on the masked parts. With different operating procedures this problem could be reduced. Commercial airline overhaul facilities, such as Trans World Airlines, have used masking wax successfully on 747 and L-1011 airliner landing gear parts, comparable in size to those at OO-ALC, for years.

Parts may require a better storage system than now being used. The parts are more safely stored after waxing on A frame carts. OO-ALC already has A frame carts in the masking area. Larger models that will hold more and larger parts

are used at airline repair facilities. They are equipped with larger tires and can be easily moved under a hoist to lift the parts from the cart.

6.3.3 Cost Benefit Analysis

Because costs of the recommended changes are dependent on several factors besides the cost of the maskant alone, OO-ALCs TI personnel and MDMSC's TO No. 7 team developed a list of data that had to be collected. This information was needed to make an evaluation that could be performed and remain within the scope of the TO No. 7 proposal.

The data considered pertinent is the following:

- Plastic maskant tank and wax maskant tank heating cost estimates
- Vapor degreasing cost estimates of heating, solvents, maintenance, and waste disposal
- Equipment cost estimates of the tanks, heat exchangers, mixers, and installation labor and material cost estimates
- Required training cost estimates
- Cost estimates for touch time and flow time
- Cost estimates of rework caused by the maskant

The information was not developed as would have been required in a process characterization but for as accurate an estimation as possible. A more detailed study may be needed if the recommended changes are incorporated. This would be done within the guidelines of an implementation plan.

An estimated annual cost savings, based on information provided and developed, of $388,500 occurs from the implementation of the recommended improvements as shown in Table 6.3-1.

	CURRENT ANNUAL COSTS	PROPOSED CHANGE INVESTMENT COSTS	PROPOSED CHANGE ANNUAL COSTS
NONRECURRING COSTS (1)			
FACILITIES			
LAND	$0	$0	$0
BUILDINGS	$0	$0	$0
SUPPORT EQUIPMENT			
DEVELOPMENT	$0	$0	$0
ACQUISITION	$0	$0	$0
TANKS	$0	($16,600) (2)	$0
STORAGE EQUIPMENT	$0	$57,000 (3)	$0
INSTALL & CHECKOUT			
TANKS	$0	$11,320 (4)	$0
INITIAL MASKANT FILL	$0	$(10,802) (5)	$0
LOGISTICS SUPPORT			
INITIAL SPARES	$0	$0	$0
INITIAL TRAINING (DEV & PRESENTATION)	$0	$19,200 (6)	$0
TECHNICAL DATA	$0	$0	$0
TOTAL NONRECURRING COST	$0	$60,118	$0
RECURRING COSTS (1)			
TOUCH LABOR			
VAPOR DEGREASER	$0	$0	$2,895 (7)
MASKING	$81,005 (8)	$0	$118,998 (9)
OTHER LABOR	$755,591 (10)	$0	$649,903 (11)
SUPPORT EQUIP MAINT	$0	$0	$0
SPARES AND SPARES MGMT			
SOLVENT TO DEGREASE	$0	$0	$8,268 (12)
MASKANT CHANGEOUTS	$243,130 (13)	$0	$0
USAGE REFILL	$47,090 (14)		$3,600 (15)
TECHNICAL DATA	$0	$0	$0
MOD KITS	$0	$0	$0
CONFIGURATION DATA MGMT	$0	$0	$0
UTILITIES			
ELECTRIC HEAT (MASKANT)	$50,600 (16)	$0	$0
STEAM HEAT (MASKANT)	$0	$0	$11,998 (17)
STEAM HEAT (DEGREASER)	$0	$0	$1,310 (18)
DISPOSAL COSTS	$0	$0	$5,442 (19)
TOTAL RECURRING COSTS	$1,177,417	$0	$802,414
TOTAL COSTS	$1,177,417	$60,118	$802,414
ANNUAL COST SAVINGS	$375,003		

SUMMARY OF INVESTMENT COST AND ANNUAL SAVINGS (CONSTANT FY89 DOLLARS)
TABLE 6.3-1 (SHEET 1 OF 3)

NOTES:

(1) ONLY ITEMS THAT ARE SIGNIFICANTLY EFFECTED BY THE PROPOSED CHANGE HAVE BEEN ESTIMATED

(2) THE DIFFERENCE BETWEEN THE RECOMMENDED WAX MASKING TANKS FULLY EQUIPPED ($87,600) AND THE REPLACEMENT COST OF AN EQUIVALENT PLASTIC MASKANT TANK IN FY89 DOLLARS ($104,200) IS A SAVINGS OF $16,600.

(3) THE COST FOR 30 MOBILE A-FRAME STORAGE RACKS CAPABLE OF HOLDING 10,000 POUNDS OF WAX MASKED PARTS SAFELY IS $57,000.

(4) THE DIFFERENCE BETWEEN THE RECOMMENDED WAX MASKING TANK INSTALLATION ($16,440) AND THE INSTALLATION COST OF AN EQUIVALENT PLASTIC MASKANT TANK REPLACEMENT ($5,120) IS $11,320.

(5) THE DIFFERENCE BETWEEN THE COST TO FILL THE RECOMMENDED WAX TANKS WITH BE-SQUARE 175 WAX ($29,720) AND A REPLACEMENT PLASTIC WITH EVANS B-100 MASKANT TANK ($40,522) IS A SAVINGS OF $10,802.

(6) BECAUSE THE NEW WAX MASKING METHOD IS FOREIGN TO OO-ALC, TRAINING COSTS OF $19,200 IS INCLUDED.

(7) EXTRA LABOR COSTS ESTIMATED AT $2,895 WILL BE REQUIRED TO CLEAN A VAPOR DEGREASER USED TO REMOVE WAX FILM LEFT FROM THE DEWAX TANK.

(8) THE TOUCH LABOR OF THE PLASTIC MASKING SYSTEM WOULD BE ABOUT 50% LESS THAN THE TOUCH LABOR FOR WAX MASKING. THIS IS BASED ON AN AVERAGE 19 PARTS PLATED PER DAY WITH TOUCH LABOR TIME ESTIMATED AT 32 MINUTES PER PART FOR 250 WORKING DAYS PER YEAR. AT $31.98 PER HOUR THIS AMOUNTS TO $81,005.

(9) THE TOUCH LABOR OF THE WAX MASKING SYSTEM WOULD BE ABOUT 50% MORE THAN THE PRESENT TOUCH LABOR FOR PLASTIC MASKING. THIS IS BASED ON AN AVERAGE 19 PARTS PLATED PER DAY WITH TOUCH LABOR TIME ESTIMATED AT 47 MINUTES PER PART FOR 250 WORKING DAYS PER YEAR. AT $31.98 PER HOUR THIS AMOUNTS TO $118,966.

(10) THE YEARLY COST FOR LABOR, OTHER THAN THE TOUCH MASKING TIME OF 15 PEOPLE, IS 250 DAYS X 8 HOURS PER DAY X $31.98 PER HOUR MINUS THE $81,005 IS $755,591.

(11) THE $755,591 LABOR THAT IS NOT TOUCH LABOR MASKING TIME IS FURTHER REDUCED TO $649,903 BECAUSE OF REDUCED MANPOWER. THE WAX MASKING SYSTEM LABOR REQUIREMENTS OF NO PITTED PARTS IS ESTIMATED TO BE $105,688. THIS IS BASED ON 198 REJECTED PARTS PER YEAR AT $534 OF LABOR PER PART.

SUMMARY OF INVESTMENT COST AND ANNUAL SAVINGS (CONSTANT FY89 DOLLARS)

TABLE 6.3-1 (SHEET 2 OF 3)

(12) THE WAX MASKING SYSTEM WILL REQUIRE $8,268 FOR NEW SOLVENT AND DISTILLATION LABOR COSTS OF REUSED SOLVENT.

(13) THE COST OF PLASTIC MASKANT REPLACED BECAUSE OF DETERIORATION BASED ON SIX REPLACEMENTS PER YEAR IS $243,130.

(14) THE COST OF THE PLASTIC MASKANT LOST ON MASKED PARTS IS $47,090 BASED ON 14,400 POUNDS LOST PER YEAR AT $3.27 PER POUND.

(15) THE WAX MASKANT LOST TO DRAGOUT IS $3,600 PER YEAR. THIS IS FOR 5,000 POUNDS PER YEAR AT $.72 PER POUND.

(16) THE COST TO HEAT THE PLASTIC MASKANT USING THE MANUFACTURERS DATA AND ASSUMING THE POWER IS OFF 1/3 OF THE TIME IS $50,600. THIS IS BASED ON POWER COSTS OF $.057 PER KWH, THE HEATERS USE 157.5 KW PER HOUR, AND THE TANK HEATING 8448 HOURS PER YEAR.

(17) THE STEAM HEAT COST OF $11,998 IS CALCULATED TO BE 1/7.9 (12.7%)OF THE COST OF ELECTRIC HEAT. THIS IS BASED ON STEAM COSTING $2.01 PER 1000 POUNDS AT OO-ALC. THE HEAT IS THEN PROPORTIONALLY ADJUSTED FOR THE DIFFERENCES IN OPERATING TEMPERATURES.

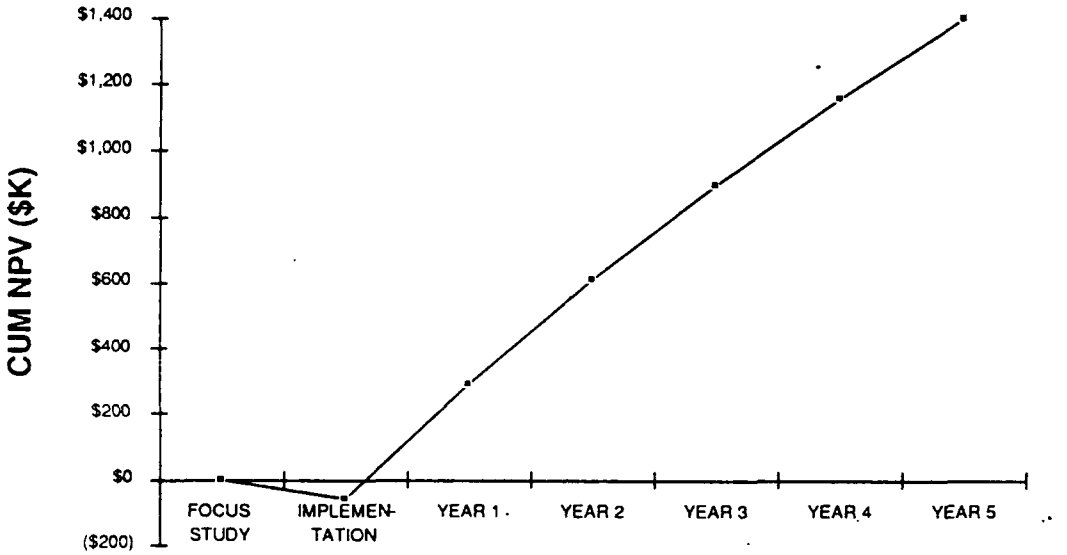
(18) THE $1,310 COST TO HEAT THE DEGREASER IS INFORMATION PROVIDED BY OO-ALC.

(19) BASED ON 96 POUND OF WAX LOST PER WEEK AND THE DEGREASING COMPONENTS INVOLVED, THE DISPOSAL COSTS OF THE WAX SYSTEM IS ESTIMATED TO BE $5,442.. COSTS FOR THE PLASTIC MASKANT DISPOSAL ARE NOT AVAILABLE BUT IT IS CURRENTLY BEING DISPOSED IN THE SANITARY TRASH.

FOR FURTHER EXPLANATIONS AND CALCULATIONS, SEE APPENDIX D.

SUMMARY OF INVESTMENT COST AND ANNUAL SAVINGS (CONSTANT FY89 DOLLARS)
TABLE 6.3-1 (SHEET 3 OF 3)

The Cost Benefit Analysis (CBA) shows a savings of $1,396,591 in terms of Net Present Value (NPV) using constant FY89 dollars, see Figure 6.3-3. The CBA is in compliance with regulation AFR 173-15, cost analysis procedures.



CUM NPV IN CONSTANT FY89 DOLLARS
FIGURE 6.3-3

The CBA covers the time frame starting with the implementation through five years after the completion of implementation. The annual cost savings was assumed to start at the end of implementation.

The NPV takes into account the time value of money and is calculated by discounting a cash flow. The focus study cost, implementation cost, and recurring savings were spread by fiscal year quarters and discounted back to the first quarter by using a mid-quarter discounting factor equivalent to an annual discount factor of 10%. Basically, this means a dollar that is earned in FY90 is worth $.91 in FY89 terms ($1.00/1.1), due to the ability to borrow or lend at a positive interest rate.

It will take six months or less to implement the proposed changes described in the recommendation.

6.4 OTHER OBSERVATIONS

The following observations were not considered as recommendations or quick fixes because they had a less significant impact on the areas of time, quality, or cost. These observations were recorded to assist the ALCs in developing ideas that will further enhance the masking operations.

6.4.1 Preparation of Aluminum For Chemical Milling

Problems were experienced at OO-ALC with masking for chemical milling. A significant problem involved the inability of the presently used maskant to adhere to identification markings on the aluminum plate to be chemically milled. This marking ink is applied at the aluminum plate rolling mill. The present procedures involve use of a quick dip in the chemical milling fluid, or a strong alkaline cleaning solution. It has been found that in some cases heavily applied ink is not removed by this method. In such cases, etching for a long enough time to remove the ink results in nonuniform chemical milling which is not acceptable. If ink markings are not completely removed by this method, a solvent such as methyl ethyl keytone is used to remove any remaining markings.

From our observations at OO-ALC, we know this process would represent a productivity improvement in terms of lower scrap rates.

6.4.2 Replacement of Organisol Maskants

The masking processes used at all five ALCs for the high temperature processes (electroless nickel and chemical milling) utilize different commercial products, but all are solvent reduced elastomers. This masking process is a significant source of solvent emissions within the plating and masking facilities. It is technically feasible to eliminate solvents.

MDC facilities have developed a water based maskant system to replace organisols, see Appendix B. Full evaluation of this system will be deferred until the execution of Phase II, but we believe we should mention its existence here. This technology has been developing over the past 15 years and only within the past four years has it attained the necessary technical performance to compete with solvent based systems.

7.0 SAN ANTONIO AIR LOGISTICS CENTER

The masking shop at SA-ALC is operating in a manner that reflects their understanding of the wax process. Their operation was the second most advanced wax system of the ALCs. Because of this no major recommendations are made, but four other observations are noted in paragraphs 7.4 - 7.4.3.

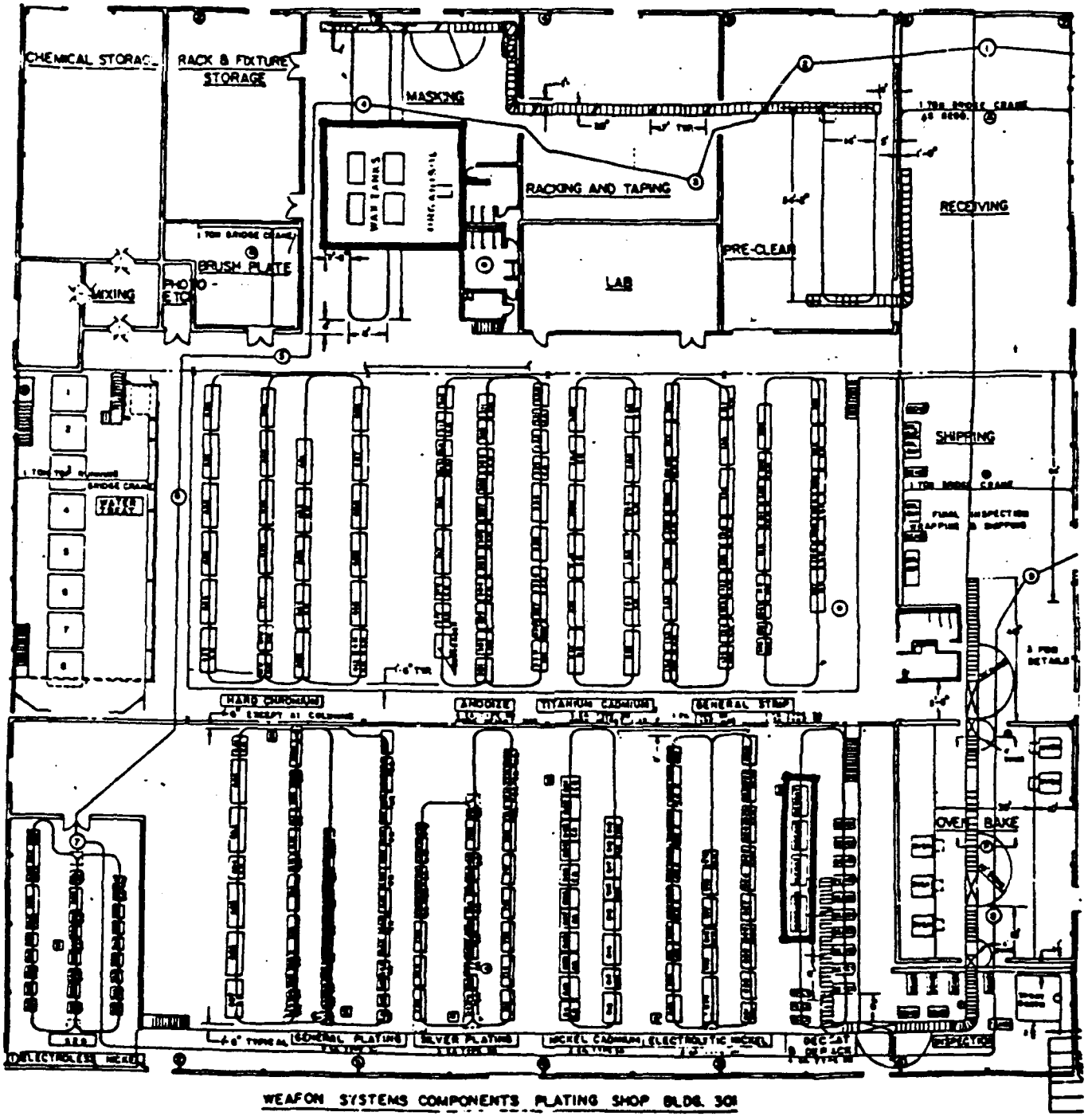
7.1 WAX MASKING OVERVIEW

SA-ALC uses wax for masking parts for all applicable metal finishing operations other than electroless nickel plating. The wax masking areas and dewax areas are located in Building 301. The chemical processing facility is also in the same building. The single wax masking area is used for protecting parts for heavy deposits of chrome, sulfamate nickel, and silver. Many parts that must be stripped of the worn or used coatings are also waxed to protect the other areas. A separate area exists to remove wax from the parts after they are finished being chemically processed. The used wax and vapor degreaser sludge is disposed of as hazardous waste.

7.1.1 Wax Masking Facility

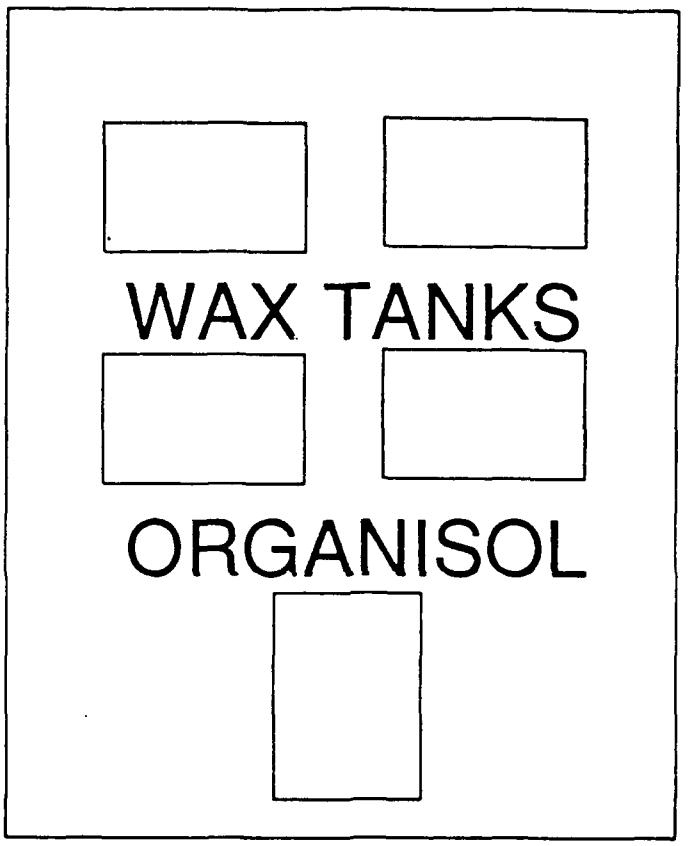
The single wax masking facility has four wax coating tanks which can be used for any of the masking operations. The floor layout for the wax masking area is shown in Figure 7.1-1 and its location relative to the chemical processing tanks. The arrangement of the masking tanks is shown in Figure 7.1-2. One of the tanks in each of the two double tank units is maintained at 240°F-250°F to provide sufficient heat to raise the temperature of the part. This assures that the first thin coat will be adherent.

The second tank of each double tank unit is operated at 180°F-190°F for the thicker coatings of wax. This provides chemical solution protection as well as the electrical insulation protection. The existing facilities for wax masking of parts prior to plating and chemical metal stripping were good but could be improved. The wax is not recycled and no chemical/physical wax controls were evident.



LOCATION OF WAX MASKING AND DE-MASKING AREAS WITH RESPECT TO OVERALL PLATING SHOP FLOOR LAYOUT (SA-ALC)

FIGURE 7.1-1



FLOOR LAYOUT OF PRESENT WAX MASKING AREA (SA-ALC)

FIGURE 7.1-2

A separate dewax area, consisting of three dewax tanks and a vapor degreaser using perchloroethylene solvent, is used to remove all wax and masking tapes from the parts subsequent to the chemical operation. The facility is shown in Figure 7.1-3.

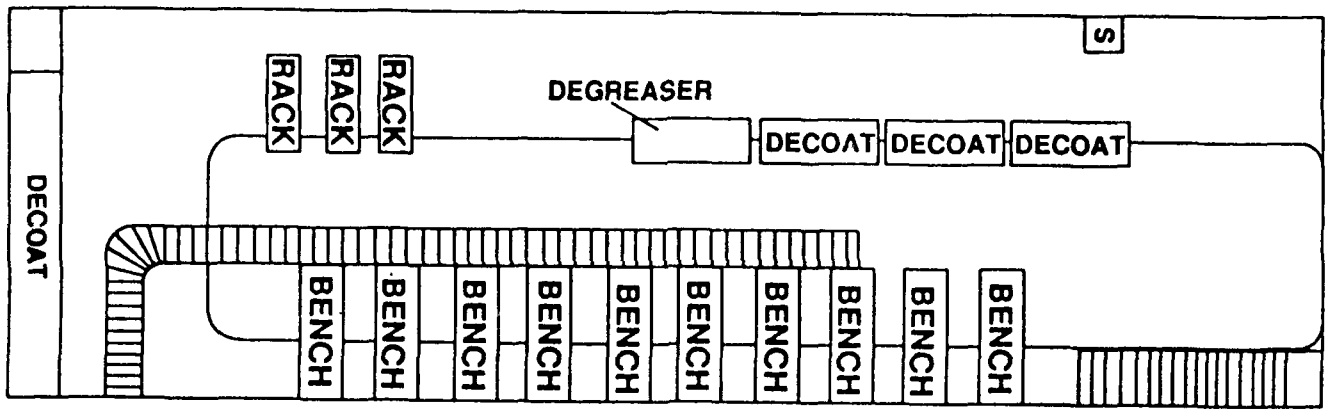
All of the wax coating and dewax tanks are heated to operating temperature with steam heat exchangers in each tank.

7.1.2 Wax Masking Process

Parts to be plated with hard chromium, sulfamate nickel or silver are vapor degreased using perchloroethylene and then dry grit blasted with aluminum oxide. The parts are then masked with a combination of one to three types of masking tapes. Lead or aluminum foil tapes are applied to those areas bordering the specific areas to be plated. Their primary function is to rob high voltages from the edges of the area to be plated, but they also help seal the wax edge.

Plastic tapes, both adhesive and non adhesive backed, are used with of wax as an added protection under the wax maskant. This procedure is not recommended because the wax will not adhere to the plastic tape well and may come off if impacted. Finally, paper masking tape is applied to the areas to be plated. The parts are attached to plating fixtures and hot-dip waxed with at least four separate coats. While the wax is still warm from the last wax coating operation, the area to be plated is scored through the wax at the edges of the tape with a knife and the paper tape removed. The area to be plated is cleaned with a piece of cheesecloth wetted with perchloroethylene. The parts' critical areas are then dry grit blasted (glass bead grit at a maximum of 40 psi) to ensure removal of all traces of wax and adhesive residue.

An alternative masking procedure has recently been implemented to reduce this labor intensive operation. A vendor is providing compression-molded plastic fixtures which are normally used in conjunction with conforming anodes. The plastic form effectively masks those areas previously wrapped manually with masking tapes.



FLOOR LAYOUT OF PRESENT WAX DE-MASKING/DEGREASE AREA (SA-ALC)

FIGURE 7.1-3

The existing facilities for hot-dip wax masking of parts prior to the plating operations were good but improvements are recommended. The wax is not recycled and no chemical/physical controls of the wax were evident. Allowance is made to provide for an adherent, initial coating of wax on the part, and SA-ALC has initiated the use of labor-saving plastic masking devices.

7.1.3 Wax Maskant Material

All waxing tanks at SA-ALC are charged with BE-Square 175 wax, supplied by Petrolite Specialty Polymers Group, which is a ductile, microcrystalline wax having a nominal melting point of 182°F. SA-ALC does not maintain the ductility, the melting point of the wax, or control acidity. The wax has no evidence of breaking down or causing any detrimental effects, either to the plating solutions or to the plating itself. The supervisors and personnel contacted state that they have not experienced any unusual problems that could be associated with the wax, such as bond failure or pitting.

Microcrystalline waxes are free from solvents and pose little safety or fire hazards at operating temperatures. The operating temperature is 180°F to 250°F. The difference between the 560°F flash point and operating temperature is 310°F, so the possibility of fire is limited.

7.2 ORGANISOL MASKING OVERVIEW

The organisol masking operation at SA-ALC is a simple one. Only one small tank masking material is used. The organisol tank is located in the same area as the wax masking tanks. The maskant is used for electroless nickel plating which is the only process at SA-ALC requiring this type of maskant. SA-ALC does not do any chemical milling.

The maskant is a readily available commercial product that is suitable for protecting parts to be electroless nickel plated. Its cost is comparable to other organisol maskants, see Appendix D.

7.2.1 Organisol Masking Facility

Since no chemical milling is done at SA-ALC, minimal organisol equipment is required. This equipment consists of a ducted, covered tank located in the same general area as the wax masking tanks in Building 301, see Figure 7.1-1. A mechanical mixer is used to stir the material to keep the viscosity homogeneous because the air moving across the top of the tank from the ducting evaporates the solvent.

7.2.2 Organisol Masking Process

Because the organisol masking installation is small, the process is not complicated. The parts are first vapor degreased in perchloroethylene. Then the parts are immersed in the material until sufficient coating thickness is achieved. This may take multiple dips depending on the humidity and viscosity. The lower the humidity, the faster the organisol dries and less drips off. Parts not requiring dipping can be masked by painting the organisol onto selected areas.

The parts are air dried thoroughly, up to 24 hours, before being trimmed. Trimming too soon damages the bond of maskant to the part. It also makes a rough uneven line which effects the plating edge smoothness. The area to be plated is carefully scored at its boundaries to avoid scratching the metal, and the maskant is hand peeled from the area to be processed. The plating area is then wiped with a perchloroethylene dampened pad, and the area is chemically cleaned, pumiced, or grit blasted for plating. After plating the maskant is manually pulled off of the part.

7.2.3 Organisol Maskant Material

The organisol currently used is Turco's Turcoform Mask 5580-G. Like all organisol maskants, this material is a solvent soluble, rubber based material (butadiene polymers) mixed with solvent soluble plastic materials, such as styrenes.

The solvent used in this maskant is perchloroethylene which is a nonflammable solvent. Although toluene can also be used as a thinner, the recommended

solvent is Turcoform thinner No. 4, which is less flammable. Perchloroethylene is a toxic material with low employee exposure limits. With the more stringent safety and environmental regulations, the feasibility of using a water based maskant should be studied in TO No. 7 Phase II, see Paragraph 5.4.1.

7.3 RECOMMENDED IMPROVEMENT

This masking shop is operating in a manner which reflects expertise and understanding of the process they are using, so we did not identify any major recommendations. We did identify engineering observations, which are discussed in the other observation paragraphs 7.4 through 7.4.3.

7.4 OTHER OBSERVATIONS

The following observations were not considered as recommendations or quick fixes because they had a less significant impact on the areas of time, quality, or cost. These observations were recorded to assist the ALCs in developing ideas that will further enhance the masking operations.

7.4.1 Replacement of Organisol Maskants

The masking processes at SA-ALC for the high temperature processes (electroless nickel) utilize Turcoform Mask 5580-G solvent reduced elastomer. This maskant is used for electroless nickel plating as shown in Table 3.3-1.

This masking process is a significant source of solvent emissions within the masking operation. The maskant contains perchloroethylene, a toxic solvent, and it is thinned with Turcoform thinner No. 4 and/or toluene. It is technically sound to look to the issue of eliminating solvents before the expected regulations to reduce VOC emissions become effective. The proposed air toxics regulation calls for a reduction in both toluene and perchloroethylene emissions.

During our familiarization work at MDC facilities and assembly of our masking technology database, we identified a water based maskant system. Full evaluation of this system will be deferred until the execution of Phase II, but we feel that we should mention its existence here. This technology has been

developing over the past 15 years, and only within the past four years has it attained the necessary technical performance to compete with solvent based systems. The water based system chosen for implementation at MDC St. Louis (see Appendix B) produces a quality advantage based upon increased environmental compliance. Preliminary cost estimates, see Appendix D, show that this system presents higher material costs than the presently used solvent based systems, but it will reduce a need for future air pollution control equipment.

7.4.2 Record Plating Rework Causes and Quantities

Currently, OO-ALC is the only ALC plating shop that keeps good records of the quantity or causes of rework. With these records, plating problems and their remedies are successfully diagnosed. The availability of rework data, which identifies the cause of the rework, would enable AFLC and the ALCs to pinpoint rising rework rates from their processes and begin formulating corrective action, as at OO-ALC.

The MDMSC TO No. 7 team believes this observation should not be confined to plating and masking operations, but should be implemented in other shops, such as painting and sheet metal.

7.4.3 Wax Recycling and Cross Contamination Control

OC-ALC and SM-ALC both have facilities in place for recycling wax used in the plating process. At OC-ALC, the wax is removed from plated parts by dipping them in high temperature wax. At SM-ALC, infrared heating cabinets are used to melt it off. MDMSC suggests that the best method to remove wax is by putting the parts in a high temperature wax. We recommend that wax recycling be included in any new facility design or renovation involving wax masking operations at SA-ALC. The capital expenditure required can be recouped over a short period of time by wax material savings and disposal costs. The two ALCs that currently recycle wax maintain separate masking tanks: one for chromium and one for all other plating processes because of possible cross contamination problems. Chromium contaminates other plating baths, such as nickel or silver, causing dull deposits, significant decreases in plating efficiency,

and lack of adhesion. In conjunction with our recommended wax control procedures, recycled wax can be analyzed for metallic salt contamination to determine the significance of any cross contamination problem.

If metallic salt cross contamination is a problem, the wax can be boiled in a mild alkaline solution which will melt and clean the wax. By reducing the temperature to just below boiling, the liquid wax floats to the top. This clean wax then can be removed through a drain at the top by slowly raising the hot water level. The water and cleaner are heavier than the wax so they can then be separated from the wax. The oxidized wax is heavier than the other wax, so it drops to the bottom of the tank to be removed when cleaning it.

8.0 SACRAMENTO AIR LOGISTICS CENTER

The masking shop at SM-ALC is operating with a technical expertise which reflects the understanding of the wax process. OC-ALC or SA-ALC use certain procedures which could be beneficial to use at SM-ALC. No major recommendations are made, but four other observations are noted in paragraphs 8.4 through 8.4.4.

8.1 WAX MASKING OVERVIEW

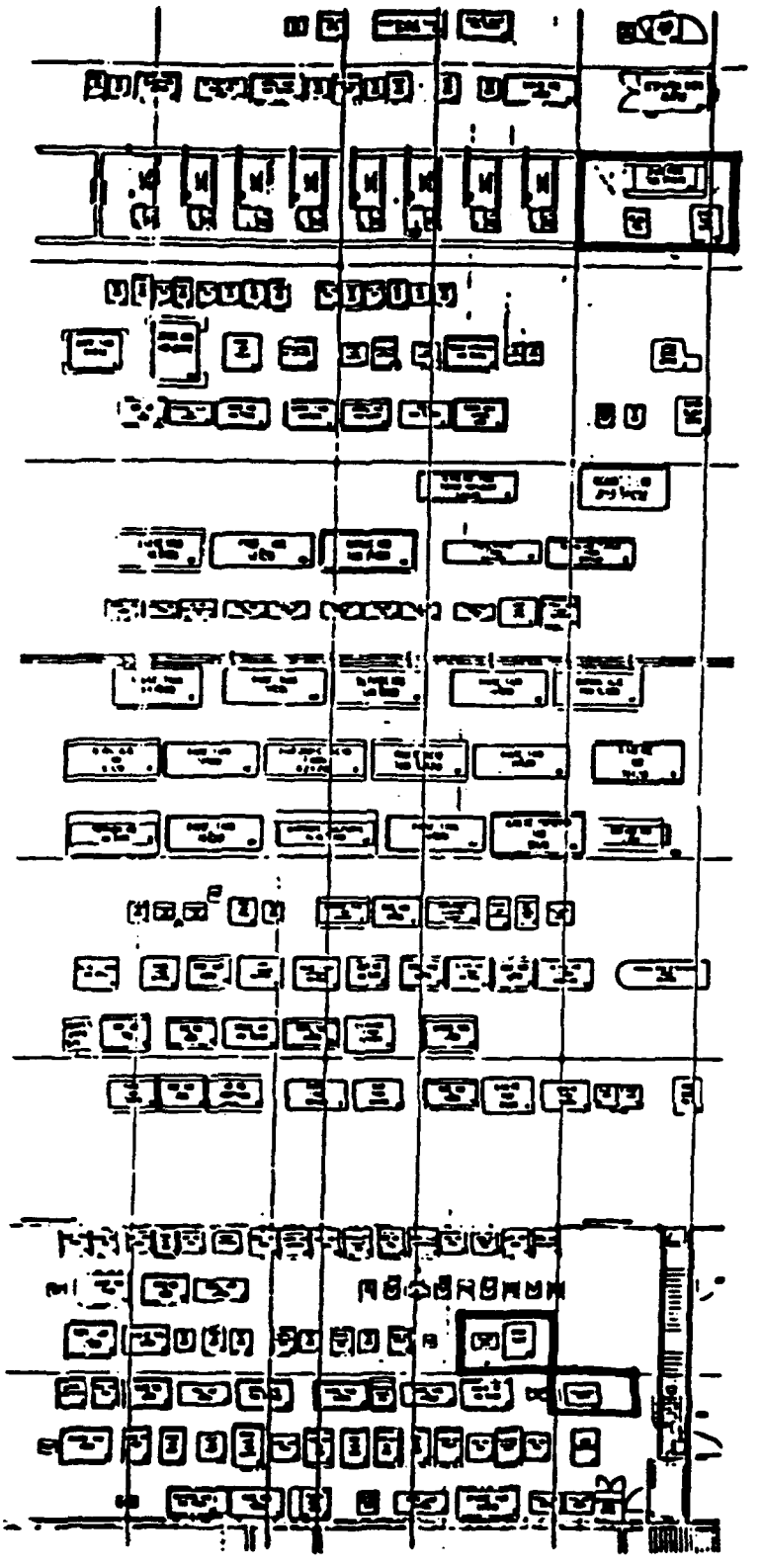
SM-ALC uses wax for masking parts for all applicable metal finishing operations other than chemical milling and electroless nickel plating. The wax masking and dewax areas are located in the plating facility. There are two separate wax masking areas: one for silver and one for chrome plating. They are used for protecting parts from heavy deposits of chrome and silver plating. Each masking area has its own dewax cabinet adjacent to a vapor degreaser that uses perchloroethylene as the solvent.

One facility, close to the chrome plating line, is designated only for masking parts requiring chromium plating. The wax system at the other end of the building is used for the silver plating line. They use two separate wax systems to eliminate any possible contamination of the chrome salts in the silver bath.

SM-ALC recycles the wax within each of the two plating areas. Most of the used wax on the chromium plated parts is removed in a dewax cabinet and then returned to the wax tank for re-use. A vapor degreaser is used to remove the film of wax not removed by the dewax cabinets. The sludge removed from the degreaser is hauled off as hazardous waste.

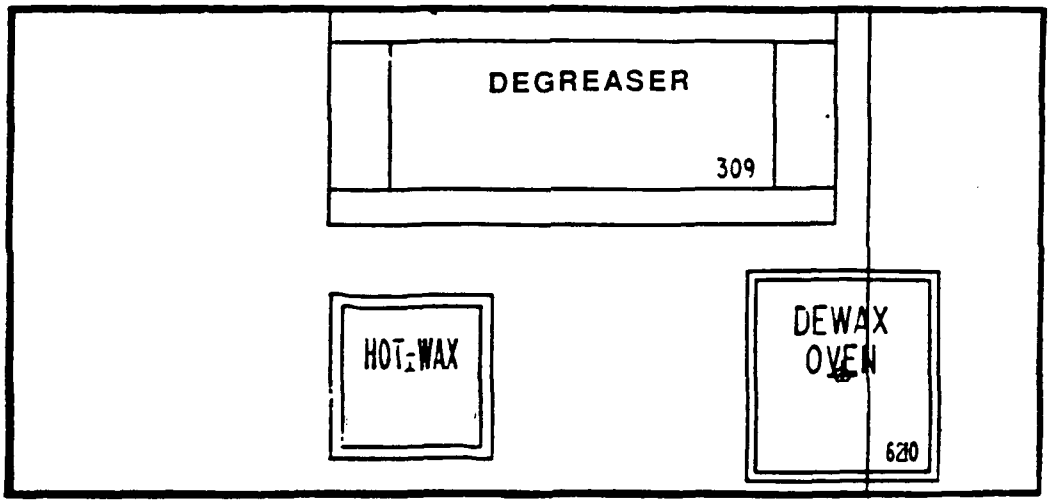
8.1.1 Wax Masking Facility

The two separate, self contained wax masking areas are similar systems. The floor layout for the wax masking area is shown in Figures 8.1-1, 8.1-2, and 8.1-3. The double walled tanks are oil filled for uniform heating and are steam heated to a temperature of 180°F - 190°F. The insulated dewax cabinets melt the wax with infrared heat-lamps. There are banks of the lamps inside the



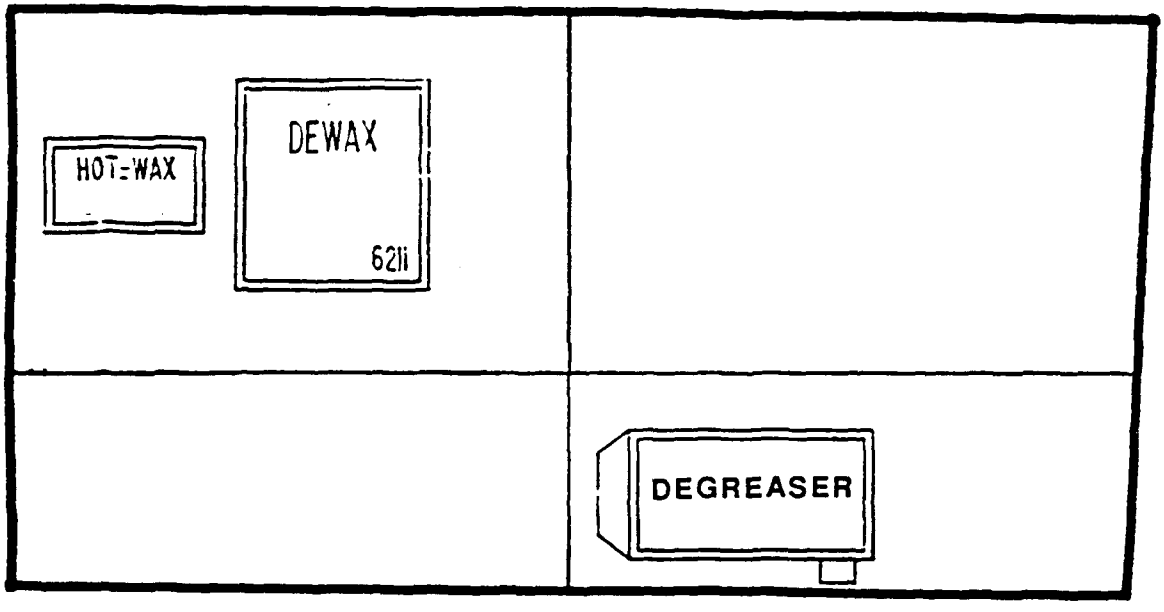
LOCATION OF HARD CHROME AND SILVER MASKING/DEMASKING AREAS WITH RESPECT TO OVERALL PLATING SHOP FLOOR LAYOUT (SM-ALC)

FIGURE 8.1-1



FLOOR LAYOUT OF PRESENT CHROME MASKING AREA (SM-ALC)

FIGURE 8.1-2



FLOOR LAYOUT OF PRESENT SILVER MASKING AREA (SM-ALC)

FIGURE 8.1-3

cabinet facing one another, and the inside is lined with a reflective foil to direct the heat to the part within the cabinet. Melted wax flows to a pan at the bottom of the cabinet. This wax is then returned to its designated wax tank.

8.1.2 Wax Masking Process

Parts to be plated with either hard chrome or heavy deposits of silver are masked with a combination of masking tapes prior to the wax coating. Pressure sensitive, adhesive backed, lead foil tape for chromium plating, and aluminum foil tape for silver plating, are applied to those areas adjoining the areas to be plated. Its function is to act as a current robber at the high current density areas. Vinyl tapes are used to supplement the wax protection. If the wax is damaged, the plastic tape under the wax still protects the part. Paper masking tape is put on the areas to be plated. The part is then attached to a fixture to support the part and to carry the required current to it. The taped part is then put into the wax tank until it absorbs enough heat to attain the same temperature as the wax. When the part has reached that temperature, it is removed from the wax. Most of the wax drains off of the part, leaving a film of hot wax. As soon as this hot thin film begins to solidify, the part is dipped again into the wax. This is repeated until an adequate thickness of wax is formed. While the wax is still fairly warm, the wax is scraped from the tape enough to locate the edge of the paper masking tape. It is peeled from the part, leaving the area for plating free from most of the wax. The metal surface is then wiped with a coarse nylon pad saturated with perchloroethylene and pumice to remove the last film of wax or adhesive left on the plating surface.

8.1.3 Wax Maskant Material

The wax used at SM-ALC is Miccrowax C-562. The wax is equivalent to the Petrolite Speciality Polymers Groups, BE-Square 175 maskant. The wax is not presently tested to determine melting point, acidity, or contamination with metal salts. Any specific detailed information can be obtained from the Petrolite vendor sheets for the BE-Square 175, which is the same as the Miccrowax C-562.

The wax has no evidence of breaking down or causing any detrimental effects to the plating solutions or to the plating deposits. The supervisors and personnel contacted state that they have not experienced any unusual problems that could be associated with the wax, such as bond failure or pitting.

All of the microcrystalline waxes are free from solvents and pose little safety or fire hazards at operating temperatures. The operating temperature is 180°F to 250°F. The difference between the 560°F wax flash point and operating temperature is 310°F, so the possibility of fire is limited.

8.2 ORGANISOL MASKING PROCESS

Masking parts for electroless nickel plating and chemical milling is accomplished by using organisol maskants. The maskant is in one large tank located in the chemical milling area. The masking material is readily available commercially and is adequate to protect the base metal for either chemical operation.

8.2.1 Organisol Masking Facility

The organisol masking facility is located in Building 243, Bay G. The area is adjacent to the equipment used for chemical milling of aluminum, but it is away from the electroless nickel plating area.

The major use of the organisol maskant at SM-ALC is for chemical milling. The masking tank is sized to handle the largest aluminum wing parts adequately. The tank is not heated and mechanical mixers are used to maintain solution uniformity. The viscosity is adjusted with a thinner, added as required, and stirred in with the mixers. A large steam heated, hot air, open top dryer is located at the end of the coating line and used to accelerate the maskant curing. The down draft ventilation provides adequate exhausting of the solvent fumes when the part is removed from the coating tank.

8.2.2 Organisol Masking Process

The parts are coated with an organisol maskant prior to chemical milling to protect the non-etched areas. Before masking, the parts are cleaned with perchloroethylene. Then they are dip coated in the maskant tank. Parts

requiring 20 mils of metal removal are dipped once. Those requiring more than 20 mils metal removal are dipped more than once with a 180 degree rotation between dips. The rotation provides a more uniform coat of maskant. The maskant is dried in an oven or in an open area.

The maskant must be dried thoroughly before scribing for an even edge. The pattern of the area to be etched is cut in the maskant with a knife following the edge of a fiberglass or metal template. The cut area is manually peeled from the part.

After chemical milling, the remaining maskant is manually peeled off. The difficulty of this operation is dependent on the surface condition of the metal. A rough initial surface will cause the maskant to be more adherent making it more difficult to remove.

8.2.3 Organisol Maskant Material

The organisol currently used is Blue Mask 15. Like all organisol maskants, this material is a solvent soluble rubber based material (butadiene polymer) mixed with solvent soluble plastic materials, such as styrenes, see Appendix F.

The solvent used in this maskant is perchloroethylene which is a nonflammable solvent. Although xylene can also be used as a thinner, the recommended solvent is Blue Mask Thinner No. 15, a blend of solvents, which is less flammable. Although perchloroethylene is nonflammable, it is more toxic than the other solvents. With the more stringent safety and environmental regulations, the feasibility of using a water based maskant should be studied in TO No. 7 Phase II, see Paragraph 5.4.1.

8.4 OTHER OBSERVATIONS

The following observations were not considered as recommendations or quick fixes because they had a less significant impact on the areas of time, quality, or cost. These observations were recorded to assist the ALCs in developing ideas that will further enhance the masking operations.

8.4.1 Preparation of Aluminum for Chemical Milling

Problems were experienced at OO-ALC, SM-ALC, and WR-ALC with adherence of the maskant for chemical milling. The maskant will not adhere to the marking ink stenciled on the metal. This is allowing the maskant to lift in certain areas resulting in poor etching quality. A solvent, such as methyl ethyl ketone, should be applied with a hand wipe to remove the ink prior to masking.

8.4.2 Replacement of Organisol Maskants

The masking processes used at all five ALCs for the high temperature processes (electroless nickel and chemical milling) utilize different commercial products, but all are solvent reduced elastomers. This masking process is a significant source of solvent emissions within the plating and masking operation at SM-ALC. Perchloroethylene and xylene are the solvents used with the Blue Mask 15 maskant. Perchloroethylene is nonflammable, but more toxic than xylene. It is technically feasible to eliminate the organic solvents.

MDC facilities has developed a water based maskant system to replace organisols. Full evaluation of this system will be deferred until the execution of Phase II, but we believe we should mention its existence here. This technology has been developing over the past 15 years. Only within the past four years has it attained the necessary technical performance to compete with solvent based systems.

8.4.3 Use of Molded Plastic Masking Fixtures

Certain repetitive parts can be masked with compression molded masking fixtures that would be relatively complex if done by hand. An evaluation to determine when and where these fixtures would be cost effective is highly recommended. SA-ALC uses these compression molded masking fixtures to mask areas on the I.D. of cylindrical parts. They have found the method useful enough to have a vendor develop more fixtures. The advantages over the labor intensive wax removal processes are evident. Because experience in determining where these fixtures can be best utilized, we recommend that an experienced vendor such as Acme Masking Company of Indianapolis, Indiana

be contacted to work with shop and process engineering personnel to develop fixtures with the greatest potential, see Appendix F.

8.4.4 Record Plating Rework Causes and Quantities

Currently, OO-ALC is the only ALC plating shop that records the quantity or causes of rework. The availability of rework data which identifies plating problems would enable the ALCs to highlight any increasing rework rates from their processes to begin formulating corrective action, as at OO-ALC.

The MDMSC TO No. 7 team believes this observation should not be confined to plating and masking operations, but should be implemented in other shops, such as painting and sheet metal.

9.0 WARNER ROBINS AIR LOGISTICS CENTER

The plating facility will be renovated shortly, with improvements planned for the wax and organisol facilities. Even though the improvement plans have been established, MDMSC recommends that the wax facility plans be revisited in light of the recommendation for OO-ALC. In addition, five observations are made which would improve the operation. Because of the planned improvements, MDMSC identified no major recommendations for WR-ALC but several other observations are listed in paragraphs 9.4 through 9.4.5.

9.1 WAX MASKING OVERVIEW

The two primary maskants used at WR-ALC are wax and organisols. Tapes and lacquers are also used, but usually only to augment the primary maskants.

There are two wax operations at opposite ends of the building. Both operations are small and do not require much space. The wax operation at the south end of the building is used primarily for masking parts to be chrome plated. Parts requiring masking for all other plating operations, except for silver, are waxed in this area also.

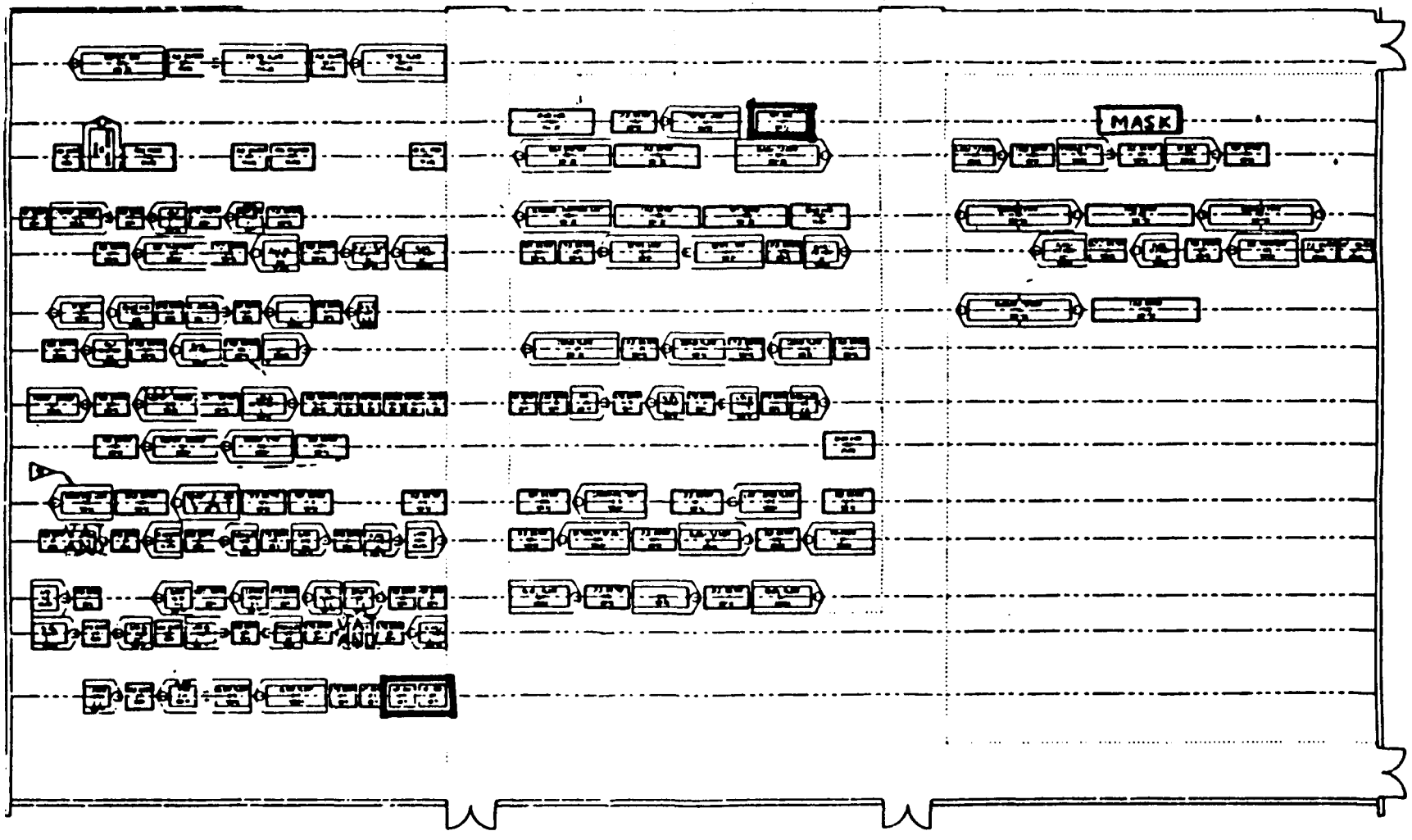
9.1.1 Wax Masking Facility

The largest and most frequently used wax operation is located at the south end of Building 142, the plating facility, see Figure 9.1-1. All of the masking equipment is located within the plating facility and occupies approximately seventy five square feet of the one hundred sixty five thousand square feet of building. This equipment consists of one wax tank and a vapor degreaser near the chrome plating area, and a smaller wax tank near the silver plating area.

Parts requiring protection from the plating solutions are either hand dipped in the wax, or, if too large to handle, a hoist is used. Storage racks are used to hold the waxed parts until they are put into the plating tank.

9.1.2 Wax Masking Process

The microcrystalline wax used at WR-ALC is free from flammable solvents and pose little safety or fire hazards at operating temperatures, which range from



LOCATIONS OF THE MASKING TANKS WITHIN THE PLATING SHOP AT WR-ALC

FIGURE 9.1-1

195°F to 205°F. The difference between the 560°F wax flash point and the maximum operating temperature (250°F) is at least 310°F. This difference is great enough that the possibility of a fire is limited.

Like all masking waxes, this material is easily recycled. To recycle the wax effectively, plating solutions which contaminate the wax need to be rinsed off after plating. The recommended recycling process is detailed in paragraph 6.4.1.

Parts to be plated with either hard chrome or heavy deposits of silver are masked with a combination of masking tapes prior to the wax coating. Pressure sensitive, adhesive backed, lead-foil tape is used for chromium plating. It is applied adjacent to the areas selected for plating. This tape functions as a current robber at the high current density areas.

Vinyl tapes are used to supplement the wax protection on the areas not requiring plating. If the wax is damaged, the underlying plastic tape will protect the part. Paper masking tape is put on areas to be plated. The part is then attached to a fixture to support the part and to carry the required current to it. Once taped, the part is put into the wax tank until it absorbs enough heat to attain the same temperature as the wax. As soon as the hot thin film coating begins to solidify the part is re-dipped into the wax. This process is repeated until an adequate thickness of wax is formed. While the wax is still fairly warm, the wax is scraped from the tape enough to locate the edge of the paper masking tape. The masking tape is then peeled from the part, leaving the area for plating free from most of the wax. The metal surface is then wiped with a coarse nylon pad or cloth saturated with perchloroethylene and/or pumice to remove the last film of wax or adhesive left on the plating surface.

9.1.3 Wax Maskant Material

The wax used at WR-ALC is BE-Square 195, produced by Petrolite Speciality Polymers Groups. The wax is not presently tested by the ALC to determine melting point, acidity, or contamination with metal salts. Specific detailed information can be obtained from the Petrolite vendor sheets for BE-Square

195, see Appendix F. This wax is more brittle and less resilient than the lower melting point waxes used at the other ALCs. Although the BE-Square 195 wax will withstand higher operating temperatures, it will not tolerate physical abuse as well. The ductility of this wax is more adversely affected by overheating or contamination from the chromium plating solution than the other lower melting point waxes.

9.2 ORGANISOL MASKING OVERVIEW

Organisol maskants are used in higher temperature processes, such as electroless nickel plating and chemical milling. It is used in both alkaline and acid solutions. When it is used in strong acids, especially oxidizing acids such as the titanium chemical milling solution, immersion time must be kept relatively short.

The organisol maskant used at the WR-ALC is a solvent reduced elastomer. It contains the same basic solid components that are soluble with either toluene and/or perchloroethylene.

9.2.1 Organisol Masking Facility

The organisol maskant operation is in the same plating facility as the wax, but it is located at the southwest end of the building, near the chemical milling operations. All parts requiring masking for either the acid or alkaline etching solutions are masked in this location.

The tank is full of the maskant and a curing oven is close by. This oven is only used to dry the maskant, but most of the parts are dried by hanging them in the air.

9.2.2 Organisol Masking Process

The parts are first vapor degreased or alkaline cleaned, then immersed in the organisol until a coating of approximately twenty mils thick is achieved. This takes multiple dips depending on the humidity and viscosity. The lower the humidity, the faster the organisol dries, and more stays on the part. Parts not

requiring dipping can be masked by painting the organisol onto selected areas with a brush.

The parts are completely dried before being trimmed, because trimming too soon damages the bond of the maskant to the part. It also makes a rough, uneven line which affects the processing smoothness at the edges. The area to be milled is carefully scored at its boundaries to avoid scratching the metal and the maskant is hand peeled from the area to be processed. The processing area is then wiped with a perchloroethylene dampened cloth, and the area is then chemically milled.

After milling, the maskant is manually pulled from the part. Sometimes the maskant is so adherent, or the part has such a complicated shape, that the maskant can not be easily removed. Small parts can be put into thinner which will slowly dissolve the material. The larger parts must be laboriously peeled and scraped with a soft tool.

9.2.3 Organisol Masking Material

The organisol currently used is Turco's Turco form 540-R. Like all organisol maskants, this material is solvent soluble, rubber materials, such as styrenes. Their product is a readily available commercial product that is suitable for part protection.

The maskant is manufactured with perchloroethylene and naphtha as the solvent. At WR-ALC, toluene is used as the thinner. Perchloroethylene is nonflammable, but it is more toxic than toluene. The toluene is a flammable solvent with a flash point of 45°F. With the more stringent safety and environmental regulations, the feasibility of using alternate maskants should be studied in TO No. 7 Phase II, see paragraph 9.4.2.

9.3 RECOMMENDED IMPROVEMENT

MDMSC did not identify any major recommendations. We identified areas for improvement which are discussed in the other observation section, paragraphs 9.4 through 9.4.5.

9.4 OTHER OBSERVATIONS

The following observations were not considered as recommendations or quick fixes because they had a less significant impact on the areas of time, quality, or cost. These observations were recorded to assist the ALCs in developing ideas that will further enhance the masking operations.

9.4.1 Preparation of Aluminum for Chemical Milling

Problems were experienced at OO-ALC, SM-ALC, and WR-ALC with adherence of the maskant for chemical milling. The maskant will not adhere to the marking ink stenciled on the metal. This is allowing the maskant to lift in certain areas resulting in poor etching quality. A solvent, such as methyl ethyl ketone or acetone, should be applied with a hand wipe to remove the ink prior to masking.

9.4.2 Replacement of Organisol Maskants

The masking processes used at all five ALCs requiring high temperatures (electroless nickel and chemical milling) utilize different commercial products, but all are solvent reduced elastomers. This masking process is a significant source of solvent emissions within the plating and masking operation at WR-ALC. Perchlorethylene and toluene are the solvents used with the Turcoform Mask 540-R maskant. Perchloroethylene is nonflammable but more toxic than toluene. It is technically feasible to eliminate these organic solvents.

MDC facilities has developed a water based maskant system to replace organisols. Full evaluation of this system will be deferred until the execution of Phase II, but we believe we should mention its existence here. This technology has been developing over the past 15 years. Only within the past four years has it attained the necessary technical performance to compete with solvent based systems.

9.4.3 Use of Molded Plastic Masking Fixtures

Certain repetitive parts can be masked with compression molded masking fixtures that would be relatively complex if done manually. An evaluation to determine when and where these fixtures would be cost effective is highly recommended. SA-ALC uses these compression molded masking fixtures to

mask areas on the I.D. of cylindrical parts. They have found the method useful enough to have a vendor develop more fixtures. The advantages over the labor intensive wax removal processes are evident. Because experience in determining where these fixtures can be best utilized, we recommend that an experienced vendor such as Acme Masking Company of Indianapolis, Indiana be contacted to work with shop and process engineering personnel to develop fixtures with the greatest potential, see Appendix F.

9.4.4 Record Plating Rework Causes and Quantities

Currently, OO-ALC is the only ALC plating shop that records the quantity or cause of rework. The availability of rework data which identifies plating problems would enable the ALCs to identify increasing rework rates from their processes and begin formulating corrective action as at OO-ALC.

The MDMSC TO No. 7 team believes this observation should not be confined to plating and masking operations, but should be implemented in other shops.

9.4.5 Wax Recycling and Cross Contamination Control

OC-ALC and SM-ALC both have facilities in place for recycling wax used in the plating process. At OC-ALC, the wax is removed from plated parts by dipping them in high temperature wax. At SM-ALC, infrared heating cabinets are used to melt it off. MDMSC recommends the better method of the two to remove wax is dipping the parts in the high temperature wax. We recommend that wax recycling be made a part of any new facility design or renovation of the wax masking areas at the other ALCs. The capital expenditure required can be recouped over a short period of time by wax material savings and disposal costs alone. The two ALCs that currently recycle wax maintain separate masking tanks for chromium and for all other plating processes because of possible cross contamination problems. Chromium contaminates other plating baths, such as nickel or silver, causing dull deposits, significant decreases in plating efficiency, and a lack of adhesion. In conjunction with our recommended wax control procedures, recycled wax can be analyzed for metallic salt contamination to determine the significance of any cross contamination problem.

If metallic salt cross contamination is a problem, the wax can be boiled in a mild alkaline solution which will melt and clean the wax. By reducing the temperature to just below boiling the liquid wax floats to the top. The clean wax then can be removed through a drain at the top by slowly raising the hot water level. The water and cleaner are heavier than the wax, so the wax can then be separated from the water. The oxidized wax is heavier than the other wax, and the alkaline solution so it drops to the bottom of the tank to be removed when cleaning it.

The costs of implementation would also be minimized if incorporated into a facility renovation.

APPENDIX A

PERSONNEL CONTACTED BY TASK ORDER NO. 7 TEAM

OLKAHOMA CITY AIR LOGISTICS CENTER (OC-ALC)

NAME	OFFICE SYMBOL	FUNCTION
Gene Leiterman	OC-ALC/MAWF	MAW-1 Technology Insertion
Glenn Graham	OC-ALC/MAENP	Chemical Engineer
Ernie Barlor	OC-ALC/MAEPSG	Foreman-Solution Maint.
Walter Strickland	OC-ALC/MAEPSG	Unit Chief-Metal Finishing
Jerry Jones	OC-ALC/MAQCC	Chemist
Avery Hull	OC-ALC/MAEPSG	Foreman-Plating
Dan Sumrall	OC-ALC/MAEPSG	Foreman-Chrome Plating
Ron Thompson	OC-ALC/MAEPSG	Foreman-Nickel Plating

OGDEN AIR LOGISTICS CENTER (OO-ALC)

NAME	OFFICE SYMBOL	FUNCTION
Andy Currie	OO-ALC/MAQTI	TIWG Representative
Rod Carter	OO-ALC/MANEP	Chief Engineer
Mark Child	OO-ALC/MANEP	Chemist
Dave Hutchinson	OO-ALC/MANPSA	Foreman-Chemical Milling
Nolan Nelson	OO-ALC/MANPSA	Mechanic
Greg Rolance	OO-ALC/MANPRC	Foreman-Plating/Masking-North
A. Shah	OO-ALC/MANEP	Facilities Engineer
Grant Cheevers	OO-ALC/MANEP	Engineer
Tammy Endou	OO-ALC/MANPRC	Scheduler-Plating
Roland Fields	OO-ALC/MANPRC	Foreman-Plating-South
Sharon Billmire	OO-ALC/MANPRC	Mechanic
Mike Harbartson	OO-ALC/MANPRC	Unit Chief
Jerry Potter	OO-ALC/MANPSA	Foreman-Chemical Milling
Dee Mackleit	OO-ALC/MANEP	Facilities Engineer

APPENDIX A
PERSONNEL CONTACTED BY THE TO NO. 7 TEAM AT THE FIVE ALCs

SAN ANTONIO AIR LOGISTICS CENTER (SA-ALC)

NAME	OFFICE SYMBOL	FUNCTION
Pete Garza	SA-ALC/MAWFT	Section Chief-MAWFT
Bill Conway	SA-ALC/MAWFT	Industrial Engineer
Jack Orms	SA-ALC/MAWFT	Metallurgist
Don Mercer	SA-ALC/MAEI	Process Engineer
Mary Ibarra	SA-ALC/MAEIA	Foreman-Masking
Joe Gueman	SA-ALC/MAEIA	Foreman-Plating
Paul Mehaffey	SA-ALC/MAEEE	Mechanical Engineer

WARNER ROBINS AIR LOGISTICS CENTER (WR-ALC)

NAME	OFFICE SYMBOL	FUNCTION
Jim Gillis	WR-ALC/MAWF	Industrial Engineer
Gerald Peavy	WR-ALC/MAWF	Industrial Engineer
Marti Walker	WR-ALC/MANEE	Chemical Engineer
Bill Elmore	WR-ALC/MANEE	Industrial Engineer
Tommy Hunnicutt	WR-ALC/MANQQ	Foreman-Plating & Masking

SACRAMENTO AIR LOGISTICS CENTER (SM-ALC)

NAME	OFFICE SYMBOL	FUNCTION
Mike Frayne	SM-ALC/MAWWB	TIWG Representative
Dan Brewer	SM-ALC/MANELC	Engineer Unit Chief
Elwin Jang	SM-ALC/MANELC	Industrial Engineer Technician
Mike Mattos	SM-ALC/MANEL	Industrial Engineer
Seymour Daniel	SM-ALC/MAQCA	Industrial Spec. Process Engineer-Plating
John Romeo	SM-ALC/MANPEP	Foreman-Plating
Tom Burns	SM-ALC/MANPET	Foreman-Chemical Milling
Charles Leslie	SM-ALC/MANPE	Supervisor-MANPE
Lt. Col. Mendez	SM-ALC/MAN	Deputy Chief-MAN Division

APPENDIX B

SUMMARY OF MDC MASKING OPERATIONS

APPENDIX B
SUMMARY OF MDC MASKING OPERATIONS

The information gathered at the ALCs was augmented by tours of the MDC masking facilities in St. Louis. The tours of the plating/masking and chemical milling/masking work areas added to our understanding of some of the issues in masking technology.

MDC's masking operations address both high volume and low volume capabilities. Since relatively little volume of plating work is done in-house at St. Louis, this area is of minimal size and the platers each mask their own work. The chemical milling shop is organized for a much higher volume of work and labor is divided with specific workers assigned to masking, trimming, milling and demasking.

MDC Plating Masking

The current facility is designed for relatively low volume of work, although chromium, nickel low embrittlement cadmium and silver plating processes are used.

For the past several years, MDC has been using the Evans B-100 plastic maskant (as is used at OO-ALC) because it was easily obtained from the internal supply system at MDC when the previously used wax maskant was taken off the market. The wax was discontinued because it contained perchloroethylene, which was banned. They are changing out the contents of this tank every two to three months and have encountered opposition to its continued use because of the odor. The process engineers in this area have also encountered the tackiness and lack of acceptable chemical resistance mentioned in our conversations with OO-ALC personnel.

MDC Chemical Milling Masking

The chemical milling shop at MDC in St. Louis is designed for a high throughput and incorporates an automated masking line with solvent emission control equipment. A pilot line is in the late stages of engineering development which

uses a water based maskant. Personnel are permanently assigned in one of the several areas of this shop (material preparation, masking, trimming, milling or demasking).

Preparation of the surface prior to aluminum chemical milling consists of a quick dip in chemical milling fluid as a means of removing ink markings on the sheet metal followed by a chromate conversion coating. Persistent inks which tend to act like a maskant and which cause non-adherence of the chemical milling maskant have been encountered. In these cases, the ink markings are removed with Turco 5469 paint stripper followed by the reapplicator of the chromate conversion coating. The same procedure has been shown to work well with the new water based maskant system discussed below.

The present chemical milling maskant used at MDC in St. Louis is AC-872, made by AC Products, Inc. As with many chemical milling maskants currently in use, AC-872 is a perchloroethylene-based solvent system which has significant long term drawbacks. These include pending air toxics regulations, Community Right-to-Know reporting, more stringent worker protection standards and environmental risks associated with handling, transporting, storage and disposal of hazardous material. It is not recyclable, thus generating relatively large quantities of waste. The VOC emissions are cleansed from the effluent air by carbon adsorption to meet current Clean Air Regulations which are expensive to install and maintain.

For these reasons, MDC has performed extensive prototype testing of a water based maskant being developed by Desoto Chemical Company. Thus far, some 600 parts have been masked using this maskant and successfully chemical milled. A new chemical milling facility utilizing this water based maskant process is in architectural design and will be built in the 1990-91 time frame. In this process, the chromate conversion coating step is combined with a surface conditioning primer.

The cost of establishing a new production chemical milling facility using a water based maskant has been compared with the cost of establishing a similar new facility using a solvent based maskant, along with its attendant solvent recovery system. The solvent based facility was designed to meet a daily 1.0 lb. solvent/gal. maskant limit that is presumed to comply with future air emission regulations. The cost of the facility using water based maskant was considerably lower. In addition, its annual operating cost was lower and its floor space requirements were significantly less. A large portion of the cost savings accrue from the lack of need for adsorption equipment needed to meet VOC emission requirements for the solvent based maskant. Mask trimming at MDC is performed both manually, using metal or fiberglass templates, and with a laser scribing machine.

The Task Order No. 7 team had an opportunity to view first hand the laser scribing machine being utilized in the MDC production chemical milling facility. Its operation is impressive and its use results in some cost savings and in improved quality. The payout period for a more modern laser scribing machine is sufficiently long that its primary advantage is in increased quality but not in significant cost savings. The laser scribing machine, incidentally, has been shown to be as effective in scribing the water based maskant as it now is in scribing the solvent based maskant. After a part has been partially or totally masked, patterns to be etched in the masked parts are scribed with an x-acto or hot knife using manually applied templates as guides. The templates are usually made of fiberglass or aluminum and require storage, transportation and periodic repair or replacement.

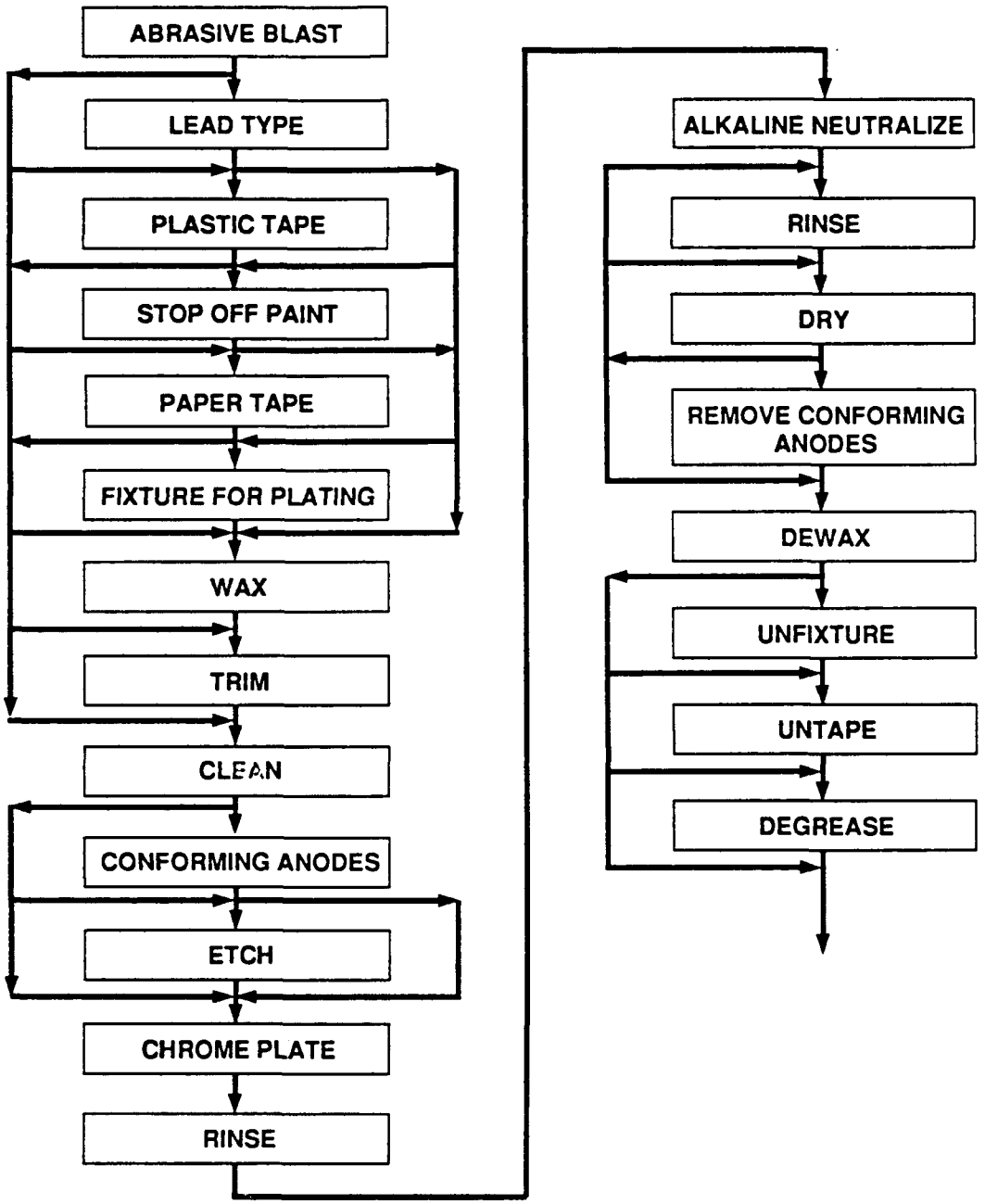
After scribing, the mask is peeled from the area to be etched. Manual scribing is a highly labor intensive operation, accounting for 40 percent of the labor expended in the overall chemical milling operation.

The laser scribing machine at MDC is used only for trimming masks in the chemical milling of skins and other parts with large flat surfaces since it is only a two axis (beam and carriage) machine. At this time a machine with more degrees of freedom and the ability to trim masks on other, more complex parts

is not thought to be cost effective. We do not have any hard data on its effectiveness in scribing wax, but the technology suggests that it would not be viable.

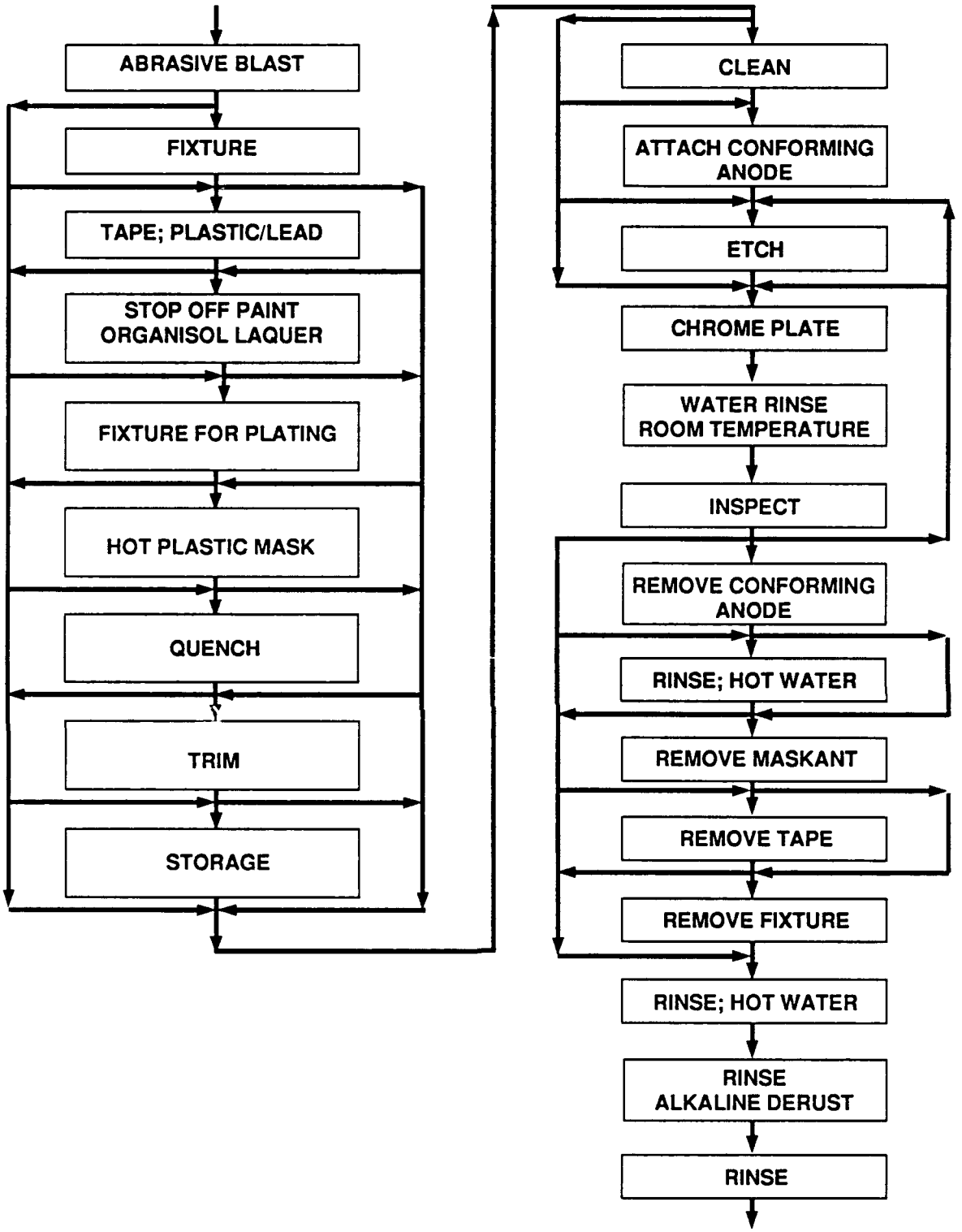
APPENDIX C

PROCESS FLOW DIAGRAMS REFERENCED IN TEXT



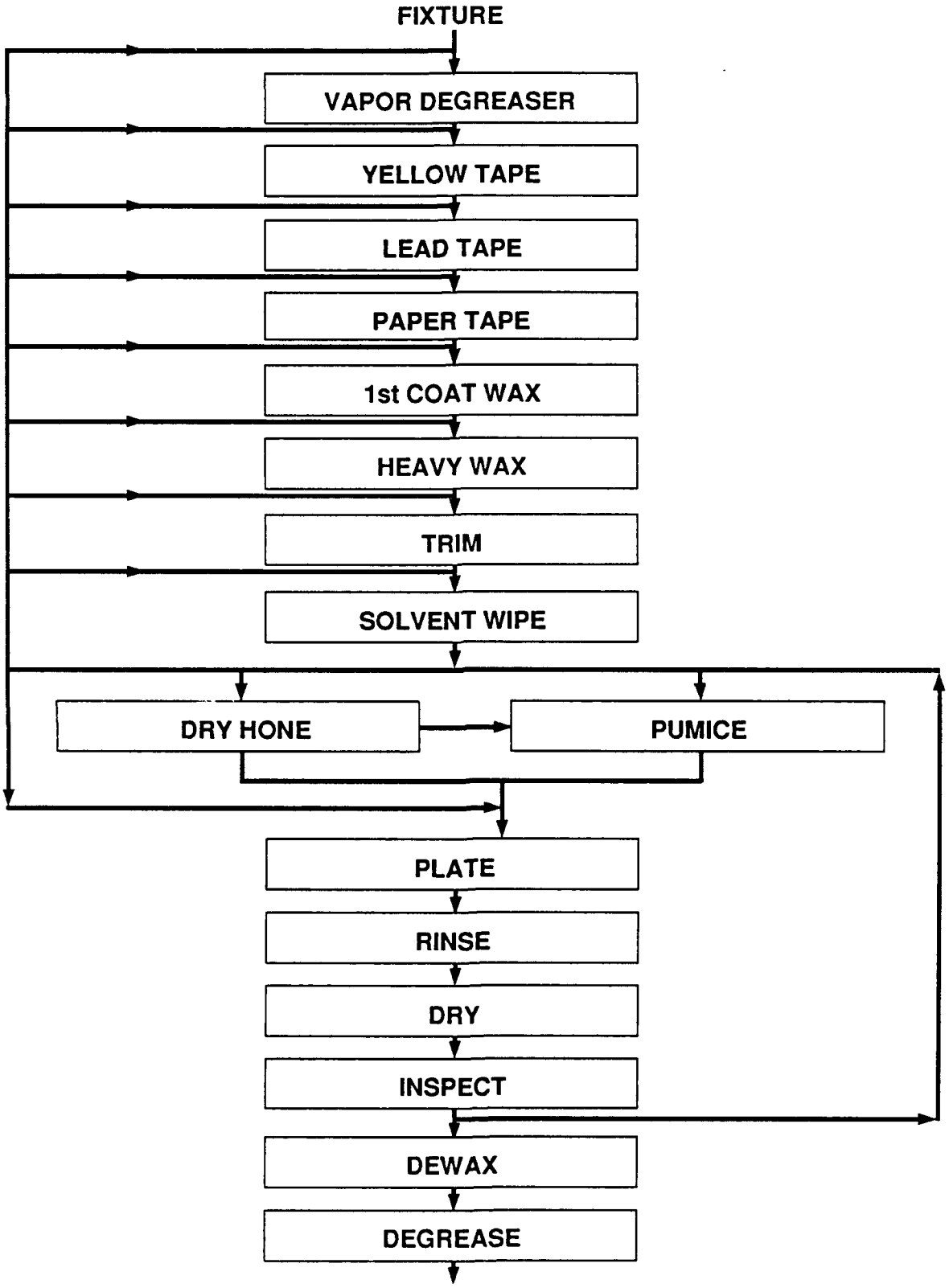
TYPICAL CHROME PROCESS FLOW FOR WAXED PARTS AT OC-ALC

LSC-20632



TYPICAL CHROME PROCESS FLOW FOR MASKED PARTS AT OO-ALC

LSC-20631

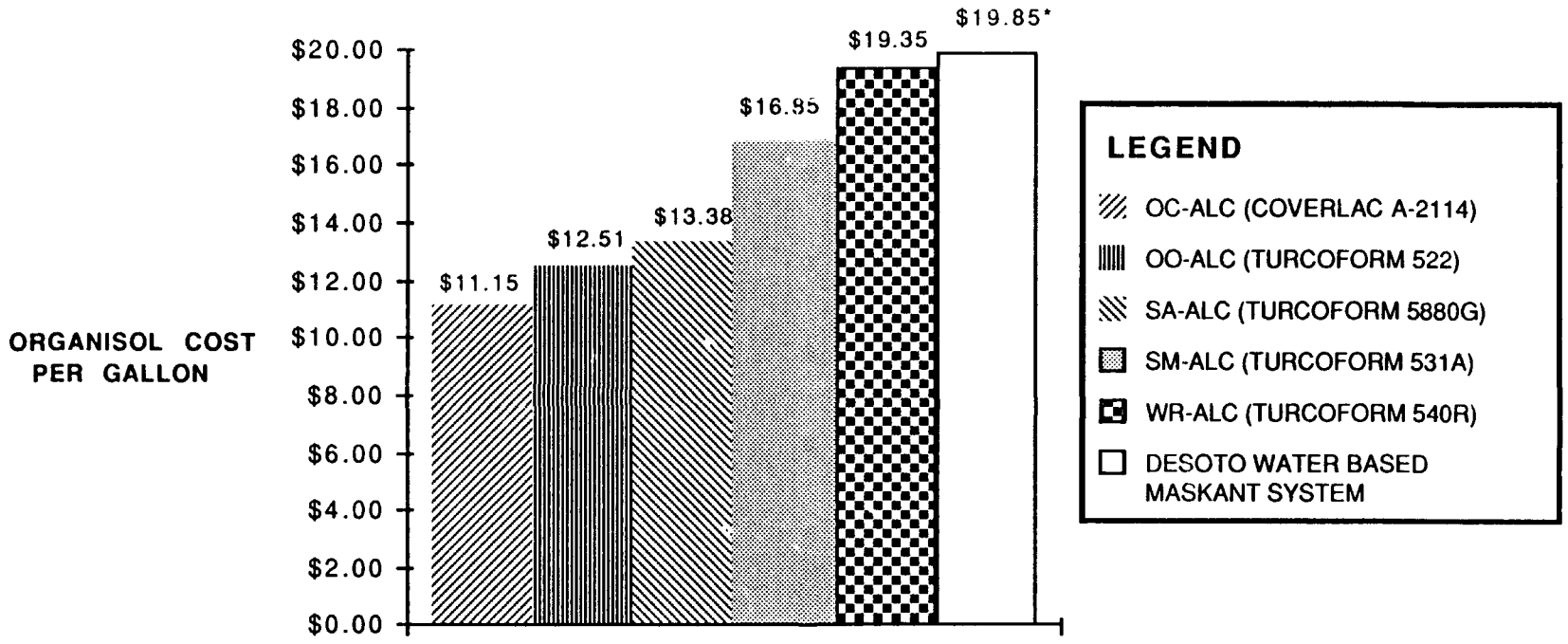


PARTS FLOW DIAGRAM FOR PROPOSED WAX SYSTEM

LSC-20630

APPENDIX D

COST ANALYSIS NOTES



* COMPOSITE PER GALLON COST FOR APPLIED 3 COAT SYSTEM (PRIMER, MASKANT & TOP COAT)

LSC-20172A

PER GALLON COSTS OF ORGANISOL MASKANTS USED IN CHEMICAL MILLING AND ELECTROLESS NICKEL

Masking Tank Floor Space Data

Data

MASKING AREA = 26.5' x 22' = 583 ft²
COST PER SQUARE FOOT AT CC-ALC = $77.26

583 ft² x $77.26 = $45,043

Engineering Judgement

THE COST OF THE FLOOR SPACE IS NOT GOING TO CHANGE SO IS NOT A FACTOR IN THE ANALYSIS

Comments:

Flow Time/Touch Labor Data
PLASTIC

Check operation performed	Flow Time Adj.	Flow Time Act.	Touch Labor Adj.	Touch Labor Act.
Fixture for masking	N/A	N/A	N/A	N/A
___ special masking fixtures	THIS IS A CONSTANT DETERMINED BY EACH ALC SO NOT A FACTOR			
X plating fixtures used for masking				
___ no fixtures used (slings, etc.)				
Part preparation for masking	0		0	0
___ vapor degrease				
___ solvent wipe				
Application of tape	7		5	5
X non adhesive pvc tape				
___ adhesive backed pvc tape				
X metal foil tape				
___ paper masking tape				
Dipping in maskant	8		5	5
___ one to two dips				
___ three to five dips				
___ six or more dips				
Trimming	6		4	4
Maskant repair	0	0	0	0
___ hot knife				
___ lacquer				
___ tape				
Clean plating area	5		1	10
___ solvent wipe	PARTS ARE NOT CLEANED PROPERLY NOW ALLOW TIM BASED ON PROPER CLEANING.			
___ abrasive blast				
___ hand scrub				
___ alkaline clean				
Inspect	5		1	1
Remove maskant	5		3	4
___ hand peel				
___ demask tank				
___ vapor degrease				
Remove masking fixture	NA	NA	NA	NA
Final clean	12		5	3
___ hand wipe				
___ vapor degrease				
X ALKALINE DIP				
Totals	48		27	32

Flow Time/Touch Labor Data
WAX

Check operation performed	Flow Time Adj.	Flow Time Act.	Touch Labor Adj.	Touch Labor Act.
Fixture for masking	NA	NA	NA	NA
___ special masking fixtures				
X plating fixtures used for masking				
___ no fixtures used (slings, etc.)				
Part preparation for masking	10	___	4	4
X vapor degrease				
___ solvent wipe				
Application of tape	25	___	12	5
X non adhesive pvc tape				
X adhesive backed pvc tape				
X metal foil tape				
X paper masking tape				
Dipping in maskant	40	___	20	13
___ one to two dips				
X three to five dips				
___ six or more dips				
Trimming	15	___	10	8
Maskant repair	0	0	0	0
___ hot knife				
___ laquer				
___ tape				
Clean plating area	10	___	28	10
___ solvent wipe				
___ abrasive blast				
X hand scrub				
___ alkaline clean				
Inspect	5	___	1	1
Remove maskant	20	___	5	3
___ hand peel				
X demask tank				
___ vapor degrease				
Remove masking fixture	NA	NA	NA	NA
Final clean	15	___	5	3
___ hand wipe				
X vapor degrease				
Totals	140		85	(47)

Flow Time/Touch Labor Comparison

Data:

The tests run at OC-ALC was prepared and moved at what was determined as an accelerated pace. The flow times were timed at about 43 minutes. As stated the times were run at an unusuall fast pace. For two other days workers were observed masking parts and by excluding the time spent talking and working on the part directly and based on this we feel the averages we are using are valid. The flow time for the plastic maskant was an average of 50 minutes while the touch time was approximately 32 minutes.

The tests run at OC-ALC were fairly accurate for comparing wax flow time ratios to touch time but to compare times between OC-ALC and OO-ALC were doubtful. With the help of mechanics at a commercial airline overhaul facility a Boeing 727 elev trunion was waxed and the times reported by telephone to us in St Louis. The flow times for wax is approximately 126 minutes and the touch time is approximately 47 minutes.

The flow time of wax is approximately 250% longer than for plastic flow time and touch time for wax is approximately 150% more than the touch time for plastic masking. Our brief assesment would also indicate that for plastic. the flow time is between 148-151% more than the touch time per part. The flow time for wax maskant is approximately 250 - 275% more than the touch time.

Based on this the following results are:

(8) Average estimated hours to mask 19 parts with plastic is :
average touch time 32minutes each X 19 = 608 minutes
608 min. / 60 min./hr = 10.1333 hr
250 work days /yr X 10.1333 hr = 2533.333 hrs/yr
2533 hr X $31.98 = $81.005 for plastic masking

(3) Average estimated hours to mask 19 parts with wax is .
average touch time 47minutes each X 19 = 893 minutes
893 minutes / 60 min/hr = 14.88 hr
250 work days /yr X 14.88 hr = 3720 hr
3720 hr / yr X $31.98 = 118.998

Engineering Judgement

Comments.
The flow time data collected at OC-ALC is an approximation mainly [illegible] the limited time allotted there

Maskant Heating Data (16)

PLASTIC

Data

- THE POWER COSTS AT CO-ALC = $.057/KWH
- POWER CONSUMPTION OF THE EXISTING TANK ACCORDING TO THE MANUFACTURER = 157.5 KW/H
- THE POWER IS OFF APPROXIMATELY 33% OF THE TIME BECAUSE OF THE TANK INSULATION AND INSULATING PROPERTIES OF THE PLASTIC
- 157.5 X .66 = 105 KW/H
- THE POWER IS OFF 13 DAYS A YEAR FOR MAINTENANCE SO 365 DAYS - 13 DAYS = 352 OPERATING DAYS
- TOTAL OPERATING HOURS = 352 X 24 = 8448 HOURS/YEAR
- TOTAL KWH = 8448 HOURS/YEAR X 105 KW/H = 887,040
- TOTAL DOLLAR COST IS 887,040 X $.057 = $50,560

Engineering Judgement

THE COST USING CO-ALC ESTIMATES WOULD BE ABOUT $13,000 LESS THAN THOSE USING THE MANUFACTURERS DATA AND OUR JUDGEMENT

Comments:

Maskant Heating Data (17)

WAX

Data

- THE VOLUME OF THE RECOMMENDED 250°F WAX TANKS = 258.8 ft^3
- THE VOLUME OF THE RECOMMENDED 200°F WAX TANKS = 258.8 ft^3
- 1 KWH = $.057 = 3412 BTUs
- 1 lb of STEAM = $.00201 = 945 BTUs
  - 3412 BTUs OF 1 lb STEAM = 3412/945 x .00201 = $.00724
  - 3412 BTUs OF ELECTRICITY COMPARED TO STEAM = $.057/$.00724 = 7.9 MORE EXPENSIVE THAN STEAM
- THE CURRENT COST FOR HEAT USING ELECTRICITY = $50,561
- THE VOLUME OF THIS TANK = 207 ft^3
- THE COST PER CUBIC FOOT = $50,561 / 207 ft^3 = $244.26
- STEAM WOULD BE 1/7.9 AS MUCH = $244.26 / 7.9 = $30.92 ft^3 AT 300°F TEMPERATURE
- FOR 250°F STEAM HEAT WOULD BE 250/300 x $30.92 = $25.75 ft^3
- FOR 200°F STEAM HEAT WOULD BE 200/300 x $30.92 = $20.60 ft^3
- THE COST TO HEAT THE 258.8 ft^3 TANK TO 250°F = 258.8 x 25.75 = $6,666.69
- THE COST TO HEAT THE 258.8 ft^3 TANK TO 200°F = 258.8 x $20.60 = $5,331.28
- TOTAL COST FOR STEM HEAT IS $6,666.69 + $5,331.28 = $11,998

Engineering Judgement

Comments:

Vapor Degreasing Data

Data

BECAUSE NO WAX IS USED THERE CAN BE NO COSTS TO DEGREASE WAX

For refrence data CA12 is currently being used for all of the plating in the chrome area. This data was developed from information provided by OO-ALC.

COST TO RECLAIM SOLVENT = $4,023 @ $1.95/gal
COST FOR NEW SOLUENT = $2,012 @ $3.90/gal
COST FOR LABOR TO MAINTAIN = $2,112 @ $32/hr
COST FOR STEAM HEAT = $1,300 @ $2.0165/1000 lbs

Engineering Judgement

Comments:

Maskant Tank Data

PLASTIC

Data

FULLY EQUIPED

PRESENT MASKANT TANK WAS PURCHASED FROM IN MAY, 1979 for $59,550.

INFLATION RATES= 1/.583

59,550 x 1.75 = $104,200

Engineering Judgement

BASED ON TODAYS AVAILABILITY OF PLATING EQUIPMENT THE COSTS HAVE GROWN GREATER THAN THE INFLATION RATE IN GENERAL.

Comments:

THIS DATA WAS OBTAINED BY BOB BISHOFF FROM GRANT CHEEVER

Maskant Material Data (4)

Data

WAX TANK VOLUMES

2 ea @ 72 ft³ = 144 ft³

2 ea @ 189 ft³ = 378 ft³

522 ft³

WAX = 79.07 # / ft³

522 ft³ × 79.07 # / ft³ = 41,274.54 # × 72 ¢ / 16 = 29,720 #

PLASTIC TANK VOLUME

207.09 ft³

Plastic = 59.85 # / ft³

207.07 ft³ × 59.84 # / ft³ = 12 391.07 # × 3.27 $ 40,522

Difference

− 40,522

+ 29,720

− 10,802

Engineering Judgement

Comments:

Labor Data

Data:

(10) Labor was estimated to be $836.596 per year for for labor in the chrome plating area. Subtracting the touch labor for masking from this amount leaves the cost for labor for all other work performed.

$836.596 - $81.005 = $755.591

(11) The wax masking system will have a reduced labor requirement because of less rework that is caused by the plastic system. The cost of reworked parts is estimated to be $105.688 (see Rework Data) per year. $755.591 - $105.688 = $649.903

Engineering Judgement

Comments:

Rework/Reject Data

Data

19 parts per day / 15 people = 1.3 parts/person
1.3 parts/person x 250 day = 325 part/yr/mm
$57,632/mm/yr / 325 part = $177.33
AVERAGE OF REJECTS PER YEAR IS ABOUT 16½
BETWEEN 308 and 586 parts are recorded as pitted/year
ESTIMATED 298 REJECTS/YEAR

COST OF REWORK
1st Run = 177.33
Strip = 177.33
RERUN = 177.33
} COST OF RERUN
= $354.66 x 298 parts = $105,688

Engineering Judgement

Comments:

APPENDIX E

MASKING OPERATION QUESTIONAIRE

MASKING QUESTIONAIRE
MDMSC TECHNOLOGY INSERTION PROGRAM
TASK ORDER NO. 7

ALC _____ ALC CONTACT AND PHONE NO. _____

MDMSC CONTACT AND PHONE NO. _____ DATE _____

	ANSWER SOURCE
• WHAT TYPE(S) OF "HOT-MELT" MASKING MATERIAL IS USED; PLASTIC AND/OR WAX? _____	_____
• WHAT IS THE MANUFACTURER'S NAME, PART NUMBER, NSN, AND MIL-SPEC. NUMBER? _____ _____ _____	_____
• IS THE MASKING MATERIAL SOLE-SOURCED? Y OR N IF NO, LIST ALL THE SOURCES AND PART NUMBERS. IF YES, THEN GIVE REASON._____ _____ _____	_____
• WITHIN WHAT TEMPERATURE RANGE (°F) IS THE MASKANT USED FOR COATING? _____ TO _____°F	_____
• IS THE MASKANT USED AT A CONSTANT FLUIDITY? Y OR N IF NOT THEN HOW IS FLUIDITY CONTROLLED? _____ UNDER WHAT CONDITIONS IS FLUIDITY CHANGED? _____ _____	_____
• IF TWO OR MORE TYPES OF "HOT-MELT" MASKANTS ARE MIXED TOGETHER LIST THE NAMES AND PART NUMBERS OF THE MASKANTS. _____ _____ _____	_____
• WHAT IS THE AVERAGE RANGE, IN MILS, OF THICKNESS OF "HOT-MELT" MASKANT THAT IS APPLIED TO PARTS AND HOW IS IT CHECKED?_____ _____ _____	_____
• WHAT IS THE AVERAGE LENGTH OF TIME THAT A PART IS DIPPED IN THE MASKANT TANK? _____ MIN(S). HOW MANY DIPS ARE NEEDED?_____	_____

	ANSWER SOURCE
• ARE ANY PARTS PREHEATED BEFORE DIPPING? Y OR N IF YES, THEN WHAT DETERMINES WHICH PARTS ARE PREHEATED? _____ _____	_____
IF YES, AT WHAT TEMPERATURE ARE PARTS PREHEATED TO? ____°F BY WHAT MEANS AND HOW LONG, ON AVERAGE, ARE PARTS PREHEATED? _____ _____ _____ _____MINS.	_____
• WHAT TYPE AND SEQUENCE OF DRYING TECHNIQUES ARE USED FOR DIPPED PARTS? _____ _____	_____
• ARE ALL PARTS DRIED THE SAME WAY? Y OR N IF NOT, HOW ARE PARTS DRIED AND WHAT DETERMINES HOW PARTS ARE DRIED? _____ _____ _____	_____
• WHAT ARE THE OPERATING HOURS UNDER HEAT PER DAY OF THE MASKANT? _____ HRS/DAY	_____
• IS THE MASKANT AT OPERATING TEMPERATURE DURING WEEKENDS AND HOLIDAYS? Y OR N IF YES, HOW LONG? SAT._____ SUN._____ HOLIDAY_____	_____
• IS THE MASKANT USED IN CHROME PLATING DISCARDED OR RECYCLED AFTER USE? _____ IF RECYCLED, HOW IS THE MASKANT CLEANED BEFORE BEING DUMPED BACK INTO THE MASKANT TANK? _____ _____ _____	_____
IF DISCARDED, HOW MANY LBS. ON AVERAGE, OF MASKANT IS DISCARDED PER MONTH (OR WEEK)? _____ LBS. PER _____	_____
• ON THE AVERAGE, HOW MANY LBS. OF "NEW" MASKANT IS ADDED TO THE MASKANT TANK PER WEEK (BASED ON ONE YEAR WITHOUT INCLUDING COMPLETE TANK MASKANT CHANGE)? _____ LBS. PER _____	_____
• HOW MANY TIMES A YEAR, ON AVERAGE, IS THE "HOT MELT" MASKANT COMPLETELY CHANGED IN THE TANK? _____ _____	_____

	ANSWER SOURCE
• ON THE AVERAGE, HOW MANY LBS. OF NEW "HOT MELT" MASKANT IS USED TO REFILL THE MASKANT TANK WHEN MASKANT MATERIAL IS COMPLETELY CHANGED? _____ LBS. PER _____	_____
• WHAT IS THE AVERAGE DOWNTIME, IN HOURS, OF THE "HOT MELT" MASKANT TANK WHILE CHANGING MASKANT? START FROM HEATER TURN OFF AND FINISH WHEN NEW MASKANT REACHES OPERATING TEMPERATURE? _____HRS.	_____
• DESCRIBE THE SEQUENCE OF EVENTS IN CHRONOLOGICAL ORDER FOR CHANGING THE MASKANT? _____ _____	_____
• IS THE MASKANT USED IN SILVER/CADMIUM NICKEL PLATING DISCARDED OR RECYCLED AFTER USE? _____ IF RECYCLED, HOW IS THE MASKANT CLEANED BEFORE BEING DUMPED BACK INTO THE MASKANT TANK? _____ _____	_____ _____
IF DISCARDED, HOW MANY LBS., ON AVERAGE, OF MASKANT IS DISCARDED PER MONTH (OR WEEK)? _____ LBS. PER _____	_____
• IS MASKANT REUSE PERFORMED? Y OR N IF YES, ANSWER THE FOLLOWING: - IS MASKING REUSE SEGRAGATED BY TYPE? Y OR N IF YES LIST SEPARATE SYSTEMS _____ _____ _____	_____
- HOW IS REUSE ACCOMPLISHED? (e.g., HAND PEELING, HOT DIPPING, INFRARED HEATING, ETC.) _____ _____	_____
- WHAT IS THE AVERAGE PERCENTAGE OF MASKANT REUSED PER MONTH (OR WEEK) FOR EACH SYSTEM? _____% PER _____ _____% PER _____	_____

MASKING QUESTIONAIRE
MDMSC TECHNOLOGY INSERTION PROGRAM
TASK ORDER NO. 7

ANSWER SOURCE

- PROVIDE THE FOLLOWING INFORMATION ON ALL MASKANT MEDIA USED EXCEPT THE "HOT MELT" PREVIOUSLY LISTED

NSN	MANUFACTURER & PART NO.	ISSUE UNIT	UNIT COST	CONSUMPTION RATE

LSC-20169

- ARE THESE MASKANTS USED INDEPENDENTLY OR IN CONJUNCTION WITH THE "HOT MELT" MASKANT? DESCRIBE EACH OF THE COMBINATIONS.

- PROVIDE THE FOLLOWING INFORMATION FOR EACH TANK USED IN THE MASKING/DEMASKING PROCESS:

IDENTIFICATION NUMBER	INSIDE DIMENSIONS			TANK MATERIAL	FLOOR SPACE (FT2)	TANK HEATER TYPE	TEMP. CONTROL TYPE	NOMINAL OPERATING TEMP. (°F)	SPECIFIC PURPOSE OF TANK*
	H	W	D						

* LOW TEMP COATING, HIGH TEMP COATING, CHROME RECYCLING, CAD RECYCLING, QUENCHING, ETC.

LSC-20166

ANSWER SOURCE

- WHAT ARE DIMENSIONALS (IN INCHES) OF THE LARGEST PART THAT IS MASKED? DRAW A SKETCH _____X_____X_____

- ARE ANY TESTING PROCEDURES USED FOR WAX CONTROL OR TESTING? Y OR N
  IF YES, COMPLETE THE FOLLOWING INFORMATION.

TYPE OF TEST PERFORMED	LABOR CLASS PERFORMING TEST	TEST FREQUENCY	MAN HRS PER TEST	TEST INSTRUMENTS USED

- IF TEST PROCEDURES ARE CARRIED OUT FOR CONTROL OF WAX PROPERTIES, WHAT ARE CURRENT PROCESS PARAMETER RANGES CONSIDERED ACCEPTABLE?
  pH_____
  HARDNESS _____
  MELT POINT_____
  OTHER _____ _____
  _____ _____
  _____ _____

- WHAT IS THE COST OF INSTRUMENTS USED IN TESTING MASKANT?

INSTRUMENT	MANUFACTURER & PART NO.	COST

LSC-20167

MASKING QUESTIONAIRE
MDMSC TECHNOLOGY INSERTION PROGRAM
TASK ORDER NO. 7

ANSWER SOURCE

- COMPLETE THE FOLLOWING INFORMATION FOR MANPOWER REQUIREMENTS AVERAGE FOR A MONTHLY (OR WEEKLY) TIME FRAME.

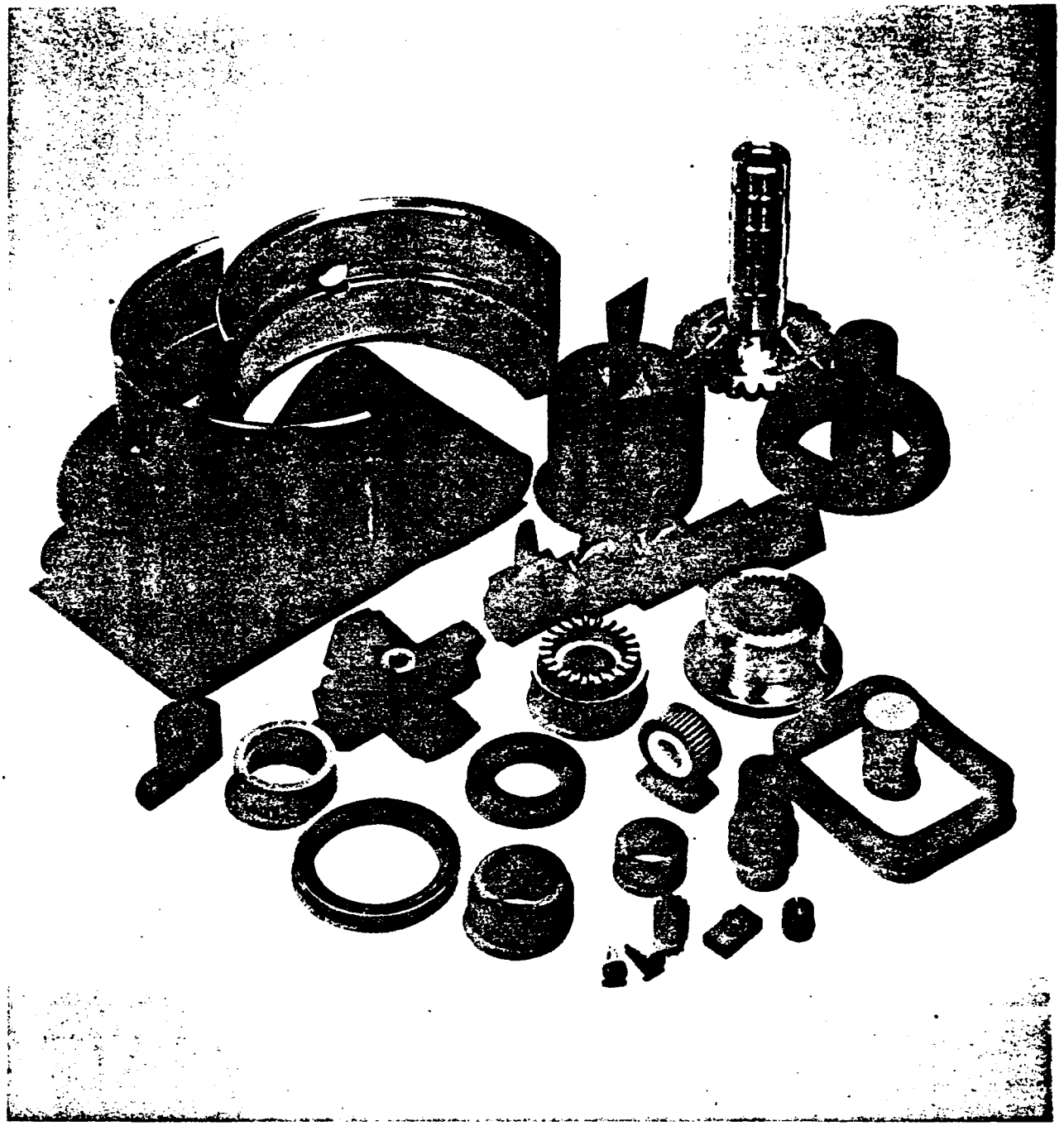
OPERATION	MANDATORY FLOW HOURS	SKILL LEVEL CODE	QTY	TIME REQUIRED		LABOR CLASS RESPONSIBLE	COMMENTS
				%	HRS		
TAPE APPLICATION							
MASKANT APPLICATION							
SCRIBING/PEELING PRIOR TO PLATING							
STOP OFF LAQUER APPLICATION							
POST PART CLEANING							
MASKANT DRAIN & FILL							

LSC-20168

- IF DATA IS NOT AVAILABLE, GIVE ESTIMATE.
- DESCRIBE MASKING OPERATIONS AND OTHER OBSERVATIONS.

APPENDIX F

MASKING PROCESS DATABASE



Acme Masking Company

INCORPORATED

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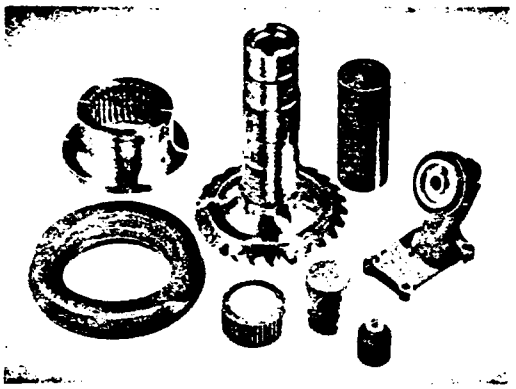
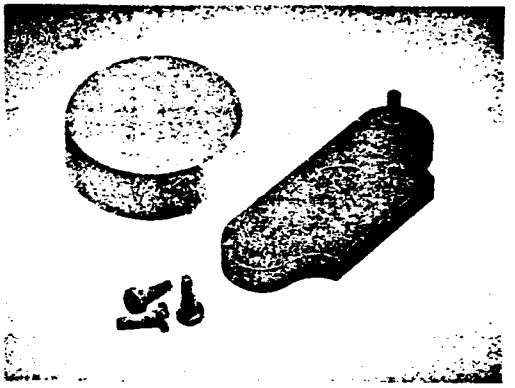
your one dependable source for quality masking devices, precision molded rubber and custom-made plating and peening fixtures

Masking devices for all types of selective surface treatment



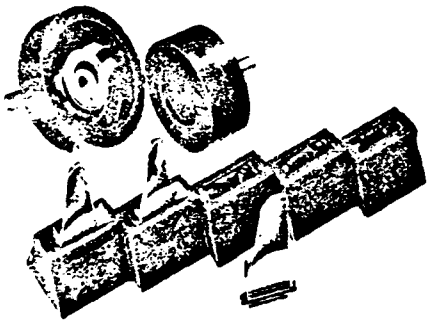
Plating

Masks for selective surface plating...for chrome, bronze, silver, gold, nickel, etc. Also for copper plating heat treat.



Painting

Plugs and masks for precision painting

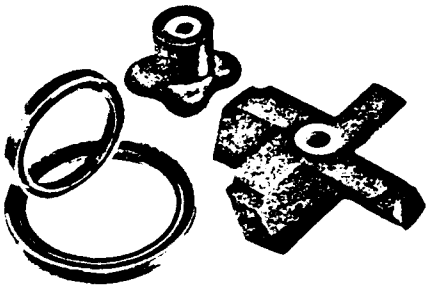


Grit Blast

Special grit-blast masks for pre-treatment, prior to plating or coating.

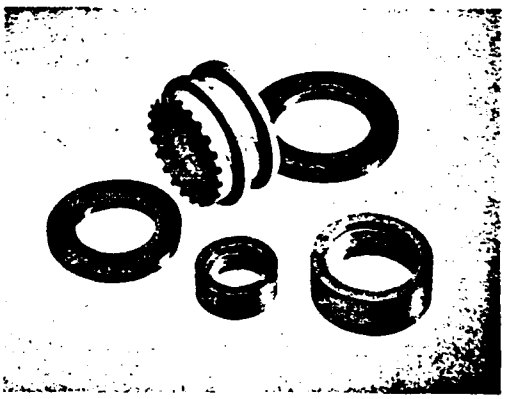
Glass-Bead Peening

Masking cells for surface finishing and polishing



Rubber-to-Metal Bonding

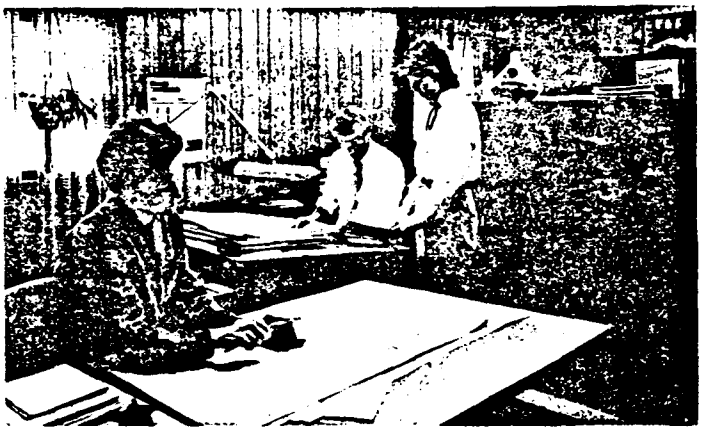
All types of synthetic and natural-base rubber-to-metal bonding



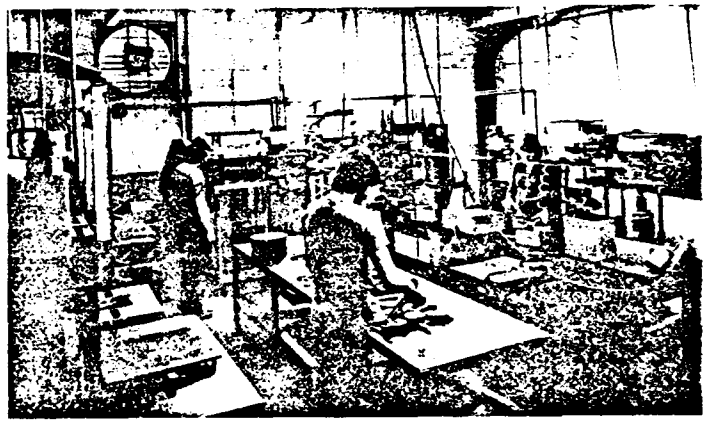
Protective

Rubber coverings to provide protection during in-plant handling and processing

Pacific Plastking Company offers design and engineering consultation services



Complete machine facility for the manufacture of molds, plating and peening fixtures



S U M M A R Y

All tooling is manufactured at Acme Masking Company facilities. Tooling costs vary depending on size and complexity of rubber masks required. This tooling becomes the exclusive property of the purchaser and may not be used for any other unless specifically authorized by you.

All tooling manufactured by Acme Masking Company remains inventoried free of charge at our facility until return or transfer is requested. Subsequent mask orders are processed accordingly. Additional masks can be made using existing tooling in a minimum of time.

CURRENT USERS

UNION CARBIDE CORPORATION

DETROIT DIESEL ALLISON, GMC

EX-CELL-O CORPORATION

PRATT & WHITNEY AIRCRAFT GROUP

GENERAL ELECTRIC AIRCRAFT
ENGINE GROUP

GARRETT TURBINE ENGINE COMPANY

HOWMET CORPORATION

MAN TURBO

BELL HELICOPTER

WESTERN GEAR CORPORATION

SIKORSKY

IGW SYSTEMS, INC.

AVIATION POWER SUPPLY

PT COMPONENTS, BEARING DIVISION

MICHIGAN CHROME & CHEMICAL COMPANY

AVAILABLE MATERIALS

NATURAL GUM RUBBER

SBR OR NEOPRENE RUBBER

ETHYLENE PROPYLENE

BUNA

SILICONE

VITON

POLY URETHANE

HYPALON

BUTYL

Most materials come in a variety of colors and durometers per customer request.

CREST INDUSTRIAL CHEMICALS, INC.

TECHNICAL DATA BULLETIN NO: 49

BLUE MASK # 15

A Hand Peelable Protective Coating

DESCRIPTION

Crest Blue Mask # 15 is a one package, hand strippable protective coating, which posses a high degree of chemical resistance. This product gives outstanding protection against the corrosive action of Hot Alkaline and Acid Solutions.

PROPERTIES

LIQUID:

Package viscosity of 70 degrees F.	50 ± 10 poises
% Solids by Weight	24 - 26
% Solids by Volume	27 - 29
Weight per Gallon	12.4
Color	Blue
Flash Point	Above 210 degrees F. TOC
Storage life at 70 degrees F.	One Year Minimum

FILM:

Appearance	Blue liquid that dries to a tough chemical resistant elastomeric film
Peel adhesion	0.7 - 1.1 Lb/inch
Tensile strength	1000 PSI (Minimum)
Elongation at rupture	600% Minimum
Abrasion resistance	Excellent
Impact resistance	Excellent
Chemical Resistance	Resists emulsion cleaners, anodizing solutions, alkaline cleaners, hot alkaline and acid chemical milling solutions, and acid deoxidizers. Will degrade upon exposure to most hydrocarbon solvents and oils.

HAZARDOUS:

Caution: Contains Chlorinated hydrocarbons. Read the precautionary information carefully before opening. Open containercarefully to avoid spurting. Prolonged exposure to high concentrations of vapor may cause irritation to eyes. Avoid prolonged or repeated breathing of vapor. Do not take internally. Use with adequate ventalation. See product label or MSDS for additional precautionary and handling information.

DIRECTIONS FOR USE

Blue Mask # 15 should be thoroughly mixed prior to and during use to assure uniformity. Caution should be exercised to prevent air from being drawn into the mask by the mixing action. The mask should be diluted with Crest Blue Mask Thinner # 15 only.

ALUMINIM AND MAGNESIUM PROCESSES:

Air-Cure Schedule: After the final coat of Blue Mask # 15 is tack-free allow mask to cure for four (4) hours minimum before etching or plating.
Oven-Cure Schedule: Tack-free may be oven-cured for 30-60 minutes at 225 degrees F to speed curing cycle.

STEEL AND TITANIUM PROCESSES:

Air-Cure Schedule: Overnight air-cure, no oven necessary.
Oven-Cure Schedule: Oven-Cure tack-free mask for 30-60 minutes at 225 degrees F.

WARRANTY & LIABILITY DISCLAIMER

The above information and recommendations concerning this product are based upon our laboratory tests and field use experience: however, since conditions of actual use are beyond our control, any recommendations or suggestions are made without warranty expressed or implied. Manufacturer's and seller's sole obligation shall be to replace that portion of the product shown to be defective. Neither shall be liable for any loss, damage, or injury , direct or consequential, arising from the use of this product.

Material Safety Data Sheet
May be used to comply with OSHA's Hazard Communication Standard. 29 CFR 1910.1200. Standard must be consulted for specific requirements

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY (As Used on Label and List): BLUE MASK . #15

Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.

Section I

Manufacturer's Name: CREST INDUSTRIAL CHEMICALS	Emergency Telephone Number: 713-780-1828
Address (Number, Street, City, State, and ZIP Code): 6341 BEVERLY HILL	Telephone Number for Information: 713-780-1828
HOUSTON, TX 77057	Date Prepared: 1/16/89
	Signature of Preparer (optional):

Section II — Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity, Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
XYLENE	100	100		
PERCHOLOROETHYLENE	100	50		

Section III — Physical/Chemical Characteristics

Boiling Point: 231°F		Specific Gravity (H_2O = 1): 1.4	
Vapor Pressure (mm Hg): NOT AVAILABLE		Melting Point: NA	
Vapor Density (AIR = 1): MORE THAN	1	Evaporation Rate (Butyl Acetate = 1): LESS THAN	1

Solubility in Water: NEGLIGIBLE

Appearance and Odor: BLUE VISCOUS LIQUID WITH PERCHLORETHYLENE ODOR

Section IV — Fire and Explosion Hazard Data

Flash Point (Method Used): ABOVE 200°F SETA	Flammable Limits: UNKNOWN	LEL: UNKNOWN	UEL: UNKNOWN

Extinguishing Media: USE EXTINGUISHING MEDA APPROPRIATE FOR SURROUNDING FIRE

Special Fire Fighting Procedures: USE SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING USE

WATER SPRAY TO COOL NEARBY CONTAINERS EXPOSED TO FIRE

Unusual Fire and Explosion Hazards: EXTINGUISH ALL NEARBY SOURCES OF IGNITION SINCE VAPORS DECOMPOSE

TO HAZARDOUS PRODUCTS AT HIGH TEMPERATURES

Section V — Reactivity Data

Stability		Conditions to Avoid
	Unstable	Open flames, welding arcs, or other high temperature sources
	Stable X	which may induce thermal decomposition

Incompatibility (*Materials to Avoid*)
Alkalies, oxidizing materials, water, moist air and acids may liberate carbon monoxide,

Hazardous Decomposition or Byproducts
carbon dioxide, HCL, chlorine or phosgene

Hazardous Polymerization			Conditions to Avoid
	May Occur		
	Will Not Occur	X	

Section VI — Health Hazard Data See attached

Route(s) of Entry: Inhalation? Skin? Ingestion?

Health Hazards (*Acute and Chronic*)

Carcinogenicity: NTP? IARC Monographs? OSHA Regulated?

Signs and Symptoms of Exposure

Medical Conditions
Generally Aggravated by Exposure

Emergency and First Aid Procedures

Section VII — Precautions for Safe Handling and Use

Steps to Be Taken in Case Material Is Released or Spilled
Wear protective equipment: Rubber boots, rubber gloves, rubber apron, and a self-contained breathing apparatus. Notify safety personal, stop discharge, if possible without risk. Do not allow spill to enter sewers, streams, ect.

Waste Disposal Method
Dispose of in accordance with Federal, State and Local Regualtions, empty containers or lines should be commercially cleaned before reuse

Precautions to Be Taken in Handling and Storing
Wear protective equipment store in tightly closed containers, in a cool dry well ventilated area away from acids, and oxidizing agents.

Other Precautions
Vapors of this product are heavier than air and will collect in low areas such as pits, degreasers, storage tanks and other confined areas.

Section VIII — Control Measures

Respiratory Protection (*Specify Type*)
NIOSH approved self-contained breathing apparatus for exposures above OSHA PEL

Ventilation			
	Local Exhaust	X	Special
X	Mechanical (General)	X	Other

Protective Gloves	Eye Protection
rubber gloves	splash proof chemical goggles

Other Protective Clothing or Equipment
Safety shower and eyewash fountain, in the immediate work area wash with soap and water

Work/Hygienic Practices
before, eating, drinking, smoking, or using toilet

* USGPO 1986-491-529/45775

5. ENVIRONMENTAL AND DISPOSAL INFORMATION:

ACTION TO TAKE FOR SPILLS/LEAKS: Small leaks - mop up, wipe up, or soak up immediately. Remove to out of doors. Large spills - evacuate area. Contain liquid; transfer to closed metal containers. Keep out of water supply.

DISPOSAL METHOD: When disposing of unused contents, the preferred options are to send to licensed reclaimers or to permitted incinerators. Any disposal practice must be in compliance with federal, state, and local regulations. Do not dump into sewers, on the ground, or into any body of water.

6. HEALTH HAZARD DATA:

EYE: May cause pain, and slight transient (temporary) irritation. Vapors may irritate the eyes at about 100 ppm.

SKIN CONTACT: Short single exposure not likely to cause significant skin irritation. Prolonged or repeated exposure may cause skin irritation, even a burn. Repeated contact may cause drying or flaking of skin.

SKIN ABSORPTION: A single prolonged exposure is not likely to result in the material being absorbed through skin in harmful amounts. The LD50 for skin absorption in rabbits is >10,000 mg/kg.

INGESTION: Single dose oral toxicity is low. The LD50 for rats is >5000 mg/kg. If aspirated (liquid enters the lung), may be rapidly absorbed through the lungs and result in injury to other body systems.

INHALATION: Dizziness may occur at 200 ppm; progressively higher levels may also cause nasal irritation, nausea, incoordination, drunkenness; and over 1000 ppm, unconsciousness and death. A single brief (minutes) inhalation exposure to levels above 6000 ppm may be immediately dangerous to life. In confined or poorly ventilated areas vapors can readily accumulate and can cause unconsciousness and death. Alcohol consumed before or after exposure may increase adverse effects. Based on structural analogy and/or equivocal data in animals, excessive exposure may potentially increase sensitivity to epinephrine and increase myocardial irritability (irregular heartbeats).

SYSTEMIC & OTHER EFFECTS: Excessive exposure may cause liver and/or kidney effects. Signs and symptoms of excessive exposure may be central nervous system effects and anesthetic or narcotic effects. Perchloroethylene has been shown to increase the rate of spontaneously occurring malignant tumors in certain laboratory rats and mice. Other long-term inhalation studies in rats failed to show a tumorigenic response. Epidemiology studies are limited and have not established an association between perchloroethylene exposure and cancer. Perchloroethylene is not believed to pose a measurable carcinogenic risk to man when handled as recommended. Birth defects are unlikely. Exposures having no effect on the mother should have no effect on the fetus. Did not cause birth defects in animals; other effects were seen in the fetus only at doses which caused toxic effects to the mother. Results of in vitro ('test tube') mutagenicity tests have been negative.

7. FIRST AID:

EYES: Irrigate immediately with water for at least 5 minutes.

SKIN: Wash off in flowing water or shower. Wash contaminated clothing before reuse.

INGESTION: Do not induce vomiting. Call a physician and/or transport to emergency facility immediately.

INHALATION: Remove to fresh air. If not breathing, give mouth-to-mouth resuscitation. If breathing is difficult, give oxygen. Call a physician.

NOTE TO PHYSICIAN: Because rapid absorption may occur through lungs if aspirated and cause systemic effects, the decision of whether to induce vomiting or not should be made by a physician. If lavage is performed, suggest endotracheal and esophageal control. Danger from lung aspiration must be weighed against toxicity when considering emptying the stomach. If burn is present, treat as any thermal burn, after decontamination. Exposure may increase "myocardial irritability". Do not administer sympathomimetic drugs unless absolutely necessary. No specific antidote. Supportive care. Treatment based on judgment of the physician in response to reactions of the patient.

8. HANDLING PRECAUTIONS:

EXPOSURE GUIDELINE(S): Perchloroethylene: ACGIH TLV is 50 ppm (stel is 200 ppm); OSHA PEL is 100 ppm.

VENTILATION: Control airborne concentrations below the exposure guideline. Use only with adequate ventilation. Local exhaust ventilation may be necessary for some operations. Lethal concentrations may exist in areas with poor ventilation.

RESPIRATORY PROTECTION: Atmospheric levels should be maintained below the exposure guideline. When respiratory protection is required for certain operations, use an approved air-purifying respirator. For emergency and other conditions where the

exposure guideline may be greatly exceeded, use an approved air-purifying respirator. In confined or poorly ventilated areas, use an approved positive pressure self-contained breathing apparatus.

SKIN PROTECTION: For brief contact, no precautions other than clean body-covering clothing should be needed. When prolonged or frequently repeated contact could occur, use protective clothing impervious to this material. Selection of specific items such as gloves, boots, apron, or full body suit will depend on operation.

EYE PROTECTION: Use safety glasses. Where contact with liquid is likely, chemical goggles are recommended because eye contact with this material may cause discomfort, even though it is unlikely to cause injury.

Material Safety Data Sheet
May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be suited for specific requirements

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form
Form Approved
OMB No. 1218-0072

IDENTITY (As Used on Label and List)
BLUE MASK THINNER #15

Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.

Section I

Manufacturer's Name CREST INDUSTRIAL CHEMICAL, INC.	Emergency Telephone Number 713 780-1828
Address (Number, Street, City, State, and ZIP Code) 6341 BEVERLY HILL	Telephone Number for Information 713- 780-1828
HOUSTON, TX 77057	Date Prepared 12/16/88
	Signature of Preparer (optional)

Section II — Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)
TOLUENE	300 ppm ceiling	150 ppm		
Perchloroethylene	200 ppm ceiling	200 ppm		
Xylene	300 ppm ceiling	150 ppm		

Section III — Physical/Chemical Characteristics

Boiling Point	245°F	Specific Gravity (H_2O = 1)	1.52
Vapor Pressure (mm Hg.)	13	Melting Point	NA
Vapor Density (AIR = 1)	5.8	Evaporation Rate (Butyl Acetate = 1) LESS THAN	1

Solubility in Water
Negligible

Appearance and Odor
Colorless water white liquid Ether-like odor

Section IV — Fire and Explosion Hazard Data

Flash Point (Method Used)	Flammable Limits	LEL	UEL
NONE	NONE	NA	NA

Extinguishing Media
Use extinguishing media appropriate for surrounding fire

Special Fire Fighting Procedures
Use self-contained breathing apparatus and full protective clothing use water spray to cool nearby containers exposed to fire.

Unusual Fire and Explosion Hazards
Extinguish all nearby sources of ignition since vapors decompose to hazardous products at high temperatures

Section V — Reactivity Data

Stability			Conditions to Avoid
	Unstable		Open flames, welding arcs, or other high temperature source
	Stable	X	which may induce thermal decomposition

Incompatibility (*Materials to Avoid*)
Alkalies, oxidizing materials, water, moist air and acids may liberate carbon d

Hazardous Decomposition or Byproducts
carbon dioxide, HCL, chlorine or phosgene

Hazardous Polymerization			Conditions to Avoid
	May Occur		
	Will Not Occur	X	

Section VI — Health Hazard Data See attached

Route(s) of Entry: Inhalation? Skin? Ingestion?

Health Hazards (*Acute and Chronic*)

Carcinogenicity: NTP? IARC Monographs? OSHA Regulated?

Signs and Symptoms of Exposure

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Generally Aggravated by Exposure

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Do not allow spill to enter sewers, streams, ect.

Waste Disposal Method
Dispose of in accordance with Federal, State and Local Regualtions, empty containers
or lines should be commercially cleaned before reuse

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Wear protective equipment store in tightly closed containers, in a cool dry well ver
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Other Precautions
Vapors of this product are heavier than air and will collect in low areas such as pi
degreasers, storage tanks and other confined areas.

Section VIII — Control Measures

Respiratory Protection (*Specify Type*)
NIOSH approved self-contained breathing apparatus for exposures above OSHA PEL

Ventilation			
	Local Exhaust	X	Special
X	Mechanical (General)	X	Other

Protective Gloves	Eye Protection
rubber gloves	splash proof chemical goggles

Other Protective Clothing or Equipment
Safety shower and eyewash fountain, in the immediate work area wash with soap and

Work/Hygienic Practices
before, eating, drinking, smoking, or using toilet

* U.S.G.P.O.: 1986-491-529/45

5. ENVIRONMENTAL AND DISPOSAL INFORMATION:

ACTION TO TAKE FOR SPILLS/LEAKS: Small leaks - mop up, wipe up, or soak up immediately. Remove to out of doors. Large spills - evacuate area. Contain liquid; transfer to closed metal containers. Keep out of water supply.

DISPOSAL METHOD: When disposing of unused contents, the preferred options are to send to licensed reclaimers or to permitted incinerators. Any disposal practice must be in compliance with federal, state, and local regulations. Do not dump into sewers, on the ground, or into any body of water.

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SYSTEMIC & OTHER EFFECTS: Excessive exposure may cause liver and/or kidney effects. Signs and symptoms of excessive exposure may be central nervous system effects and anesthetic or narcotic effects. Perchloroethylene has been shown to increase the rate of spontaneously occurring malignant tumors in certain laboratory rats and mice. Other long-term inhalation studies in rats failed to show a tumorigenic response. Epidemiology studies are limited and have not established an association between perchloroethylene exposure and cancer. Perchloroethylene is not believed to pose a measurable carcinogenic risk to man when handled as recommended. Birth defects are unlikely. Exposures having no effect on the mother should have no effect on the fetus. Did not cause birth defects in animals; other effects were seen in the fetus only at doses which caused toxic effects to the mother. Results of in vitro ('test tube') mutagenicity tests have been negative.

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INHALATION: Remove to fresh air. If not breathing, give mouth-to-mouth resuscitation. If breathing is difficult, give oxygen. Call a physician.

NOTE TO PHYSICIAN: Because rapid absorption may occur through lungs if aspirated and cause systemic effects, the decision of whether to induce vomiting or not should be made by a physician. If lavage is performed, suggest endotracheal and/or esophageal control. Danger from lung aspiration must be weighed against toxicity when considering emptying the stomach. If burn is present, treat as any thermal burn, after decontamination. Exposure may increase "myocardial irritability". Do not administer sympathomimetic drugs unless absolutely necessary. No specific antidote. Supportive care. Treatment based on judgment of the physician in response to reactions of the patient.

8. HANDLING PRECAUTIONS:

EXPOSURE GUIDELINE(S): Perchloroethylene: ACGIH TLV is 50 ppm (stel is 200 ppm); OSHA PEL is 100 ppm.

VENTILATION: Control airborne concentrations below the exposure guideline. Use only with adequate ventilation. Local exhaust ventilation may be necessary for some operations. Lethal concentrations may exist in areas with poor ventilation.

RESPIRATORY PROTECTION: Atmospheric levels should be maintained below the exposure guideline. When respiratory protection is required for certain operations, use an approved air-purifying respirator. For emergency and other conditions where the exposure guideline may be greatly exceeded, use an approved air-purifying respirator. In confined or poorly ventilated areas, use an approved positive pressure self-contained breathing apparatus.

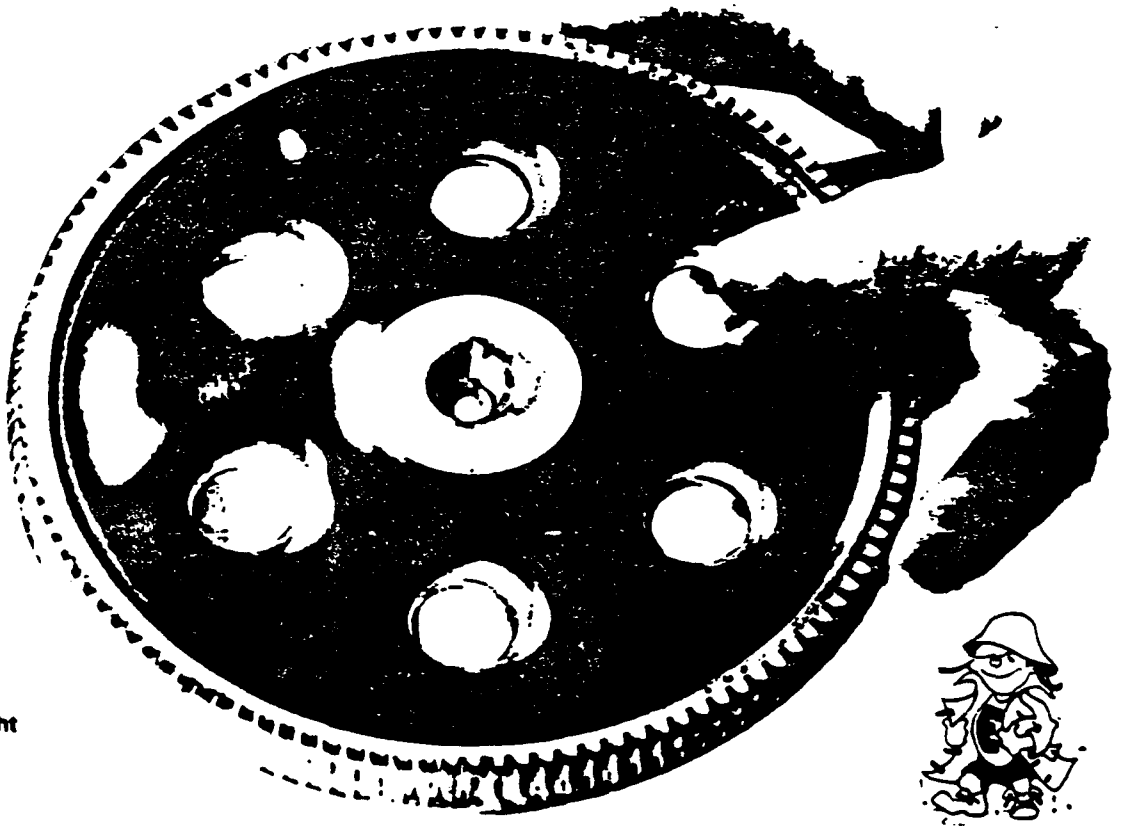
SKIN PROTECTION: For brief contact, no precautions other than clean body-covering clothing should be needed. When prolonged or frequently repeated contact could occur, use protective clothing impervious to this material. Selection of specific items such as gloves, boots, apron, or full body suit will depend on operation.

EYE PROTECTION: Use safety glasses. Where contact with liquid is likely, chemical goggles are recommended because eye contact with this material may cause discomfort, even though it is unlikely to cause injury.

EVANS MANUFACTURING

PEEL COAT

THE NEW, IMPROVED
Hot Melt Protective Strippable Coating



Complete Protection,
Easy to Apply
Easy to Remove
Saves Space and Weight

EVANS MANUFACTURING, INC.

1330 SOUTER TROY, MICHIGAN 48083 (313) 583-9890
FAX (313) 583-2050

EVANS MANUFACTURING, INC.

1330 SOUTER
TROY, MICHIGAN 48083
(313) 583-9890

B-100

EXPLANATION: It is compound of Cellulose Acetate Butyrate and various plasticizers. It contains no solvent or harmful ingredients.

COLOR:	Chrystal Clear / Pink	
DENSITY:	8.37 lbs/gal	(1.06 gm/m
VISCOSITY AT 350°F (177°C): Brookfield RVF Spindle 4-20 RPM	3900 CPS	
OPERATING TEMPERATURE °F (°C):	350°-370° F	(177°-188°
COATING THICKNESS:	.05 in	(1.27 mm)
FLASH POINT COC °F (°C):	455°F	(235°C)
FIRE POINT COC °F (°C):	515°F	(268°C)
SOFTENING POINT °F (°C): Ring & Ball	250°F	(121°C)
COOLING TIME:	75 sec	
HARDNESS SHORE A:	77	
TENSILE STRENGTH: Instron 1130	593.9 PSI	(41.8 kg/sc
ELONGATION: Instron 1130	71.3%	
ELECTRICAL RESISTANCE: Meg Check	EXCELLENT	
MOISTURE RESISTANCE:	EXCELLENT	

CHEMICAL RESISTANCE: Attacked by solvents and long immersion in strong acids and bases

AVAILABLE COLORS: Clear, Pink

USES: Plating stop-off - sharp line. No contamination of solution, potting compound, electrical insulation, seal parts exposed to salt water. Meets MIL-P-23242A

Peel Coat

Hot Melt

PEEL-COAT, Type I

E-1
A transparent Golden Hot Melt, 100% solids coating. Based on Ethylcellulose, that can be reused. Has excellent pot life and can be mixed with any Ethylcellulose based Hot-Melt coating. Also available in heat-resistant opaque colors.

E-2
A Clear Golden Hot Melt. The coating is transparent and any identification marks can easily be observed. Used to protect tools and spare parts from rust.

E-5
A tough Golden coating meeting the requirements of Military Specification JAN-C-149, Type I, and MIL-P 149C, Type I. Used for long time storage

E-30
The most widely used of all Hot melt coatings. Water-Clear, Type I coating with very few fumes, and very little odor. Part numbers can be easily read through the film. Also available in transparent Green, Red, and Blue at the same price.

E-40
Highest quality Type I coating, based on Ethylcellulose and white mineral oil that has unusual resistance to darkening and is available in transparent colors.

E-45
A specialty hot melt coating with higher operating and softening temperature. Used for baking applications, on paint stop-off and armature varnish applications.

PEEL-COAT, Type III

P-10
A Type III Hot Melt coating based on Cellulose Acetate Propionate. Has similar properties to the Type II coating, with very little odor, but less pot life.

PEEL-COAT, Type II

B-50
Low cost, transparent, Butyrate based, Type II Hot Melt Coating. Has the fastest setup time and very little odor. Available in transparent colors. The film thickness can very easily be varied by the pot temperature.

B-55
Clear, soft, very flexible Type II coating. The coating is easily stripped and it will mix with any of the Type II coatings. Has excellent color retention.

B-60
Clear, tough, Type II coating, meeting the requirements of JAN-C-149. For maximum abrasion and longtime storage. High tensile strength. Also available in oil-less grade for protecting earth core and epoxy mold applications. Gives long time storage protection.

B-85
Very hard tough rack coating, semi-strippable. Available in opaque gray and black.

B-90
A 100% solid Hot Melt coating that is extra tough and is used in many plating stopoff operations where severe chemical conditions exist, and for some paint bake applications. Can be remelted and reused many times. Has excellent pot life.

B-100 MASK PEEL
Oil-free, Type II coating used as a stopoff in electroplating, capping of Oxygen Tubing, sealing the ends of electric cable, and other plating compound applications where no exudation of any type can be tolerated. Meets the requirements of MIL-P-23242-B. Available in Clear and Transparent Pink. Easily trimmed.

B-149
Type II Hot Melt Coating that meets the requirements of Military Specification MIL-P-149C, and is used for Government packaging. This coating is also used for low-temperature applications. It is flexible at minus 75° C. It is an all-weather coating.

PEEL-COAT, Type IV

K-20
The K-20 is a thermo-plastic rubber solid hot melt material. It has no odor and no oil film. Ideal for saws and small items that do not require long term rust protection. Available in transparent colors.

K-25
Similar to K-20 except higher softening temperature, faster set up time, and easier to remove.

DOES THE JOB RIGHT THE FIRST TIME!

NOTICE

HANG THIS NEAR TANK

Please Read These Operating Instructions Carefully!

Temperature control is the most important factor in the use of Hot Melt Coatings and we definitely recommend electrically heated, thermostatically controlled melting equipment, such as we have available. Excessively large equipment or improper equipment will result in overheating or heating the material too long and degrading will occur.

The following temperatures are recommended for use with the various coatings. (Remember that these temperatures are for the coating compound, not necessarily the thermostat setting.) The thermostat can be out of calibration, and we definitely suggest obtaining a thermometer and inserting it in the molten compound and use this reading to set the thermostat. When the thermostat is correct, use the following temperatures:

CODE NO.	TYPE I DESCRIPTION	OPER. TEMP.	CODE NO.	TYPE II DESCRIPTION	OPER. TEMP.
E-1	Transparent Golden	350° F	B-50	Clear, Thin	340° F
E-2	Clear Golden	360° F	B-55	Clear Very Flexible	340° F
E-5	Amber Tough - Mil-P-149C	375° F	B-60	Clear - JAN-C-149	350° F
E-30	Water Clear	350° F	B-90	Tough Transparent	350° F
E-40	Clear Tough	360° F	B-100	Plating - MIL-P-23242B	360° F
E-45	Hi-Temp Bake Stopoff	425° F	B-149	Clear - MIL-P-149C	350° F
	TYPE III			TYPE IV	
P-10	Water Clear	350° F	K-20	Clear Thermo-Plastic	290° F
P-15	Transparent Colors	350° F	K-25	Clear Thermo-Plastic	300° F

IF THE TANK IS NOT GOING TO BE USED FOR EXTENDED PERIODS OF TIME, IT SHOULD BE TURNED OFF OR THE THERMOSTAT LOWERED. It is important to try to use as much plastic as possible from the dip tank before new plastic is added. If approximately ¼ of the molten coating material can be used every day, the coating will stay light in color and free from odor. These products are thermoplastic and can be remelted and reused. Make sure the material is clean and not contaminated before returning it to the tank. Degraded material will deteriorate the material in the tank. These materials are nontoxic, and 8 lbs. of solid coating will melt into 1 liquid gallon. 1 lb. of coating will cover 500 square inches at 90-100 mils or 1/10" in thickness.

DO NOT MIX TOGETHER ANY OF THE TYPE I, II, III, OR IV COATINGS AS THEY ARE INCOMPATIBLE. However, any coatings of the same type may be mixed together.

The item to be protected should be immersed in the molten plastic for 1 - 2 seconds. When the item is removed the coating will solidify within 60 seconds and the part is ready for handling. The coating thickness can be varied by raising or lowering the temperature, or by preheating the part. The item to be protected should be clean, and if possible cotton or canvas gloves should be worn.

If you desire to completely envelop the item, the coating should be double-dipped, or single-dipped by using a non-wicking string, such as fiberglass or nylon. Hot melt coatings are very heat sensitive and in the initial melt the thermostat should never be elevated above the operating temperature, as the plastic is a very good insulator and this will cause overheating of the solid plastic. When new material is added it will sink to the bottom and you might want to screen off one portion of the tank with a metal barrier to restrict new material being added to one portion of the tank. The coating can be very easily removed, as it does not adhere but envelopes. It can be slit and peeled like an orange or banana.

The best method to clean the tank is to insert a piece of scrap metal into the molten plastic, allow it to solidify, turn on the tank for less than 5 minutes, then pull the plug from the tank by means of the scrap metal, like pulling a cork from a bottle. The remaining plastic can be removed with a rag.

PEEL - COAT

EVANS MANUFACTURING, INC.

1390 SOUTER TROY, MICHIGAN 48083 (313) 583-8890

MATERIAL SAFETY DATA SHEET

SECTION I

MANUFACTURER'S NAME	EMERGENCY TELEPHONE NO.
EVANS MANUFACTURING, INC.	1-313-583-9890
ADDRESS (Number, Street, City, State and ZIP Code) 1330 Souter, Troy, Michigan 48083	
CHEMICAL NAME AND SYNONYMS CELLULOSE ACETATE BUTYRATE HOT DIP	TRADE NAME AND SYNONYMS PEEL-COAT, Type II
CHEMICAL FAMILY CELLULOSE	FORMULA B-100

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS N.A.			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS NONE		
OTHERS NONE					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
NONE - AS DEFINED IN ACCORDANCE WITH		
29CFR1910.1200: THE PRECISE COMPOSITION OF THIS MIXTURE		
IS PROPRIETARY INFORMATION. A MORE COMPLETE DISCLOSURE		
AVAILABLE IN EVENT OF A MEDICAL EMERGENCY.		

SECTION III - PHYSICAL DATA

BOILING POINT (°F.) OVER 700°F		SPECIFIC GRAVITY (H_2O=1)	1
VAPOR PRESSURE (mm Hg.) Not applicable		PERCENT, VOLATILE BY VOLUME (%) Not applicable	
VAPOR DENSITY (AIR=1) # #		EVAPORATION RATE # # (_____ =1)	
SOLUBILITY IN WATER INSOLUBLE			
APPEARANCE AND ODOR 100% Solid Thermoplastic, wax-like, with oil odor			

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	FLAMMABLE LIMITS	Lel	Uel
Open cup, over 400°F	Not applicable		
EXTINGUISHING MEDIA Carbon Dioxide			
SPECIAL FIRE FIGHTING PROCEDURES Treat as oil fire			
UNUSUAL FIRE AND EXPLOSION HAZARDS NONE			

(Continued on reverse side)

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE: NOT ESTABLISHED

EFFECTS OF OVEREXPOSURE: NONE

EMERGENCY AND FIRST AID PROCEDURES

Applied at 350°F. If it comes in contact with the skin, treat as an oil burn

SECTION VI - REACTIVITY DATA

STABILITY: STABLE	UNSTABLE		CONDITIONS TO AVOID
	STABLE	X	NONE

INCOMPATABILITY (Materials to avoid): NONE

HAZARDOUS DECOMPOSITION PRODUCTS: NONE, ONLY CARBON

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	NOT APPLICABLE

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: NOT APPLICABLE - SOLID

WASTE DISPOSAL METHOD: SAME AS WAX OR OIL - INCINERATION OR LAND FILL

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type): NONE

VENTILATION: Not needed	LOCAL EXHAUST: IF ODOR IS OBJECTIONABLE	SPECIAL: NONE KNOWN
	MECHANICAL (General)	OTHER: NONE KNOWN

PROTECTIVE GLOVES: WHILE DIPPING

EYE PROTECTION: NONE

OTHER PROTECTIVE EQUIPMENT: NONE

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: NONE

OTHER PRECAUTIONS

GPO 930-540

EVANS MANUFACTURING, INC.

Franklin B. Evans

Franklin B. Evans, Chemist

6-30-89

MICHIGAN CHROME AND CHEMICAL

tolber division MICHIGAN CHROME & CHEMICAL COMPANY

Technical Information Data

MICCROWAX

- MICCROWAX is a single-material wax for selective stop-off that is especially suited for masking on complicated parts and sharp edges.
- MICCROWAX will not crack, and may be readily melted for use by any common heating medium.
- MICCROWAX shows a remarkable degree of adhesion, even when used on flat surfaces. It requires no prime coat before application which means only one dip tank is necessary for the complete operation.
- MICCROWAX hardens immediately after the part is dipped, thereby minimizing preparation time and speeding production of parts before plating.
- MICCROWAX can be reused without loss of its efficiency.
- MICCROWAX may be used in most plating cycles as long as cycle temperatures do not exceed melting point.

MICCROWAX C-562

MICCROWAX C-562 should be held at temperatures between 175°F. and 185°F. to attain a maximum thickness of coating for use in selective hard chromium plating. The parts to be stopped-off should be cleaned of all dirt, grease, etc. Immerse in MICCROWAX for a few moments to raise the temperature of the part and withdraw. Two or three successive, fast dips will provide a heavy coating that will withstand any hard chromium cycle. The portion to be plated can be bared with a knife and the surface cleaned with naphtha before plating.

MICCROWAX C-562 can be removed easily by peeling or placing part in boiling water to melt the coating.

MICCROWAX C-562 comes in 10 lb. cakes, 5 cakes per carton.

PRECAUTIONARY INFORMATION

STORAGE: This coating material should be stored and used in accordance with normal standards of good practice for handling industrial paints.

USE: Maintain adequate ventilation in working area. Wear approved respirators and protective clothing when working in confined areas. Avoid repeated breathing of concentrated vapors. Prolonged contact of material with the skin may be irritating; wash exposed surface thoroughly with soap and water. In case of eye contact, flush out the eyes with water for 15 minutes and consult a physician.

tolber division MICHIGAN CHROME & CHEMICAL COMPANY

Technical Information Data

MICCRO SUPER XP 2000 -

MICCRO SUPER XP 2000 STOP OFF LACQUER FOR ELECTROLESS NICKEL PLATING, HARD COAT ANODIZING, AND CHEMICAL MILLING.

The latest development by the laboratories of Michigan Chrome & Chemical is the new Miccro Super XP 2000 stop off lacquer. This breakthrough provides the plating industry with the latest, and without a doubt, the most exacting resistant coat ever formulated for use in the metal finishing industry.

Miccro Super XP 2000 is designed for use in all plating cycles, as well as hard coat anodizing and chemical milling.

Miccro Super XP 2000 will maintain a hair line demarcation and can be readily peeled from the part after electroless cycles when applied in sufficient thickness.

Miccro Super XP 2000 will remain on the part through nickel stripping operations, and need not be reapplied for repeat plating operations.

Miccro Super XP 2000 is bright orange and may be applied by brushing or dipping — for dipping it can be reduced with the Miccro XP 2000 Reducer.

APPLICATION PROCEDURES. Miccro Super XP 2000 is shipped ready to use for brushing and dipping application. IT MUST BE STIRRED BEFORE USING. It also should be stirred periodically while being used or after setting.

1. Two or three coats are recommended, depending on sharpness of edges to be covered. Be sure the second and third coats are applied up to the line of demarcation.
2. The area to be masked should be chemically and physically cleaned. Wiping with solvent should be the minimum operation.
3. Then allow at least 35 minutes air dry between coats and overnight after final coat. To expedite a forced dry may be employed. A typical cycle might be 30 minutes at 130° to 140° after the last coat has been air dried 30 minutes.
4. Holding the part in Miccro Super XP 2000 for 30 seconds and withdrawing at a reasonable rate gives a dry film of 12 mils per coat.

If part is to be electro clean after Miccro Super XP 2000 is applied, use "REVERSE ELECTRO CLEAN."

An apparent pinhole blistering condition may be noticed in the coated film. This is normal and will not cause plate-through when it occurs. Although Miccro Super XP 2000 will peel off after electroless nickel cycle, for mass stripping or removal from recesses use: 1. Miccro XP 2000 Reducer; 2. Toluene; 3. Miccro Strip A. The first two are the fastest.

Removal is easier if Miccro Super XP 2000 is peeled while part is still warm.

To maintain original viscosity, use Miccro XP 2000 Reducer to replace evaporated solvents.

PRECAUTIONARY INFORMATION

STORAGE: This coating material should be stored and used in accordance with normal standards of good practice for handling industrial paints.
CONTAINS VOLATILE SOLVENTS. Keep away from heat, sparks and open flames. Store at temperatures above freezing and below 105°F. Keep containers closed when not in use.
USE: Maintain adequate ventilation in working area. Wear approved respirators and protective clothing when working in confined areas. Avoid repeated breathing of concentrated vapors. Prolonged contact of liquid material with the skin may be irritating; wash exposed surface thoroughly with soap and water. In case of eye contact, flush out the eyes with water for 15 minutes and consult a physician.

tolber division MICHIGAN CHROME & CHEMICAL COMPANY

Technical Information Data

MICCROSTOP
For Selective Plating

MICCROSTOP was developed by Michigan Chrome & Chemical Co. for use in selective plating cycles which require hairline demarcation between plated and non-plated surfaces. MICCROSTOP will maintain its adhesion through boiling cleaners and acid rinses which makes it ideal for the following types of plating:

- High-Speed Copper
- Chrome (Decorative)
- Phosphate Coatings
- Alloy Solutions
- Tin
- Zinc
- Gold
- Silver
- Nickel
- Cadmium
- Gold on Silver
- Silver on Gold

Not Hard Chrome
Electroless Nickel
Chemical Milling

APPLICATION PROCEDURE

MICCROSTOP may be dipped, brushed, or sprayed with equal results, if recommended instructions are followed.

Remove all grease, oil and buffing compounds from the work before applying MICCROSTOP. The best method is a short dip in the electrolytic cleaner, using cathodic current, followed by a cold-water, acid, cold-water and hot-water rinse. The area to be lacquered should not be handled.

In brushing MICCROSTOP lay the material on the surface with a full brush using a minimum number of strokes. Do not brush out as in applying ordinary paint.

Be sure to cover thoroughly all sharp edges, corners, etc., with a maximum thickness of the material.

For ordinary deposits two coats of MICCROSTOP are recommended and three or more coats for heavier deposits.

To spray MICCROSTOP, the material should be reduced approximately 50%, using MICCROSTOP REDUCER only. This may be varied in either direction to suit any specialized spraying equipment.

Approximately 20-30 minutes air-dry between coats is recommended, with a minimum of two hours air-dry after the final coat.

Faster drying of MICCROSTOP can be accomplished by force-drying for 20 minutes over a hot plate, or in an oven not exceeding 150° Farenheit.

For fast, effective removal of MICCROSTOP stop-off Lacquer, MICCROSTOP REDUCER is recommended. Also, a short soak in caustic cleaner, both at 212° F., will break the adhesion and the coating is easily removed.

MICCROSTOP is available in red only because of its better visibility in blind holes and recessed areas. It also lessens eye strain.

PRECAUTIONARY INFORMATION

STORAGE: This coating material should be stored and used in accordance with normal standards of good practice for handling industrial paints.

CONTAINS VOLATILE SOLVENTS. Keep away from heat, sparks and open flames. Store at temperatures above freezing and below 105° F. Keep containers closed when not in use.

USE: Maintain adequate ventilation in working area. Wear approved respirators and protective clothing when working in confined areas. Avoid repeated breathing of concentrated vapors. Prolonged contact of liquid material with the skin may be irritating; wash exposed surface thoroughly with soap and water. In case of eye contact, flush out the eyes with water for 15 minutes and consult a physician.

MICCRO PRODUCTS *Developed and manufactured by experienced platers*

tolber division MICHIGAN CHROME & CHEMICAL COMPANY

Technical Information Data

MICCROSHIELD
Stop-Off Lacquer

MICCROSHIELD was developed by Michigan Chrome and Chemical Company to function in all plating cycles. It is, however, primarily intended to use in difficult ACIDIC solutions. MICCROSHIELD is unmatched for masking in ELECTROLESS NICKEL and similar baths. It will also do an excellent job in such difficult cycles as anodizing (both chromic and sulphuric), Dow 7 and 17 processes for magnesium, acid etching on steel, electropolishing, and other severe cycles.
MICCROSHIELD is a high-solids, air-dry lacquer, transparent orange in color, which can be brushed, sprayed, or dipped. (For spraying, it should be reduced as desired with MICCROSHIELD REDUCER only.)

Particular advantages of MICCROSHIELD:

- Stands up in the toughest cycles
- Takes higher temperatures
- Has superior chemical resistance
- Hold hairline demarcation
- Fewer coats required
- 100% stable with no gelation or settling tendencies
- Easy on the eyes with excellent "brushability"
- Will not contaminate any plating solutions

APPLICATION PROCEDURE

MICCROSHIELD Stop-Off Lacquer can be applied by brushing, spraying, or dipping. For spraying, it should be reduced as desired with MICCROSHIELD REDUCER only.

As with all stop-off lacquers, two coats are recommended, to avoid minute pin-holding. Evaporated solvent should be replaced using MICCROSHIELD REDUCER only.

The part to be masked should be chemically clean, prior to application of the lacquer. Under normal humidity conditions MICCROSHIELD possesses fast air-drying characteristics. For typical conditions, a 30 minute air dry between coats and four hour air dry prior to introduction to hot solutions will suffice. Faster drying of MICCROSHIELD can be accomplished by force-drying for 20 minutes over a hot plate, or in an oven not exceeding 150° Farenheit.

MICCROSTRIP "B" is an excellent removal agent for MICCROSHIELD. It also can be removed in a trichlorethylene vapor degreaser, or with MICCROSTRIP "A". If MICCROSHIELD REDUCER is the only available solvent, it can be used, although it is slower than the above methods.

PRECAUTIONARY INFORMATION

STORAGE: This coating material should be stored and used in accordance with normal standards of good practice for handling industrial paints.

CONTAINS VOLATILE SOLVENTS. Keep away from heat, sparks and open flames. Store at temperatures above freezing and below 105° F. Keep containers closed when not in use.

USE: Maintain adequate ventilation in working area. Wear approved respirators and protective clothing when working in confined areas. Avoid repeated breathing of concentrated vapors. Prolonged contact of liquid material with the skin may be irritating; wash exposed surface thoroughly with soap and water. In case of eye contact, flush out the eyes with water for 15 minutes and consult a physician.

tolber division MICHIGAN CHROME & CHEMICAL COMPANY

Technical Information Data

MICCROMASK
Stop-Off Lacquer

MICCROMASK stop-off lacquer, developed by Michigan Chrome and Chemical Company, is the most effective product stop-off in its field. Developed primarily for hard chrome plating it can be used in lead plating and similar cycles.

MICCROMASK is available in red for high visibility.

- Has exceptional adhesive qualities but can be removed easily after plating.
- Has good dielectric strength resulting in a clean line of demarcation with no loss of current.
- Easy to apply — can be brushed, dipped or sprayed with equal success.
- Possesses rapid air-drying qualities, reducing drying time between coats and in preparation for racking.
- Absolutely neutral and will not contaminate any plating solution.
- Assures extreme accuracy, with no possibility of a lacquer etch on precision-lapped finishes.

APPLICATION PROCEDURE

MICCROMASK Stop-off Lacquer may be dipped, brushed or sprayed with equal results if recommended instructions are followed.

All parts should be thoroughly cleaned before applying MICCROMASK Stop-off Lacquer either by degreasing, sandblasting or electrolytic cleaner.

In brushing MICCROMASK lay the material on the surface with a full brush using a minimum number of strokes. Do not brush out as in applying ordinary paint.

Be sure to thoroughly cover all sharp edges, corners, etc., with a maximum thickness of the material.

For deposits of .002" to .010" two coats of MICCROMASK Stop-off Lacquer are recommended, and three or more coats for heav' deposits.

Approximately one hour air-d. betwean coats is recommended with two hours air-dry after the final coat.

Faster drying of MICCROMAST Stop-off Lacquer can be accomplished by force-drying for 20 minutes over a hot plate or in an oven not exceeding 150° Fahrenheit.

In the event MICCROMASK Stop-off Lacquer is sprayed, the viscosity should be reduced approximately 50%, **using MICCROMASK REDUCER only.**

For fast, effective removal of MICCROMASK Stop-off Lacquer, MICCROSTRIP A is recommended. However, parts may be submerged in hot water or caustic cleaner, both at 212° F., until adhesion is broken. The coating can then be easily removed.

PRECAUTIONARY INFORMATION

STORAGE: This coating material should be stored and used in accordance with normal standards of good practice for handling industrial paints.

CONTAINS VOLATILE SOLVENTS. Keep away from heat, sparks and open flames. Store at temperatures above freezing and below 105°F. Keep containers closed when not in use.
USE: Maintain adequate ventilation in working area. Wear approved respirators and protective clothing when working in confined areas. Avoid repeated breathing of concentrated vapors. Prolonged contact of liquid material with the skin may be irritating; wash exposed surface thoroughly with soap and water. In case of eye contact, flush out the eyes with water for 15 minutes and consult a physician.

MICCRO PRODUCTS *Developed and manufactured by experienced platers*

tolber division MICHIGAN CHROME & CHEMICAL COMPANY

Technical Information Data

MICCROSTRIP "A"

MICCROSTRIP "A" is specifically designed for the removal of Stop-off Lacquers. The items to be stripped should be fully immersed in MICCROSTRIP "A" at room temperature for a period of time long enough to dissolve or soften the lacquer to the extent that it can be removed with a soft bristle brush.

MICCROSTRIP "A" should never be used as a lacquer thinner.

MICCROSTRIP "A" is a volatile solvent. Operators should therefore be cautioned against handling this material without proper safety equipment. In the event it is splashed in the eyes, wash immediately with water and consult with medical personnel as soon as possible. Adequate ventilation should be provided to prevent excessive inhalation of vapors. This material should be stored in a cool place.

WARNING: Flammable. Keep away from open fire.

MICCROSTRIP "B"

(NON-FLAMMABLE)

MICCROSTRIP "B" is specifically designed for stripping plastisol coatings from electroplating racks, conveyor hooks, etc.

MICCROSTRIP "B" does not dissolve the coating, but penetrates and breaks the bond, facilitating easy removal.

As the stripper has no solvent action, it does not lose its strength, and additions are made only to replace the material lost by drag-out or evaporation.

MICCROSTRIP "B" may be used in the drum in which it is shipped, or if a larger tank is desired, it should be constructed of welded steel plate, with a suitable cover. (A one or two-inch layer of water should be added and maintained on the surface of MICCROSTRIP "B" to prevent excessive evaporation of the stripper).

Racks or other items which are to be stripped should be fully immersed in MICCROSTRIP "B" at room temperature for a period of time long enough to loosen the coating. The time required, whether a few hours or over night, will depend upon the coating and its thickness.

Stripping may be speeded up considerably by cutting the coating lengthwise to allow easy access of the stripper to the under side of the material. When the plastisol has swelled and loosened sufficiently, the part can be withdrawn from the stripper and the coating easily removed. Primers that are not completely removed by MICCROSTRIP "B" can be taken care of by sandblasting or removed in caustic.

Operators should use ordinary precautions in handling MICCROSTRIP "B" and should wear goggles and rubber gloves for adequate protection. Do not repeatedly immerse hands in the stripper, and if splashed in the eyes, wash immediately with water. Provide adequate ventilation to prevent excessive breathing of fumes.

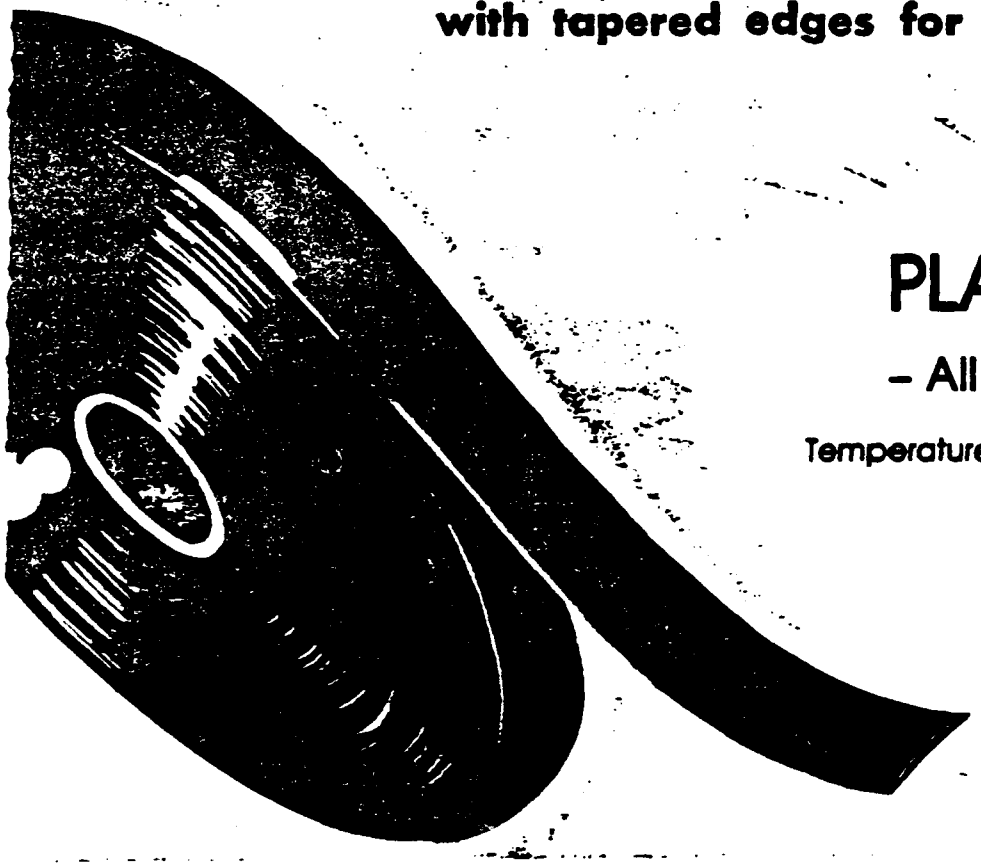
MICCROTAPE

U. S. Patent No. 2420604

NEW
MICCROTAPE 1210
SELF-ADHESIVE

NEW
MICCROTAPE 1220
SELF-ADHESIVE

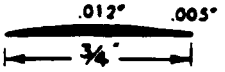
with tapered edges for positive sealing



PLATERS TAPE

– All Plating Cycles –

Temperature Range from 180°F to 220°F



- Will Not Contaminate Solutions
- Tapered Edges - Fusion Capabilities
- Adhesive Qualities and Flexibility
- Various Widths
- Electroless Nickel - Hard Chrome Anodizing - Chemical Milling

Developed and Manufactured by Experienced Platers

MICCRO PRODUCTS

tolber division
Pyramid Plastics, Inc.

220 WEST 5TH • HOPE, ARKANSAS 71801

MICCROTAPE — TAPERED EDGES

Color - Black
Thickness - .012 down to .005
Width - ¾ in.
Length - 170 ft. per roll
Adhesion - No adhesion. Miccrotape Cement provides for sealing ends when baking or fusion not possible.

Excellent for all plating cycles and plating racks. Maximum temperature 190°F.

NOT RECOMMENDED FOR CHLORINATED SOLVENTS

MICCROTAPE 1210 — SELF-ADHESIVE

Color - Yellow
Thickness - 5½ to 6 mils.
Width - 1 in. and 2 in.
Length - 166 ft. per roll
Flexibility - Will conform to a straight edge without undercutting.

DO NOT STRETCH ON A FLAT SURFACE.

Excellent self adhesive abilities for electroless nickel, type II and III anodizing, chemical milling, abrasive blasting. Virtually all plating solutions from 15-210°F.

MICCROTAPE 1220 — SELF-ADHESIVE

Color - Green
Thickness - 7 mils.
Width - 1 in. and 2 in.
Length - 180 ft. per roll
Flexibility - Not recommended for flexing

Excellent self adhesive abilities for high temperature (220°F+) electroless nickel plating. Very little or no residue when removed.

tolber division
Pyramid Plastics, Inc.
220 WEST 5TH • HOPE, ARKANSAS 71801

Miccro Products are sold by

PETROLITE SPECIALITY POLYMERS

PETROLITE WAXES IN MASKING APPLICATIONS

Melting Point Options

As can be readily seen by looking down the list of microcrystalline waxes on the product guide, the melting points range from about 155F to 202F. A glance to the penetration column of each wax shows the increase in hardness with melting point. This trend translates into decreased flexibility and, therefore, an increase of flaking.

Increase in hardness also effects adhesion of a wax to a part. If one is masking a massive piece, a harder wax will tend to solidify faster due to the temperature difference and will have trouble bonding.

There are a few options available for adapting waxes to the application. One can simply blend their "base" wax with a harder/softer wax to get the characteristics they need. Waxes are unique in that their physical properties are proportional to the ratio of the blend. This means that a blend of Be Square (R) 195 and 175 will yield a product somewhat like 185. Or, one could soften the base wax using mineral oil.

Another possibility is the use of an oxidized wax. Oxidized waxes are typically more plastic and have the increased melting points that many desire. The drawbacks to using an oxidized wax include an obvious susceptibility to chemical attack and an increased price.

Cross Contamination

Cross contamination of plating tanks when recycling wax is a problem for which there is no solution. Chemical seperation of contaminants would not be cost effective. The only thing that can be done to "used" wax is boil the water out of it.

Brittleness

Brittleness is primarily a result of bringing the temperature of the wax too high. High temperatures cause the wax to break down and lose its flexibility. A prevention program would include heating at a minimum temperature in an air restricted environment.

Obviously, exposure to harsh chemicals and metal contamination have a negative effect on wax flexibility. This is another problem with recycling.

Demasking

Aromatic solvents are commonly used for removing waxes. An alternative to solvent use is steam cleaning. Lower melting waxes are more appropriate here.

Acidity

Contolling acidity in recycling is possible through the addition of bases. Possible bases are morpholine, KOH, DEAE, and ammonia. One may notice the color of the wax becoming lighter as base is added. This indicates neutralization. Base should be stirred into molten wax very slowly.

PRODUCT PROFILES

PLASTIC MICROCRYSTALLINE WAXES

RELEASE NO. 400

GENERAL DESCRIPTION

The Petrolite Specialty Polymers Group, a pioneer in microcrystalline wax production dating back to the 1930's—provides BARECO® plastic waxes as a complementary product line to the BARECO hard microcrystalline waxes.

BARECO plastic waxes are petroleum-derived microcrystalline waxes refined to provide a useful series of ductile, flexible, thermoplastic materials.

BARECO plastic waxes are much less crystalline than either the paraffin waxes or BARECO hard microcrystalline waxes due to their lower concentration of n-paraffinic hydrocarbons and their higher concentration of branched hydrocarbons. While paraffin waxes usually contain 70 percent to 90 percent n-paraffinic hydrocarbon, the BARECO plastic waxes contain only 20 percent to 40 percent n-paraffinic hydrocarbon.

In addition, the smaller crystals of BARECO plastic microcrystalline waxes are more flexible and are interdispersed in an amorphous material. This amorphous material is comprised of highly branched hydrocarbons that have an extremely high viscosity at ambient temperatures. The amorphous material can represent 50 percent to 60 percent of the plastic microcrystalline wax. This amorphous material interdispersed with the crystalline components provides the unique properties of microcrystalline wax. It acts as a plasticizer and improves flexibility as well as ductility in these materials. Although this amorphous material is rigid, it is far more flexible than that of a highly crystalline material of the same molecular weight range.

APPLICATIONS

Laminating Adhesives

BARECO plastic waxes are engineered to meet the highest requirements of the packaging industry, where they are widely used as functional laminating adhesives having low MVTR and low gas transmission rates. They demonstrate many other excellent characteristics: high ductility, low odor, lack of taste, and flexibility at very low temperatures. Because of their low surface tension they readily wet many papers, films, and foils substrates. Because of their excellent solvency for various types of amorphous hydrocarbon resins and synthetic elastomers such as PIB, butyl rubber and block copolymer elastomers, BARECO plastic waxes can be further compounded to meet specific requirements imposed by either substrates or converting equipment.

BARECO plastic waxes provide outstanding protective barrier properties against both moisture vapor and gases. Typical examples follow:

Typical Water Vapor Transmission Rates
(grams/M2/24 hours)

Construction	WVTR
1. Plastic wax lamination (glass/foil/glassine)	0.11
2. Plastic wax lamination (P.E. coated foil/glassine)	0.31
3. Plastic wax lamination (glassine/glassine)	2.5
4. 0.5 mils LDPE on Kraft	46.5
5. 1.5 mils LDPE on Kraft	10.8

Typical Oxygen Transmission Rates
(c.c./100 in 2/24 hours)

Construction	O_2 Rate
1. Wax laminated glassine	5.8
2. Plastic wax-based hot melt coating on paper	10.0
3. 1 mil LDPE on paper	400
4. 1 mil HDPE on paper	150

As a 100 percent solids hot melt laminate, BARECO plastic waxes provide excellent adhesion properties to papers, films and foils.

Compounded Laminating Adhesives

BARECO plastic waxes plasticize amorphous hydrocarbons, copolymer resins and synthetic elastomers. The addition of up to 15 percent PIB, butyl rubber or amorphous hydrocarbon resins extends the range of applications in which the plastic waxes can be utilized as functional laminating adhesives.

Technical Release No. 305.0 "Microcrystalline Waxes in Protective Packaging," provides further information.

Hot Melt Coatings In Contact with Oily or Greasy Foods

Hot melt coatings have greatly improved resistance to animal and vegetable fats when these plastic waxes are used as the wax component. Ductile plastic waxes improve adhesion to cellulose and ethylene vinyl acetate and are more resistant to cracking at very low temperatures. The addition of 10 percent to 40 percent promotes gloss retention, flexibility and sealing strength of hot melt coating based on the paraffin waxes.

Electrical Insulating Agents

BARECO plastic waxes can be very effectively utilized as conformal coatings for printed circuit boards. They offer significant economic advantages over heat-cured varnishes.

(Continued)

PETROLITE SPECIALTY POLYMERS GROUP
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They require no cure time and provide an excellent moisture barrier and flexible film. The incorporation of a plastic wax can modify a potting compound by controlling the melting point and viscosity during application. Once applied, the wax will aid in preventing premature softening of the compound.

Candles

As additives to candles, BARECO plastic waxes enhance plasticity and inhibit crystallization of the other more crystalline wax components.

Cosmetics

Anhydrous systems such as lipsticks and deodorant sticks can be improved by additions of BARECO plastic waxes. The low melting point and flexible properties impart emolliency as well as dimensional stability to solid sticks. Emulsions, creams and lotions also exhibit improved emolliency due to the addition of plastic waxes.

Manufacture of Rubber Compounds

As an additive to suncheck waxes, the more highly branched BARECO plastic waxes help provide a controlled migration to the surface of rubber and rubber-related products.

Casting Wax for Metals

BARECO plastic waxes can be used as pattern waxes for investment and precision castings of metal parts. The addition of a plastic wax decreases the crystallinity of a filled or unfilled casting wax and reduces the amount of shrinkage of the casting wax from the metal surface.

Technical Release No. 101.457 provides further information.

Other Applications

- Leather treating agents
- Solvent-based rust-proofed coatings
- Water-repellent for textiles
- Plasticizers for other petroleum waxes used in crayons, dental compounds, chewing gum base, and candles.

FDA STATUS

Petroleum waxes may be refined to meet the purity requirements of the U.S. Food and Drug Administration as specified in the basic regulations governing their use. These basic regulations are 21 CFR 172.886 and 178.3710.

Technical Release "FDA" provides further information.

AVAILABILITY

BARECO plastic waxes are available in slabs which are packaged in cartons containing approximately 50 pounds (five 10 pound slabs) or in pallet cartons containing 2200 pounds (222-10 pound slabs). Single carton (50 pound) quantities are available. Palletized cartons are available only in multiples of nine (9).

TYPICAL PROPERTIES

PROPERTY	TEST METHOD	UNITS	BE SQUARE 175	VICTORY	ULTRAFLEX
Melting Point	ASTM D-127	°F (°C)	182 (83.3)	175 (79.4)	148 (64.4)
Density @ 75°F (23.9°C)	ASTM D-1168	grams/cc	0.93	0.93	0.92
Density @ 210°F (98.8°C)	ASTM D-1168	grams/cc	0.79	0.79	0.79
Viscosity @ 210°F (98.8°C)	ASTM D-88	SUS	88	85	83
Viscosity @ 210°F (98.8°C)	ASTM D-3236	cPs	13.9	12	11
Penetration @ 77°F (25°C)	ASTM D-1321	0.1 mm	17	28	28
Color	ASTM D-1500		1.5*	1.5*	1.5*
Flash Point	ASTM D-92	°F (°C)	560 (293.3)	560 (293.3)	560 (293.3)

*White color also available *White and brown colors also available *Black color also available

PRODUCT PROFILES

HARD MICROCRYSTALLINE WAXES

RELEASE NO. 300.0

GENERAL DESCRIPTION

Since the 1930's, the Petrolite Specialty Polymers Group has been involved in microcrystalline wax production. BARECO® hard waxes are provided as a complementary line to the BARECO plastic microcrystalline waxes.

BARECO hard waxes are a series of high-melting-point waxes engineered to provide a single source from which to select a wax optimized for your specific requirements.

They are produced by the solvent recrystallization of selected petroleum fractions and consist of n-paraffinic, branched paraffinic and naphthenic hydrocarbons in the C-30 to C-40 range. Proprietary solvent refining techniques developed at Petrolite permit the close control of these fractions into a series of high-melting, hard petroleum waxes with unique physical and functional properties. BARECO hard microcrystalline waxes are extensively used in a wide variety of industrial products. They are most often used in conjunction with other materials or chemicals to impart specific properties.

APPLICATIONS

Hot Melt Adhesives

BARECO hard microcrystalline waxes are compatible in adhesive systems containing the more widely used copolymer resins and amorphous hydrocarbon resins. The proper selection of BARECO hard wax grade permits adjusting the high-temperature adhesives functionality. For high temperature functioning adhesives, the highest melting grades are most useful, while the lower melting grades are most useful for general purpose hot melts. All of the BARECO hard waxes stabilize adhesive strength upon aging and their low surface tension aids in wetting many different surfaces.

Technical Release No. 304.0, "Microcrystalline Waxes in Hot Melt Adhesives," provides further information.

Hot Melt Coatings

BARECO hard microcrystalline waxes offer a range of physical properties which can be broadened by the various possible combinations with the softer, more adhesive BARECO plastic waxes. The higher melting point waxes, such as BE SQUARE® 195 microcrystalline wax, increase the dry compressive strength which can be carefully controlled by the appropriate selection of the waxes.

Technical Release No. 303.0, "Microcrystalline Waxes in Hot Melt Coatings and Impregnants," provides further information.

Cup and Paper Coatings

The lower amount of crystallinity, higher melting points and different chemical composition of microcrystalline waxes improve the adhesive, cohesive strength and flexibility for packaging coatings.

Features such as improved gloss and blocking point, and reduced friction can be achieved with additions of 1 to 10 percent by weight of hard microcrystalline wax to paraffin wax.

Technical Release No. 305.0, "Microcrystalline Waxes in Protective Packaging," provides further information.

Printing Inks, Paints and Solvent-based Coatings

BARECO hard microcrystalline waxes exhibit very low solubility in organic solvents. The solubility is on the order of less than 1 gram per hundred cubic centimeters of solvent at room temperature. PETROLITE® C-700 and BE SQUARE 195 and 185 waxes can form dispersions by dissolving the wax in hot solvent and cooling under agitation. The higher melting point and more friable MEKON® and FORTEX® waxes are available in various powder/micronized physical forms and can be stirred directly into the ink or paint.

Whether in a dispersion or a powder/micronized form, BARECO hard microcrystalline waxes can be added to printing inks and paints at levels ranging from 0.5 to 2.0 percent. They provide improved rub and reduced offset in printing inks. As additives to lacquers, paints and varnishes these waxes act as lubricants, delustering and anti-soiling agents, and reduce moisture vapor transmission.

Electrical

The BARECO hard waxes, such as BE SQUARE 195 wax, offer good electrical insulating properties. These products can provide a moisture barrier seal that acts as potting, filling and impregnant compounds for electrical components. Hard waxes can also be used to seal between the leaves of foil-type capacitors.

Ceramics

PETROLITE C-700, FORTEX and BE SQUARE 195 microcrystalline waxes act as binders to provide green strength to ceramic slip. These products improve the moldability, milling, and structural integrity prior to firing.

Cosmetics

BARECO hard microcrystalline waxes, as a major component in anhydrous products such as lipsticks, impart high temperature stability. By stabilizing the viscosity of emulsion products, controlled consistency can be achieved easily in creams and lotion products.

Investment Castings

BARECO hard waxes, especially STARWAX® 100 and BE SQUARE 185, are used in forming pattern waxes for metal investment casting. These two lower-melting-point waxes provide good dimensional stability and low ash to the wax pattern. Flexibility of these waxes promotes good adhesion to metal surfaces.

Technical Release No. 101.457 "Investment Casting" provides further information.

(Continued)

PETROLITE SPECIALTY POLYMERS GROUP

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Emulsion Coatings

Hard microcrystalline waxes can be formulated into nonionic water-to-wax emulsions using high sheer. As a chemically inert component, these waxes provide high gloss lubricating films for polishes, textile chemicals, and polymer latex cooling systems.

FDA STATUS

Petroleum waxes may be refined to meet the purity requirements of the U.S. Food and Drug Administration as specified in the basic regulations governing their use. These basic regulations are 21 CFR 172.886 (direct food additives) and 21 CFR 178.3710 (indirect food additives).

Technical Release "FDA" provides further information.

AVAILABILITY

All BARECO hard microcrystalline waxes are available in prilled form which is packaged in 55-pound (25-kilo) bags except STARWAX 100. STARWAX 100 wax is available in slabbed form which is packaged in cartons containing approximately 50 pounds (five 10 pound slabs) or in pallet cartons containing 2200 pounds. MEKON White and FORTEX waxes are also available in a micronized physical form. The average particle size is 10 microns and the material is packaged in fiber drums of 160 pounds.

TYPICAL PROPERTIES

Product/Property	Melting Point ASTM D-127 °F (°C)	Penetration ASTM D/1321 @ 77°F (25°C) 0.1 mm	Viscosity @ 210°F (98.9°C)		Specific Gravity @ T/60°F		Color	
			ASTM D-88 SUS	ASTM D-3236 cps	ASTM D-792 @ 75°F (23.9°C) g/cc	ASTM D-1298 @ 210°F (98.9°C) g/cc	ASTM D-1500	ASTM D-156
MEKON White	199 (92.8)	5	83	11.7	0.93	0.78		16
FORTEX	205 (96.1)	5	143	23.5	0.93	0.78	1.5	
PETROLITE C-1035	199 (92.8)	5	85	11.7	0.93	0.78	0.5	
PETROLITE C-700	196 (91.1)	6	90	12.5	0.93	0.78	1.5	
BE SQUARE 195	196 (91.1)	7	90	12.5	0.93	0.78	0.5*	
BE SQUARE 185	190 (87.8)	11	85	11.3	0.92	0.79	1.0	
STARWAX 100	187 (86.1)	16	87	11.7	0.92	0.79	1.0	

*White and brown colors also available

PRODUCT GUIDE

		PROPERTIES					APPLICATIONS																
		MELTING POINT (°F)	MELTING POINT (°C)	PENETRATION @ 77°F (25°C)	PENETRATION @ 140°F (60°C)	ACID NUMBER	ADHESIVES	CANDLES	CERAMICS	CHEWING GUM	COSMETICS	ELECTRICAL	EXPLOSIVES	INVESTMENT CASTING	LUBRICANTS	PACKAGING	PAINTS	PARAFFIN MODIFICATION	POLISH	PRINTING INKS	PROCESSING AID & PLASTICS	RUST PROOFING	TEXTILES
MICROCRYSTALLINE WAXES																							
Plastic	ULTRAFLEX®	156	69	29	190*		●			●						●		●					
Plastic	VICTORY®	174	79	26	130*		●	●		●	●			●		●							
Plastic	BE SQUARE® 175	182	83	17	64*		●			●		●	●	●	●	●						●	
Hard	STARWAX® 100	190	88	14	52*		●			●				●		●			●				
Hard	BE SQUARE 185	192	89	10	27*		●							●		●		●		●		●	
Hard	BE SQUARE 195	199	93	6	62		●		●	●	●	●	●			●	●		●	●	●	●	
Hard	PETROLITE® C-700	199	93	6	63		●										●		●			●	
Hard	PETROLITE C-1035	201	94	5	47		●									●			●				
Hard	MEKON® WHITE	201	94	5	47		●									●	●		●	●	●		
POLYWAX® POLYETHYLENES																							
	POLYWAX 500	190	88	7	52		●	●		●						●		●		●	●		
	POLYWAX 655	211	99	2	16		●							●		●		●		●	●		●
	POLYWAX 1000	235	113	1	5		●								●			●		●	●		
	POLYWAX 2000	259	126	0.5	2		●					●			●		●	●	●	●			
SYNTHETIC POLYMERS																							
	PETROLITE C-4040	219	104	1.5	9.5		●											●					
	PETROLITE CP-7	202	94	5.5	45		●				●							●					
	PETROLITE CP-11	230	110	4	32		●											●					
	PETROLITE CP-12	233	112	2	20		●											●					
	VYBAR® 825	<-30	<-34								●				●				●				
	VYBAR 260	128	53	13				●								●		●	●				
	VYBAR 253	152	67	7				●															
	VYBAR 103	160	71	5																			

JIZED HYDROCARBONS					
CARDIS® 1	201	94	4		17
CARDIS 10	206	97	4		16
CARDIS 370	185	85	14		36
CARDIS 314	189	87	8		18
CARDIS 319	198	92	8		28
CARDIS 320	196	91	11		36
CARDIS 36	198	92	9		33
PETRONAUBA® C	199	93	7		25
PETROLITE C-5500	213	101	2		21
PETROLITE C-9500	202	94	5		31
PETROLITE C-8500	203	95	5		9
PETROLITE C-7500	206	97	3		15
PETROLITE E-1040	220	104	4		40
PETROLITE E-2020	241	116	1		22
CARDIPOL® LP 0-25	218	103	4		31
CARDIPOL LP	238	114	2		3
MODIFIED HYDROCARBONS					
POLYMEKON®	200	93	5	72	
POLYMEKON 300	235	113	1	6	
CERAMER® 1608	170	77	2		160
CERAMER 67	206	97	3		48
PETROLITE CA-11	168	76	5		7
PETROLITE C-400	223	106	3		13
DISPERSIONS	SOLIDS	pH	VISC		
POLYMEKON SPP-W Dispersion	40	10	50		
PETROLITE 75 Dispersion	40	9.5	80		
CARDIPOL LP 0-25/E Dispersion	24	9.5	20		

*@110°F (43.3°C)

PETROLITE

Petrolite Specialty Polymers Group

FIRST AID: EYES: Immediately flush eyes with large volumes of water. Continue for at least 15 minutes. Hold lids apart to assure contact with all surfaces. Obtain medical attention.

SKIN: Flush affected area with clear cool water. Wash with soap and water. Rinse thoroughly. If irritation persists or blistering occurs, obtain medical attention.

INHALATION: Remove to fresh air. If breathing is difficult, administer oxygen. If breathing has stopped, apply artificial respiration. Obtain medical attention.

INGESTION: Do not induce vomiting except on advice of competent medical personnel. If victim is conscious, dilute by giving large volumes of milk or water. Obtain immediate medical attention. Never attempt to induce vomiting or give anything by mouth to an unconscious person.

PRIMARY ROUTES OF ENTRY: INHALATION X SKIN CONTACT X OTHER _____

SECTION VI — REACTIVITY DATE:

STABILITY: STABLE X UNSTABLE _____ HAZARDOUS POLYMERIZATION WILL NOT OCCUR

CONDITIONS TO AVOID:
Contact with strong oxidizing agents, strong acids, strongly heated reactive metals, open flame

HAZARDOUS DECOMPOSITION PRODUCTS: Toxic oxides of carbon, nitrogen and chlorine, acid gases, other toxic volatile organic compounds.

SECTION VII — SPILL, LEAK AND DISPOSAL PROCEDURE:

SPILL OR RELEASE PROCEDURE: CONCENTRATE: Contain spillage. Stop leak at source if this can be done safely. Ventilate area. Evacuate nonessential personnel. Pump liquid into DOT-approved drums for disposal. Absorb remaining liquid onto inert absorbent and place in DOT-approved drums for disposal. Wash area with water. Collect washings and place in DOT-approved drums for disposal. Keep concentrate and wash water from entering sewers or waterways.

USE SOLUTION:

Not applicable

DISPOSAL INFORMATION: CONCENTRATE: (1) Transfer to reclaiming center for recycling or solvent recovery. (2) Transfer to licensed hazardous waste treatment or disposal site for disposition under applicable local, state and regional regulations as hazardous waste.

SPENT SOLUTION AND RINSES:

Dispose of spent solution per (1) and (2) above. Rinse water may be treated as follows. Remove chromate, if present, by reduction and precipitation. Remove organics by skimming followed by oxidation and/or carbon treatment to remove residual organics. Clarified rinse water may be released to sewer if local regulations permit.

SECTION VIII — SPECIAL PROTECTION INFORMATION:

RESPIRATORY PROTECTION: If TLV is exceeded, a NIOSH-approved self-contained breathing apparatus, positive pressure hose mask or an air line mask is advised. These should have a full face piece and be operated in a positive pressure mode. For limited exposure time, in areas of good ventilation, a full face mask with an organic vapor cartridge or canister may be used. These must not be used in any areas where a danger of oxygen deficiency exists, such as partly enclosed or low lying areas, including sumps or tanks. If respirators are used, a formal training and screening program must be initiated. See 29 CFR 1910 -134.

VENTILATION:
Maintain sufficient mechanical ventilation to keep concentration below TLV.

PROTECTIVE EQUIPMENT: CHEMICAL FACE SHIELD OR GOGGLES: X GLOVES X BOOTS X APRON X PROTECTIVE SUIT If necessary to avoid prolonged or repeated exposure.

GLOVES, BOOTS, APRON AND SUIT MADE FROM: Neoprene

RECOMMENDED PERSONAL HYGIENE: Wash hands and face with soap and water before smoking or eating. Immediately remove contaminated clothing. Launder separately before reuse. Do not launder at home. Discard shoes that become contaminated on the interior.

SECTION IX — OTHER INFORMATION:

SPECIAL PRECAUTIONS — STORAGE AND HANDLING: Store in cool area protected from exposure to direct sunlight, rain or standing water. Use care in opening containers to avoid spurting. CAUTION: Vapors from this product are heavier than air and will travel along the ground to collect in low lying areas, such as sumps. Personnel entering such areas must be provided with respiratory protection and a safety line. They should be kept under observation while in the area by another man at a safe distance. Persons wearing contact lenses should wear vapor-proof well-fitting goggles. NOTE: Do not use 1,1,1 trichloroethane, methylene chloride, perchloroethylene, or other halogenated solvents or solvent mixture containing halogenated solvents with pressurizable fluid handling equipment such as airless spray equipment containing aluminum or galvanized wetted parts. Direct contact between aluminum or galvanized metal and these or other chlorinated solvents could result in an uncontrollable chemical reaction and possible explosion.

MIXING:
Not applicable

REPAIR AND MAINTENANCE OF CONTAMINATED EQUIPMENT: Relieve any pressure. Cover openings to avoid spurting. Clean exterior and interior by flushing with water or solvent. Collect flushings for disposal. Use protective equipment for eyes, skin and inhalation.

DATE PREPARED: DATE REVIEWED:

PREPARED BY: RD 8/1/89 APPROVED BY: JFC

PETROLITE

MATERIAL SAFETY DATA SHEET

PETROLITE CORPORATION
369 MARSHALL AVE.
ST.LOUIS MO 63119 U.S.A

REVISION DATE: 02/27/89
EMERGENCY PHONE: 1-314-961-3500
CHEMTREC EMER NO: 1-800-424-9300

SECTION 1 PRODUCT IDENTIFICATION

PRODUCT: BE SQUARE 175 AMBER MSDS#: SP000236 LABEL: N/A

SHIPPING NAME: NOT HAZARDOUS PER D.O.T. CFR TITLE 49

CHEMICAL DESCRIPTION
BLEACHED MICROCRYSTALLINE WAX. FOOD GRADE MEETS U.S. FDA REGULATIONS 21 CFR 172.886 AND 21 CFR 178.3710 AMONG OTHERS.

SECTION 2 HAZARDOUS INGREDIENTS

None as defined under the U.S. OSHA Hazard Communication Standard (29 CFR 1910.1200) or the Canadian Hazardous Products Act (S.C. 1987, c. 30(Part I)).

SECTION 3 PHYSICAL DATA

SPECIFIC GRAVITY: @75 F ~0.93 VOLATILITY: NIL
VAPOR PRESSURE: Not Determined SOL. IN WATER: Insoluble

MISC. DATA: Melting Point: 182 F
APPEARANCE AND ODOR: Amber solid. Little or no odor.

SECTION 4 FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: >500 F FLAMMABLE LIMITS: Not Applicable

FLASH METHOD:
COC ASTM D-92

EXTINGUISHING MEDIA:
Use water spray or fog, alcohol-type foam, dry chemical or CO2.

FIRE FIGHTING PROCEDURES:
Use a self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive pressure mode. Non-flammable. Keep fire-exposed containers cool using water spray.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
None known.

CONTINUED ON PAGE: 2

CONTINUATION OF SP000236

As with most solid or particulate organic materials, extremely high dust concentrations in air may result in a potential explosion hazard. Use good housekeeping to prevent significant solids accumulation.

****

SECTION 5 HEALTH HAZARD DATA

EFFECTS OF OVEREXPOSURE:

INHALATION:

If heated to decomposition, fumes generated may result in respiratory irritation. ACGIH exposure limit for paraffin wax fume is a TLV-TWA of 2 mg/m3.
When finely divided, inhalation of dust may cause irritation of mucous membranes and respiratory tract. OSHA permissible exposure limit (PEL-TWA) and ACGIH threshold limit value (TLV-TWA) for respirable dust: 5 mg/m3. Total nuisance dust OSHA PEL-TWA: 15 mg/m3; total dust ACGIH TLV-TWA: 10 mg/m3.
Not expected to be a problem under normal conditions of use.

SKIN AND EYE CONTACT:

Not expected to be a problem under normal conditions of use. May produce mild irritation on prolonged contact with skin or eyes. Not expected to be absorbed through the skin in significant quantities.
The cool solid material is not expected to cause skin or eye irritation; however, contact with molten material may result in thermal burns.

INGESTION:

May be harmful if swallowed. May cause gastrointestinal disturbances.

ORAL LD50: >5 g/kg (Rat)

EMERGENCY AND FIRST AID PROCEDURES:

Wash skin thoroughly with soap and water. Launder clothing before reuse. If in eyes, irrigate with flowing water immediately and continuously for fifteen minutes. Consult a physician. If inhaled, remove to fresh air and administer oxygen if necessary. If ingested, consult a physician.
If molten polymer gets on skin, cool rapidly with cold water. Do not attempt to peel polymer from skin. Obtain medical attention for thermal burns.

****

SECTION 6 REACTIVITY DATA

STABILITY:

Stable under normal conditions of storage and use.

CONTINUED ON PAGE: 3

CONTINUATION OF SP000236

INCOMPATIBILITY:
Keep away from strong oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS:
None known.

HAZARDOUS POLYMERIZATION:
Will not occur.

****

SECTION 7 SPILL AND LEAK PROCEDURES

IF MATERIAL IS SPILLED OR RELEASED:
Sweep up material and place in appropriate disposal container. Use sweeping compound or other cleaning aids to pick-up residues. Wash down area thoroughly with water. Use appropriate personal protective equipment as necessary.
If liquid is hot, attempt to confine spill and let the liquid solidify. Once solid, the product may be recovered as any other solid material.

DISPOSAL METHOD:
Secure container and take to an approved waste disposal site. Dispose of residues in accordance with applicable waste management regulations.

DECONTAMINATION PROCEDURES:
Not appropriate.

****

SECTION 8 SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:
Respirator use is not expected to be necessary under normal conditions of handling. In emergency situations, use of a NIOSH-approved respirator may be required.

VENTILATION:
General ventilation should be provided to maintain ambient concentrations below nuisance levels.

PROTECTIVE CLOTHING:
Chemical-resistant gloves and chemical goggles should be used to prevent skin and eye contact.

CONTINUED ON PAGE: 4

PETROLITE

MATERIAL SAFETY DATA SHEET

CONTINUATION OF SP000236

****

SECTION 9 SPECIAL PRECAUTIONS

None known.
Molten product may cause thermal burns.

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Although the information and recommendations set forth herein are believed to be correct as of the date hereof, Petrolite makes no representations to the accuracy of such information and recommendations. It is the user's responsibility to determine the suitability and completeness of such information and recommendation for its own particular use.Petrolite shall not be responsible for any direct,indirect,incidental or consequential damages of whatsoever nature resulting from the publication,use of or reliance upon such information and recommendations.

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SPRAYLAT

SPRAYLAT CORP.
716 SOUTH COLUMBUS AVENUE
MOUNT VERNON, N.Y. 10550
(914) 699-3030
ENGINEERED INDUSTRIAL COATINGS

COVERLAC A-2114

MASKANT FOR PLATING OPERATIONS

Coverlac A-2114 is a maskant for chemical plating cycles such as electroless nickel plating. The film is hand strippable after these cycles, but can be removed chemically in a remover bath.

The application of the A-2114 can be by dipping, brushing or spraying. In a dip, as brushing application, the compound can be used as shipped, with no dilution. However, viscosity can be adjusted using xylene or toluene to fit individual requirements.

A brush application can apply the A-2114 only in selective areas. Care must be taken to build up film thickness, especially along edges or lines so that the film will have the necessary chemical resistance (5-8 mils dry). Usually it will require two or more applications to build up this film thickness.

A dip application can be done on a part up to a particular line by controlling the depth of the dip, or the part can be overall coated. Reversing the part after each dip will even up film thickness from top to bottom.

Once the film is fully dry, the film can be cut and stripped to expose the areas to be plated. The sharper the knife, the cleaner the edges will be.

If applied by spraying, airless spray equipment is recommended so as to apply wet compounds with minimum of air bubbles and entrapment. The following equipment is recommended:

Graco 28:1 President Hot Airless System

Inbound air pressure to pump	85 psi
Minimum available air pressure	100 psi
Spraying temperature	120-150°F.
Airless spray tip	617 to 721

Four passes with 10-20 minutes between passes, will produce a dry film thickness of 8-10 mils.

Cont'd.

Application Viscosity Adjustments

	Dipping (Brushing)	Hot Airless Spray
Solvent	Toluene	Xylene
Dilution	2 parts solvent to 5 parts A-2114	2.5 parts solvent to 5 parts A-2114
Viscosity (#5 Zahn Cup)	15 seconds	10-13 seconds

Film Thickness

Two dip coats	4/5 mils minimum
Three dip coats	9/10 mils minimum
Four spray passes	8/10 mils minimum

Compound Data

COLOR:	Translucent
SOLIDS:	40%
APPLICATION METHODS:	dip, hot airless spray, brush
VISCOSITY:	115 ± 5 KU
TENSILE STRENGTH:	1400 psi
ELONGATION:	500%
ADHESION TO 7075-T6 BARE ALUMINUM (lbs. per lineal inch @ 2" per min. pull rate)	1.5 ± .5
LINE DEFINITION:	Excellent
CHEMICAL RESISTANCE: (acid & caustic baths)	Excellent
COMPOUND STABILITY:	Excellent
THINNER:	Toluene

MATERIAL SAFETY DATA SHEET
FOR COATING, RESINS, AND RELATED MATERIALS

Date of Preparation- 02/23/89 (supercedes all previous MSDS)

Manufacturer: SPRAYLAT CORPORATION
Address : 716 SOUTH COLUMBUS AVENUE, MT. VERNON, N.Y. 10550

EMERGENCY/INFORMATION TELEPHONE # -- NY DAY/NIGHT: (914) 699-3030
CA DAY/NIGHT: (213) 559-2335

SECTION I PRODUCT IDENTIFICATION

Manufacturer's Code Identification: S2842
Product Class: CHEMICAL MILLING COATING
Trade Name: COVERLAC SC-284-2 (ALSO: A-2114)

HMIS Information: Health- 1 Flammability- 3
Reactivity- 0 Personal Protective Equipment-
HAZARD INDEX: 4= Severe 3= Serious 2= Moderate 1= Slight 0= Least

SECTION II HAZARDOUS INGREDIENTS

SECTION 313 SUPPLIER NOTIFICATION:
Those ingredients (if any) which have an asterisk (*) preceding the CAS# are subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-To-Know Act of 1986 and of 40 CFR 372.

--- INGREDIENT --- MATERIAL DESCRIPTION REF#	CAS #	% BY WT.	ACGIH TLV(TWA) PPM	OSHA PEL PPM	LEL VAPOR PRESSURE OTHER LIMITS
03 TOLUENE	* 108-88-3	<75	100.00	200.00	24.00
08 TALC	14807-96-6	<25	2.00	20.00	
					/MG/M3 (TLV)
					/MPPCF (PEL)
	% LEAD	.00			
	% CHROMATE	.00			

SECTION III PHYSICAL DATA

BOILING RANGE	HIGH 405.0 F LOW 200 F
VAPOR PRESSURE	SEE SECTION II
VAPOR DENSITY	HEAVIER THAN AIR
EVAPORATION RATE	FASTER THAN BUTYL ACETATE
WEIGHT PER GALLON	8.4
VOC	.588
APPEARANCE-ODOR-	AMBER LIQUID
PH - SOLUBILITY-	WATER INSOLUBLE

This product contains no reported carcinogens or suspected carcinogens.

SECTION IV FIRE AND EXPLOSION HAZARD DATA

Flammability Classification CLASS 1B DOT- FLAMMABLE LIQUID
Lowest Flashpoint TCC 45.0 F Lower Explosion Level(LEL) 1.2

EXTINGUISHING MEDIA:
Use CO2, DRY CHEMICAL, FOAM.

Based on SECTION II ingredient(s) (03) Water spray may be useful in minimizing vapors and cooling containers exposed to heat and flame. Avoid spreading burning liquid with water used for cooling purposes.
SPECIAL FIRE FIGHTING PROCEDURES
Clear fire area of unprotected personnel. Do not enter confined space without helmet, face shield, bunker coat, gloves, rubber boots, and a positive pressure NIOSH-approved self-contained breathing apparatus.
UNUSUAL FIRE AND EXPLOSION HAZARD:
This liquid and its vapors are dangerous fire hazard and moderate explosion hazard when exposed to heat, flame or any source of ignition. Vapors may be heavier than air and may travel along the ground to distant ignition source and flash back. Keep welding or cutting equipment away from product.

SECTION V HEALTH HAZARD DATA

EFFECTS OF EXCESSIVE OVEREXPOSURE:
Do not breathe spray mist/vapors (if present) of any spray paint. Wear an appropriate, properly fitted respirator (NOISH/MSHA approved) during and after application unless air monitoring demonstrates vapor/mist levels are below applicable limits if any appear in section II. Follow respirator manufacturer's directions for respirator use.
Based on SECTION II ingredient(s) (03) chronic overexposure or ingestion of this material may cause kidney and liver injury.
Based on SECTION II ingredient(s) (03) prolonged overexposure may cause headache, nausea, loss of balance, coordination and consciousness, narcosis, coma and death due to respiratory failure. Repeated excessive exposure may also cause chronic adverse systemic effects.
Based on SECTION II ingredient(s) (03) direct contact with eyes may cause damage to the conjunctiva and cornea if not promptly removed.
Based on SECTION II ingredient(s) (08) may cause lung injury.

TURCO PRODUCTS

TECHNICAL DATA BULLETIN NO. 490

TURCO PRODUCTS INC., 7300 BOLSA AVENUE, WESTMINSTER, CALIFORNIA 92684-3600

TURCOFORM® MASK 522

DIP AND FLOW COAT CHEM-MILL MASKANT

DESCRIPTION:

TURCOFORM® MASK 522 is a tan, liquid, single component, air curing, peelable protective coating formulated to provide protection against the corrosive action of hot caustic and acidic solutions used in the Chem-Mill processing of aluminum, magnesium, steel and titanium alloys.

TURCOFORM MASK 522 can be applied by immersion or flow coating methods and dries to a chemical resistant elastomeric film within 12 hours. TURCOFORM MASK 522 can be forced dried by conventional methods, after air drying for 2 to 3 hours at room temperature.

A top-coat of TURCOFORM MASK 550 is recommended for steel and titanium processing to provide additional protection against aggressive acid etchant solutions.

LIQUID PROPERTIES:

Appearance	Tan viscous liquid
Solids by wt.	34.5 ± 1%
Gallon weight	8.0# min.
Viscosity, Poise	15 ± 4
Flash Point (SETA)	40°F
Storage life @ 75°F	1 year min.

FILM PROPERTIES:

Tensile strength	900 psi min.
Elongation at rupture	475% min.
Peel Adhesion:	(pounds/in. width)

Solvent wiped panels	Before etch	After etch
2024-T3 Clad Aluminum	0.8 ± 0.3	1.3 max.

DIRECTIONS FOR USE:

1. **Precleaning:** For optimum uniformity in adhesion and performance the parts to be masked must be free of oil, grease, dirt or corrosion. Your TURCO Territory Manager can recommend suitable TURCO cleaners based on specifications and production needs.
2. **Mixing:** To assure reproducible results in application and performance of the TURCOFORM MASK 522, adequate mixing of the solution is very important prior to and during use. Caution must be exercised to prevent air from being drawn into the mask by the mixing action. Since some solvent is lost during use due to evaporation, periodic additions of thinner are required. The amount of thinner required is based on viscosity measurements. A #5 Zahn cup viscometer may be used to measure and adjust the maskant to the desired operating viscosity.

3. **Selection of Thinner:** When the user is required to comply with air pollution regulations, such as the California South Coast Air Quality Management District, TURCOFORM MASK THINNER #4 should be used. Where no regulations are in effect, toluene or xylene or a blend of toluene and xylene may be used to reduce the viscocity of the mask. When a faster drying solvent is desired, as in the cold season, toluene should be used. The slower evaporating solvent, xylene, may be desirable during the hot summer months. Blends of toluene and xylene have been used to achieve optimum drying conditions.

4. **Dip Application:**

   4.1 Proper circulation of the mask in the dip tank is necessary for optimum results. Continuous movement of the mask from one end of the tank to the opposite end avoids dipping into the drainage of excess mask from the previous parts.

   4.2 Adjust the mask to the desired viscosity with thinner.

   4.3 Slowly immerse clean parts into the mask up to but not over the top edge of the part. **Caution —** immersing the parts too rapidly into the mask will introduce air and produce bubbles in the film.

   4.4 Remove the parts from the tank and allow to dry until the film is tack-free.

   4.5 Rotate part 180° in the vertical plane and dip again for an additional coat. In a three-coat system, common practice is to rotate the part only between the second and third coat.

   4.6 Repeat the cycle until the required dry film thickness is obtained.

5. **Flow Coat Application:**

   5.1 Adjust the viscosity of TURCOFORM® MASK 522 to the desired limits using a #5 Zahn cup viscometer.

   5.2 Flow mask onto the clean part. **Avoid flowing over the top of the part.** Flow the mask nearly to the top leaving a narrow band uncoated. This narrow uncoated area will be covered when the part is rotated. On all subsequent coats leave a narrow strip uncoated.

   5.3 Allow part to dry until tack-free then rotate 180° in the vertical plane and recoat.

   5.4 Repeat cycle until the desired dry film thickness is obtained.

6. **Viscosity:** The useful viscosity range (#5 Zahn cup) for TURCOFORM MASK 522 is from 16 seconds to 45 seconds depending on the particular set of conditions. In general, to provide a film thickness of 9 to 14 mils, a viscosity in the lower range is recommended for long parts. A viscosity in the higher range is recommended for short parts.

	3 Coat System	2 Coat System
Short Parts	24-33 sec.	35-45 + sec.
Long Parts	16-23 sec.	30-40 sec.

(Suggested starting point viscosity #5 Zahn cup)

   Through experience and user preference, an intermediate viscosity range may be selected that accommodates most parts but may require an extra coat on small and net (no trim) parts.

7. **Drying:** Avoid excessive heat and drafts on wet film to eliminate undesirable skin-drying and poor, uneven flow. Heat or air movement may be applied to force dry the film only if the user is satisfied that the quality of the film is satisfactory after force drying.

8. **Curing:** Air cure at room temperature overnight. To accelerate the cure, an air dry at room temperature for 2 to 3 hours followed by an oven cure for 45 minutes to 1 hour @ 175°F may be used.

DISPOSAL INFORMATION:

Dispose of spent solution per local, state and regional regulations. Refer to your local TURCO Territory Manager, Region Sales Office or TURCO MATERIAL SAFETY DATA SHEET for additional disposal information.

CAUTION:

TURCOFORM® MASK 522 contains toluene, xylene and naptha (aromatic flammable solvents). Avoid contact with eyes, skin and clothing. Do not take internally. Avoid prolonged breathing of vapors. Use with adequate (equivalent to outdoor) ventilation.

Protective clothing, such as a chemical face shield or goggles, gloves, boots and apron made of chemical resistant neoprene should be worn when handling and using this product. A NIOSH-approved respirator should be worn when working in confined or enclosed areas or during mist conditions.

Keep away from flames and other ignition sources, such as sparks and welding or cutting torches.

Open containers carefully to avoid spurting. Keep containers closed when not in use. For maximum life containers should be stored below 120°F. Containers should be grounded for added safety.

Refer to container label or TURCO MATERIAL SAFETY DATA SHEET for additional precautionary, handling and first aid information.

NOTICE:

The above information and recommendations concerning this product are based upon our laboratory tests and field use experience. However, since conditions of actual use are beyond our control, any recommendations or suggestions are made without warranty, express or implied. Manufacturer's and seller's sole obligation shall be to replace that portion of the product shown to be defective. Neither shall be liable for any loss, damage or injury, direct or consequential, arising out of the use of this product.

5/88

TURCO PRODUCTS, INC.
MATERIAL SAFETY DATA SHEET

PENNWALT

05114
6319-1

SECTION I — PRODUCT NAME: Turcoform Mask 522

Manufacturer's Name:	TURCO PRODUCTS, INC.
Address:	7300 Bolsa Ave., Westminster, CA 92684-3600
Emergency Telephone No.:	(614) 387-6200 Info. Tel. No. (714) 890-3600

SECTION II — HAZARDOUS INFORMATION:

COMPONENTS	C.A.S. Number	CERCLA RQ SPILL lbs.	RCRA Waste No.	ACGIH TLV	OSHA TWA	%, WT.
Toluene *	108-88-3	1000	U222	100PPMskin	100 PPM	40
VM & P naphtha	8030-30-6	Nt.Lstd.	D001	300 PPM	100 PPM	15
Xylene *	1330-20-7	1000	U239	100 PPM	100 PPM	10
Talc	14807-96-6	Nt.Lstd.	NtLstd	2mg/m³dust	2 MG/M³	5
The following non-hazardous ingredients are listedin accordance with the Worker and Community Right-to-Know Act of certain states, including Pennsylvania and New Jersey: Aluminum silicate(12141-46-7), Styrene-1,3 butdiene polymer(9003-55-8).						

CARCINOGENS (As defined in 29CFR 1910.1200)	NTP	IARC	OSHA
Contains no components defined to be carcinogens	Not listed	Not listed	Not regulated

PROPER SHIPPING NAME:	HAZARD CLASS:	HAZARD I.D. No.:
Coating Solution	Flammable liquid	UN 1139

* Chemicals in Section II that have an asterick are subject to SARA Section 313 reporting.

SECTION III — PHYSICAL DATA:

BOILING POINT, °F:	220°F	SPECIFIC GRAVITY:	0.97
VAPOR PRESSURE (mmHg):	Approx. 40mmHg	VOLATILE, % BY VOL.:	75%
VAPOR DENSITY (AIR = 1):	More than 1	EVAPORATION RATE (Bu. Ac. = 1):	More than 1
APPEARANCE AND ODOR: Tan liquid; aromatic odor		SOLUBILITY IN WATER:	Negligible
		pH	Not applicable

SECTION IV — FIRE AND EXPLOSION HAZARDS:

FLASH POINT AND METHOD USED:
45°F Setaflash

EXTINGUISHING MEDIA:
Foam, Carbon dioxide, dry chemical

SPECIAL FIRE FIGHTING PROCEDURE AND PRECAUTIONS:
Use self-contained respiratory protection.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Vapors from this product are heavier than air and may travel along the ground to be ignited at a point remote from material handling area.

SECTION V — HEALTH, EMERGENCY AND FIRST AID INFORMATION:

EFFECTS OF OVER EXPOSURE: EYES:
Moderate to severe irritation.

SKIN:
Moderate to severe irritation, drying, defatting. May be absorbed through skin in toxic amounts.

INHALATION:
Vapors: Moderate irritation, dizziness, headache. Mist: Severe respiratory irritation, nausea.

INGESTION:
Severe irritation to gastrointestinal tract, nausea.

MEDICAL CONDITIONS WHICH MAY BE AGGRAVATED: Prolonged or repeated overexposure to aromatic hydrocarbons may cause kidney and liver damage. Repeated overexposure may aggravate any preexisting dysfunction of these systems.

NO: N-1738

FIRST AID: EYES: Flush eyes with large volumes of water for at least 15 minutes. If irritation persists, obtain medical attention.

SKIN: Flush affected area with clean cool water. Wash with soap and water. Rinse thoroughly. If irritation persists, obtain medical attention.

INHALATION: Remove to fresh air. If breathing is difficult, administer oxygen. If breathing has stopped, apply artificial respiration. Obtain medical attention.

INGESTION: Do not induce vomiting except on advice of competent medical personnel. If vomiting occurs spontaneously, keep head below hip level to reduce possibility of aspiration pneumonitis. If victim is conscious, dilute by giving large volumes of milk or water. Obtain immediate medical attention. Never attempt to induce vomiting or give anything by mouth to an unconscious person.

PRIMARY ROUTES OF ENTRY: INHALATION X SKIN CONTACT X OTHER _____

SECTION VI — REACTIVITY DATE:

STABILITY: STABLE X UNSTABLE _____ HAZARDOUS POLYMERIZATION WILL NOT OCCUR

CONDITIONS TO AVOID:
Contact with strong oxidizing materials, strong acids, strong alkali

HAZARDOUS DECOMPOSITION PRODUCTS:
Carbon monoxide, dioxide, other toxic volatile organic compounds.

SECTION VII — SPILL, LEAK AND DISPOSAL PROCEDURE:

SPILL OR RELEASE PROCEDURE: CONCENTRATE: Contain spillage. Eliminate all sources of ignition. Stop leak at source if this can be done safely. Ventilate area. Evacuate nonessential personnel. Pump liquid into DOT-approved drums for disposal. Absorb remaining liquid onto inert absorbent and place in DOT-approved drums for disposal. Wash area with water. Collect washings and place in DOT-approved drums for disposal. Keep concentrate and wash water from entering sewers or waterways.

USE SOLUTION:

As for concentrate

DISPOSAL INFORMATION: CONCENTRATE: (1) Transfer to reclaiming center for recycling or reuse, if possible. (2) Transfer to licensed hazardous waste treatment or disposal site for disposition under applicable local, state and regional regulations as hazardous waste.

SPENT SOLUTION AND RINSES:
If applicable, rinse water may be neutralized (if not already neutral) and allowed to stand. The separated solvent should be skimmed off and disposed as described above. The water may then be treated to remove residual organic material by oxidation and/or carbon treatment. The clarified water may be released to sewer if local regulations permit.

SECTION VIII — SPECIAL PROTECTION INFORMATION:

RESPIRATORY PROTECTION: If TLV is exceeded, a NIOSH-approved self-contained apparatus, positive pressure hose mask or air line mask is advised. These should have a full face piece and be operated in a positive pressure mode. For limited exposure time, in areas of good ventilation, a full face mask with an organic vapor cartridge or canister may be used. These must not be used in any areas where a danger of oxygen deficiency exists, such as partly enclosed or low lying areas, including sumps or tanks. If respirators are used, a formal training and screening program must be initiated. See 29 CFR 1910-134.

VENTILATION:
Maintain sufficient mechanical ventilation to keep concentration below TLV.

PROTECTIVE EQUIPMENT. CHEMICAL FACE SHIELD OR GOGGLES: X GLOVES X BOOTS X APRON X PROTECTIVE SUIT Not normally required
GLOVES, BOOTS, APRON AND SUIT MADE FROM: Solvent resistant material (e.g. neoprene, Viton, etc.)

RECOMMENDED PERSONAL HYGIENE: Wash hands and face with soap and water before smoking or eating. Immediately remove contaminated clothing. Launder before reuse.

SECTION IX — OTHER INFORMATION:

SPECIAL PRECAUTIONS — STORAGE AND HANDLING: Store in dry protected area away from strong oxidixing agents, strong acids and strong alkalies. Metal containers should be fitted with a bonded ground wire when material is transferred. Empty containers may contain flammable vapors in explosive amounts.

MIXING:

Does not apply.

REPAIR AND MAINTENANCE OF CONTAMINATED EQUIPMENT: Relieve pressure. Cover openings to avoid spurting. Clean exterior and interior by flushing with solvent. Collect flushings for disposal. Use appropriate protective equipment.

DATE PREPARED: DATE REVIEWED:
APPROVED: JD 5/89 Q.C. DEPT./ [signature] R & D DEPT./ JFG SAFETY & ENVIRON. EEV

TMSDS 4-6/88

TURCO

TECHNICAL DATA BULLETIN NO.

PENNWALT

TEMPORARY

TURCO PRODUCTS, INC. • 7300 BOLSA AVENUE, WESTMINSTER, CALIFORNIA 92684-3600 • 714/890-3600

TURCOFORM® MASK 540-R

DESCRIPTION:

TURCOFORM(R) MASK 540-R is a one-package, hand-strippable protective coating which possesses a high degree of chemical resistance. This product gives outstanding protection against the corrosive action of etchant solutions and was specially developed for use in the Chem-Mill Process.

LIQUID PROPERTIES:

Viscosity, poises at 70°F	75
Solids content, percent by weight	28
Solids content, percent by volume	30
Gallon weight, pounds	12.0
Flash point, °F	over 110°F
Storage life at 70°F	1 year min.
Color	light beige

FILM PROPERTIES:

Tensile strength, psi	1100 min.
Elongation, percent at rupture	650 min.
Peel adhesion, pounds per inch width, aluminum:	
before etching	0.8 ± 0.4
after etching	1.1 ± 0.5

DIRECTIONS FOR USE:

The directions and recommendations given are intended to serve as a general guide to processors and may require modification, based on field experience, to meet local conditions.

MIXING: To assure uniform and reproducible results in applying mask, adequate mixing of the solution is necessary, prior to and during use. Caution should be exercised to prevent air from being drawn into the mask by the mixing action. Since some solvent is lost during use, periodic additions of thinner, based on viscosity measurements, are required. After measuring the viscosity with a #5 Zahn Cup, adjust to the desired operating viscosity with thinner.

Selection of Thinner

For dip and flowcoat application, to reduce the as-received mask, perchloroethylene is recommended; and the same, to replace solvent lost by evaporation.

Viscosity Ranges

Application viscosity, #5 Zahn Cup: for dip and flowcoat, 25 to 30 seconds, depending on part size and film thickness desired.

length of part:	over 4 feet	under 4 feet
viscosity:	25 seconds	30 seconds
number of coats:	2 coats	3 coats
dry film thickness:	9 mils (approx)	9 mils (approx)

NOTE: These recommendations are starting points only. Modifications based on field experience should be made as necessary to accommodate normal seasonal changes, and other local variables.

DRYING: Avoid excessive heat and drafts on wet film, as these can cause undesirable skin-drying. Heat or ventilation applied to force drying should be used only if the user observes that film quality is satisfactory under these conditions.

CURE SCHEDULE

Air cure schedule - After the final coat of mask is tack-free, allow the film to dry for four hours minimum before etching.

Oven cure schedule - Tack-free mask may be oven-cured for thirty minutes at 175-225°F to speed the curing cycle.

CHEM-MILL PROCESS APPLICATION

x Aluminum x Magnesium x Steel* x Titanium*

* In the steel and titanium processes, TURCOFORM MASK 550 is recommended as a top-coat over the mask film to provide additional resistance against these aggressive acid etchant systems.

DIP APPLICATION

a. Dilute with thinner to the desired dipping viscosity.
b. Slowly immerse clean part into the dip tank, up to but not over the top edge of the part.
c. Remove part from dip tank.
d. The masked part is allowed to dry until the surface is tack-free, rotated 180°, and again dipped into the mask.
e. The cycle is repeated until the desired film build is obtained.

FLOWCOAT APPLICATION

a. Dilute mask with thinner to the desired flowcoat viscosity.
b. Flow mask onto clean part. Avoid flowing over the top.
c. Allow to dry until the film is tack-free; rotate 180° and re-coat.
d. The cycle is repeated until the desired film thickness is obtained.

APPLICATION TECHNIQUE - DIP AND FLOWCOAT

Avoid dipping a part rapidly into the mask, as this introduces air and creates bubbles in the film. Slowly immerse the clean part into the dip tank, up to but not over the top edge of the part, to further minimize bubbles. Proper circulation of mask in the dip tank is recommended to avoid dipping into run-off (drainage of excess mask) from previous parts. When flowcoating, avoid flowing over the top of a part, as this creates bubbles on the back side. Flow nearly to the top leaving a narrow strip of bare metal. This will be coated when the part is in the reversed position. On subsequent coats, leave a narrow strip uncoated in the same manner.

DISPOSAL INFORMATION:

Dispose of material per local, state and regional regulations. Refer to your local TURCO Territory Manager, Region Sales Office or TURCO MATERIAL SAFETY DATA SHEET for additional information.

CAUTION:

TURCOFORM(R) MASK 540-R contains perchloroethylene. Avoid contact with eyes, skin and clothing. Do not take internally. Avoid prolonged breathing of vapors. Use with adequate (equivalent to outdoor) ventilation.

Protective clothing, such as a chemical face shield or goggles and gloves, boots and apron made from solvent resistant neoprene, should be worn when using this product. A NIOSH-approved respirator should be used during mist conditions.

Do not use or spray this product near sparks, welding torches or open flames, since hazardous vapors may be formed.

Use care in opening drums to avoid spurting. Store in closed containers below 110°F.

Refer to container label or TURCO MATERIAL SAFETY DATA SHEET for additional precautionary, handling and first aid information.

NOTICE:

The above information and recommendations concerning this product are based upon our laboratory tests and field use experience. However, since conditions of actual use are beyond our control, any recommendations or suggestions are made without warranty, express or implied. Manufacturer's and seller's sole obligation shall be to replace that portion of the product shown to be defective. Neither shall be liable for any loss, damage or injury, direct or consequential, arising out of the use of this product.

TURCO PRODUCTS, INC.
MATERIAL SAFETY DATA SHEET

PENNWALT

05195
5998-1

SECTION I — PRODUCT NAME: Turcoform Mask 540-R

Manufacturer's Name:	TURCO PRODUCTS, INC.
Address:	7300 Bolsa Ave., Westminster, CA 92684-3600
Emergency Telephone No.:	(614) 387-6200 Info. Tel. No. (714) 890-3600

SECTION II — HAZARDOUS INFORMATION:

COMPONENTS	C.A.S. Number	SARA Sect. 313 Reportable	CERCLA RQ SPILL lbs.	RCRA Waste No.	ACGIH TLV	OSHA TWA	%. WT.
Perchloroethylene	127-18-4	Yes	1	U210	50 PPM	25 PPM	65
VM&P Naphtha	8032-32-4	No	NA	D001	300 PPM	300 PPM	5
Talc (containing no asbestos) Respirable dust	14807-96-6	No	NA	NA	2mg/m³ dust	2mg/m³	10
The following non-hazardous ingredients are listed in accordance with the Worker and Community Right-to-Know Act of certain states, including Pennsylvania and New Jersey: Styrene, 1,3-butadiene polymer (9003-55-8)							

Chemicals (as defined in 29 CFR 1910-1200, Appendix A (1))	NTP	IARC	OSHA
Perchloroethylene	not listed	listed	Not regulated

PROPER SHIPPING NAME:	HAZARD CLASS:	HAZARD I.D. No.:
RQ ORM-A, N.O.S. (Perchloroethylene)	ORM-A	NA 1693

SECTION III — PHYSICAL DATA:

BOILING POINT, °F: 212 - 310°F	SPECIFIC GRAVITY: 1.44
VAPOR PRESSURE (mmHg): Approx. 15mm	VOLATILE, % BY VOL.: 70
VAPOR DENSITY (AIR = 1): More than 1	EVAPORATION RATE (Bu. Ac. = 1): More than 2.1
APPEARANCE AND ODOR: Tan liquid, chlorinated solvent odor	SOLUBILITY IN WATER: Negligible pH: Not applicable

SECTION IV — FIRE AND EXPLOSION HAZARDS:

FLASH POINT AND METHOD USED:
112°F (Setaflash)

EXTINGUISHING MEDIA:
Carbon dioxide, foam, water fog

SPECIAL FIRE FIGHTING PROCEDURE AND PRECAUTIONS:
Use self-contained respiratory protection

UNUSUAL FIRE AND EXPLOSION HAZARDS: Thermal decomposition may produce toxic oxides of carbon, nitrogen and chlorine, acid gases and toxic volatile organic compounds.

SECTION V — HEALTH, EMERGENCY AND FIRST AID INFORMATION:

EFFECTS OF OVER EXPOSURE: EYES:
Vapors: Moderate to severe irritation
Liquid: Severe irritation, possible tissue damage

SKIN:
Moderate to severe irritation. May be absorbed through skin in toxic amounts.

INHALATION:
Moderate to severe irritation of respiratory tract, nausea, headache.

INGESTION: Severe irritation to gastrointestinal tract, possible tissue damage, may be harmful or fatal if swallowed. Toxic effects may not appear immediately.

MEDICAL CONDITIONS WHICH MAY BE AGGRAVATED: Overexposure to chlorinated hydrocarbons may cause cardiac irritability and/or lead to cardiac arrythmia, aggravating any preexisting cardiac damage or dysfunction.

TECHNICAL DATA

BULLETIN NO. C-304

TURCO PRODUCTS, INC. • 7300 BOLSA AVENUE, WESTMINSTER, CALIFORNIA 92684-3600 • 714/890-3600

TURCO® 5580-G

HAND PEELABLE COATING

DESCRIPTION:

TURCO® 5580-G is a hand-strippable coating formulated to provide protection to metal surfaces during successive fabrication operations, such as forming, chemical cleaning, conversion coating, Type I and Type II anodizing, adhesive bonding and machining.

TURCO 5580-G is applied by hot airless spray methods and can be used on ferrous and nonferrous alloys.

APPLICABLE SPECIFICATIONS:

TURCO 5580-G meets the requirements of Boeing Specification BMS 10-65 and Douglas DPS 4.50-139, System 3 (DPM 5252).

LIQUID PROPERTIES:

Weight per gallon	12.0 lbs.
Solids, % by weight	17.5 ± 0.5
Solids, % by volume	18.7 ± 0.5
Coverage (sq.ft./gal./1 mil dry film)	300
Flash point, Pensky Martens Method	110°F minimum
Color	Green
Solvent composition	Non-photochemically reactive per South Coast Air Quality Control District Rule 102 and Bay Area Regulation #3
Viscosity, #5 ZAHN CUP	20 ± 3 seconds

NOTE: TURCO 5580-G may revert to a soft gel on standing. This will in no way impair its performance. Simply mix well before using.

FILM PROPERTIES:

Peel adhesion*, lbs./in. width	0.8 ± 0.2
Tensil strength, psi minimum	1200
Elongation, % minimum	500%
Abrasion resistance	Excellent
Impact resistance	Excellent
Salt spray resistance	168 hours

*On solvent wiped Al clad 2024 alloy

TURCO 5580-G resists emulsion cleaners, anodizing solutions, alkaline cleaners, acid deoxidizers, strong caustic solutions (at 250°F) and various plating solutions.

INSTRUCTIONS FOR USE OF TURCO® 5580-G:

1. **PRECLEANING:** The parts to be coated must be dry and clean; free of corrosion, dirt, oil and grease. Your TURCO Territory Manager can recommend suitable precleaners based on your production requirements.

2. **SPRAY APPLICATION:**

   2.1 **Equipment:** Hot Airless Spray equipment such as Graco Nordson or Binks may be used. Example: Graco President or Bulldog 30:1 circulating unit with two heaters adapted with 680-688 insert rods. A Graco Reflex Gun for hand spray fitted with a Graco tip filter assembly, #206-681, with a #205-264 filter element, #163-919 or 163-921 spray tips for large parts, #163-515 for small parts. Adequate compressed air volume at 80 to 100 psi is required for the pump. Set "back pressure" at 1800 to 2100 psi and the heater thermostat to maintain a temperature of 160° to 180°F.

   2.2 **Application Procedure:** Hold the spray gun approximately 12 to 15 inches from the work surface moving the gun parallel to the work surface and at right angles to the work surface. Use straight uniform strokes. Apply one fast half (1/2) box coat, i.e. one horizontal pass overlapping about 50 to 75%. Then spray full box coat (one horizontal pass and one vertical pass) overlapping approximately 50%.

   One and one half box coats will provide a 6 to 10-mil dry film depending on the speed at which the spray gun is moved. Approximately a 15 to 18-mil wet film equates to 5 to 7-mil dry film.

   2.3 **Cold Airless Spray:** TURCO 5580-G may be sprayed cold. However, 5 box coats may be required to obtain the same dry film thickness as 1½ to 2 box coats when applied hot. Hot spray allows application of heavier wet films without sagging than can be obtained with cold spray.

   2.4 **Dilution:** TURCO 5580-G is packaged ready for use. However, if desired or performance indicates thinning is required, add TURCOFORM® MASK THINNER #4 or toluene.

   Zahn cup viscosity readings of TURCO 5580-G may be misleading and are not recommended for control of TURCO 5580-G. To assure uniform and reproducible results, adequate mixing of the product is necessary and should be done at least once per 8 hour shift.

3. **CURING:** Allow the coating to dry overnight (approximately 16 hours) at room temperature before processing. If it is desired to accelerate the cure, allow coating to dry 4 hours at room temperature and then oven cure for 1 hour at 160° to 170°F.

   When used as a stop-off for plating or anodizing, optimum results are obtained by an additional cure of 30 to 40 minutes at 250°F.

4. **REMOVAL:** TURCO 5580-G is hand peelable. However, on rough and oxidized surfaces, the adhesion will be higher than normal.

   TURCO 5580-G may be stripped by immersing coated parts in TURCO 5416 for 10 to 20 minutes followed by air drying for 10 to 30 minutes. TURCO 5416 lowers the adhesion of TURCO 5580-G so that it is easily removed from very thin or fragile parts.

DISPOSAL INFORMATION:

Dispose of spent material per local, state and regional regulations. Refer to your local TURCO Territory Manager, Region Sales Office or TURCO MATERIAL SAFETY DATA SHEET for additional disposal information.

WARNING! Causes skin irritation, may cause eye irritation.

TURCO® 5580-G contains chlorinated solvent. Avoid contact with eyes, skin and clothing. Do not take internally. Avoid prolonged breathing of vapors. Use with adequate (equivalent to outdoor) ventilation.

Protective clothing, such as a chemical face shield or goggles, gloves and apron made from solvent-resistant materials should be worn when using this product.

Do not use 1,1,1-trichloroethane, methylene chloride, perchloroethylene, or other halogenated solvents or solvent mixture containing halogenated solvents with pressurizable fluid handling equipment such as airless spray equipment containing aluminum or galvanized wetted parts. Direct contact between aluminum or galvanized metal and these or other chlorinated solvents could result in an uncontrollable chemical reaction and possible explosion.

Keep away from flames or other ignition sources, such as welding arcs or cutting torches, since hazardous gases may be formed.

Before using this product refer to container label and TURCO MATERIAL SAFETY DATA SHEET for additional precautionary, handling and first aid information.

NOTICE:

The above information and recommendations concerning this product are based upon our laboratory tests and field use experience. However, since conditions of actual use are beyond our control, any recommendations or suggestions are made without warranty, express or implied. Manufacturer's and seller's sole obligation shall be to replace that portion of the product shown to be defective. Neither shall be liable for any loss, damage or injury, direct or consequential, arising out of the use of this product.

TURCO PRODUCTS, INC.
MATERIAL SAFETY DATA SHEET

PENNWALT

03705
5580-16

SECTION I — PRODUCT NAME: * Turco 5580-G

Manufacturer's Name:	TURCO PRODUCTS, INC.
Address:	7300 Bolsa Ave., Westminster, CA 92684-3600
Emergency Telephone No.:	(814) 387-8200 Info. Tel. No. (714) 890-3600

SECTION II — HAZARDOUS INFORMATION:

COMPONENTS	C.A.S. Number	CERCLA RQ SPILL lbs.	RCRA Waste No.	ACGIH TLV	OSHA TWA	%, WT.
Perchloroethylene *	127-18-4	1	U210	50PPM	100PPMskin	75
Xylene *	1330-20-7	1000	U239	100PPM	100PPMskin	5
Toluene *	108-88-3	1000	U220	100PPM	200PPMskin	5
Talc (containing no asbestos fibers)	14807-96-6	ntlstd	ntlstd	2mg/m³dust	20mmpcf+	10
The following non-hazardous ingredient is listed in accordance with the Worker Community Right-to-Know Act of certain states, including Pennsylvania and New Jersey: Styrene - 1,3 Butadiene Polymer (9003-55-8)					+Respirable dust	

CARCINOGENS (As defined in 29CFR 1910.1200)	NTP	IARC	OSHA
Perchloroethylene	not listed	listed	Not regulated

PROPER SHIPPING NAME:	HAZARD CLASS:	HAZARD I.D. No.:
RQ ORM-A, NOS (Perchloroethylene)	ORM-A	NA1693

* Chemicals in Section II that have an asterick are subject to SARA Section 313 reporting.

SECTION III — PHYSICAL DATA:

BOILING POINT, °F: 250°F	SPECIFIC GRAVITY: 1.43
VAPOR PRESSURE (mmHg): Approx. 13mm	VOLATILE, % BY VOL.: 80%
VAPOR DENSITY (AIR = 1): Over 1	EVAPORATION RATE (Bu. Ac. = 1): Over 1
APPEARANCE AND ODOR: Green Liquid, chlorinated solvent vapor	SOLUBILITY IN WATER: Negligible pH Not applicable

SECTION IV — FIRE AND EXPLOSION HAZARDS:

FLASH POINT AND METHOD USED:
None to boil (Setaflash)

EXTINGUISHING MEDIA:
Carbon dioxide, foam, water fog

SPECIAL FIRE FIGHTING PROCEDURE AND PRECAUTIONS:
Use self-contained respiratory protection

UNUSUAL FIRE AND EXPLOSION HAZARDS: Thermal decomposition may produce toxic oxides of carbon, nitrogen and chlorine, acid gases and/or other toxic volatile organic compounds.

SECTION V — HEALTH, EMERGENCY AND FIRST AID INFORMATION:

EFFECTS OF OVER EXPOSURE: EYES:
Vapors: Moderate to severe irritation
Liquid: Severe irritation

SKIN:
Moderate to severe irritation. May be absorbed through skin in toxic amounts.

INHALATION:
Moderate to severe irritation of respiratory tract, nausea, headache.

INGESTION:
Severe irritation to gastrointestinal tract, may be harmful if swallowed. Toxic effects may not appear immediately.

MEDICAL CONDITIONS WHICH MAY BE AGGRAVATED: Overexposure to chlorinated hydrocarbons may cause cardiac irritability and/or lead to cardiac arrythmia, aggravating any preexisting cardiac damage or dysfunction. Repeated overexposure may cause liver and/or kidney damage.

N-1888

NO: N-1888

FIRST AID: EYES: Immediately flush eyes with large volumes of water. Continue for at least 15 minutes. Hold lids apart to assure contact with all surfaces. Obtain medical attention.

SKIN: Flush affected area with clear cool water. Wash with soap and water. Rinse thoroughly. If irritation persists, obtain medical attention.

INHALATION: Remove to fresh air. If breathing is difficult, administer oxygen. If breathing has stopped, apply artificial respiration. Obtain medical attention.

INGESTION: Do not induce vomiting except on the advice of competent medical personnel. If victim is conscious, dilute by giving large volumes of milk or water. Obtain immediate medical attention. Never attempt to induce vomiting or give anything by mouth to an unconscious person.

PRIMARY ROUTES OF ENTRY: INHALATION X SKIN CONTACT X OTHER _____

SECTION VI — REACTIVITY DATE:

STABILITY: STABLE X UNSTABLE _____ HAZARDOUS POLYMERIZATION WILL NOT OCCUR

CONDITIONS TO AVOID:
Contact with strong oxidizing agents, strong acids, strongly heated reactive metals

HAZARDOUS DECOMPOSITION PRODUCTS: Toxic oxides of carbon, nitrogen and chlorine, acid gases, other toxic volatile organic compounds

SECTION VII — SPILL, LEAK AND DISPOSAL PROCEDURE:

SPILL OR RELEASE PROCEDURE: CONCENTRATE: Contain spillage. Stop leak at source if this can be done safely. Ventilate area. Evacuate nonessential personnel. Pump or scoop liquid into DOT-approved drums for disposal. Absorb remaining liquid onto inert absorbent and place in DOT-approved drums for disposal. Wash area with solvent followed by soap and water. Collect washings and place in DOT-approved drums for disposal. Keep concentrate and wash water from entering sewer or waterways.

USE SOLUTION:

Not applicable

DISPOSAL INFORMATION: CONCENTRATE: (1) Transfer to reclaiming center for recycling or solvent recovery. (2) Transfer to licensed hazardous waste treatment or disposal site for disposition under applicable local, state and regional regulations as hazardous waste.

SPENT SOLUTION AND RINSES:
Dispose of concentrate per (1) and (2) above. Used stripped coatings may be combined with other solid waste and be disposed of as nonhazardous waste if local regulations permit.

SECTION VIII — SPECIAL PROTECTION INFORMATION:

RESPIRATORY PROTECTION: If TLV is exceeded, a NIOSH-approved self-contained breathing apparatus, positive pressure hose mask or air line mask is advised. These should have a full face piece and be operated in a positive pressure mode. For limited exposure time, in areas of good ventilation, a full face mask with an organic vapor cartridge or canister may be used. These must not be used in any areas where a danger of oxygen deficiency exists, such as partly enclosed or low lying areas, including sumps or tanks. If respirators are used, a formal training and screening program must be initiated. See 29 CFR 1910-134.

VENTILATION:
Maintain sufficient mechanical ventilation to keep concentration below TLV.

PROTECTIVE EQUIPMENT: CHEMICAL FACE SHIELD OR GOGGLES: X **GLOVES** X **BOOTS** X **APRON** X **PROTECTIVE SUIT** Not normally required, but advised if necessary to avoid prolonged or repeated exposure

GLOVES, BOOTS, APRON AND SUIT MADE FROM: solvent resistant material (e.g. neoprene, Viton, etc.)

RECOMMENDED PERSONAL HYGIENE: Wash hands and face with soap and water before smoking or eating. Immediately remove contaminated clothing. Launder separately before reuse.

SECTION IX — OTHER INFORMATION:

SPECIAL PRECAUTIONS — STORAGE AND HANDLING: Store in dry protected area. CAUTION: Vapors from this product are heavier than air and will travel along the ground to collect in low lying areas, such as sumps. Follow appropriate tank entry procedures (See ANSI Z117-1-1977). Personnel entering such areas must be provided with respiratory protection and a safety line. They should be kept under observation while in the area by another man at a safe distance. Persons wearing contact lenses should wear vapor-proof well-fitting goggles. NOTE: (1) Many chlorinated hydrocarbons have, in some tests been found to cause an increase in some types of cancer and benign tumors in certain strains of some mammalian species. NOTE: (2) Do not use 1,1,1 trichloroethane, methylene chloride, perchloroethylene, or other halogenated solvents or solvent mixtures containing halogenated solvents with pressurizable fluid handling equipment such as airless spray equipment containing aluminum or galvanized wetted parts. Direct contact between aluminum or galvanized metal and these or other chlorinated solvents, under pressure, could result in an uncontrollable chemical reaction and possible explosion.

MIXING: Not applicable

REPAIR AND MAINTENANCE OF CONTAMINATED EQUIPMENT: Relieve any pressure. Cover openings to avoid spurting. Clean exterior and interior by flushing with water or solvent. Collect flushings for disposal. Use protective equipment for eyes, skin and inhalation.

DATE PREPARED: **DATE REVIEWED:**

APPROVED: JD 12/88 **Q.C. DEPT.:** **R & D DEPT.:** **SAFETY & ENVIRON.**

THESDS 4-88B

TURCO PRODUCTS, INC.
MATERIAL SAFETY DATA SHEET

PENNWALT

00521
5351-29A(30A)

SECTION I — PRODUCT NAME: Turco 5469

Manufacturer's Name:	TURCO PRODUCTS, INC.
Address:	7300 Bolsa Ave., Westminster, CA 92684-3600
Emergency Telephone No.:	(614) 387-6200 Info. Tel. No. (714) 890-3600

SECTION II — HAZARDOUS INFORMATION:

COMPONENTS	C.A.S. Number	CERCLA RQ SPILL lbs.	RCRA Waste No.	ACGIH TLV	OSHA TWA	%. WT.
methylene chloride *	75-09-2	1000	U080	100 PPM	500 PPM	55
phenol *	108-95-2	1000	U188	5 PPM skin	5 PPM skin	20
sodium chromate *	7775-11-3	1000	D007	50µg/m³Cr	.1 PPM CrO_3	1
The following non-hazardous ingredient is listed in accordance with the Worker and Community Right-to-Know Act of certain states, including Pennsylvania and New Jersey: Water (7732-18-5)						

CARCINOGENS (As defined in 29CFR 1910.1200)	NTP	IARC	OSHA
methylene chloride	not listed	listed	not regulated
Chromate (1 %)	Listed	Listed	Not regulated

PROPER SHIPPING NAME:	HAZARD CLASS:	HAZARD I.D. No.:
Paint Related Material	Corrosive Material	NA 1760

* Chemicals in Section II that have an asterick are subject to SARA Section 313 reporting.

SECTION III — PHYSICAL DATA:

BOILING POINT, °F:	Approx 105°F	SPECIFIC GRAVITY:	1.14
VAPOR PRESSURE (mmHg):	Approx 400mm	VOLATILE, % BY VOL.:	Approx. 90%
VAPOR DENSITY (AIR = 1):	More than 1	EVAPORATION RATE (Bu. Ac. = 1):	Less than 1
APPEARANCE AND ODOR:	Viscous opaque yellow brown liquid, phenolic acid	SOLUBILITY IN WATER:	Appreciable
		pH	3.1% in H_2O 7-9

SECTION IV — FIRE AND EXPLOSION HAZARDS:

FLASH POINT AND METHOD USED:
None to boil (Setaflash)

EXTINGUISHING MEDIA:
Carbon dioxide, foam, water fog

SPECIAL FIRE FIGHTING PROCEDURE AND PRECAUTIONS: Use self-contained respiratory protection. Any water run-off may contain hexavalent chrome and should not be allowed to enter sewer or waterways.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Thermal decomposition may produce toxic oxides of carbon and/or chlorine. Drums exposed to 100°F and above may develop sufficient internal pressure to rupture.

SECTION V — HEALTH, EMERGENCY AND FIRST AID INFORMATION:

EFFECTS OF OVER EXPOSURE: EYES:
Vapors: Moderate to severe irritation.
Liquid: Severe damage, may cause blindness

SKIN: Chemical burns, possible necrosis, defatting. May be absorbed through skin in toxic amounts. Chromates are skin sensitizers.

INHALATION: Dizziness, headache, intoxication. Inhalation of mist of chromate-containing materials may cause permanent damage to upper respiratory tract, and may cause lung cancer risk.

INGESTION: Severe irritation to gastrointestinal tract, may be harmful or fatal if swallowed. Toxic effects may not appear immediately.

MEDICAL CONDITIONS WHICH MAY BE AGGRAVATED: Metabolism of methylene chloride to carbon monoxide may lead to accumulation of dangerous levels of carboxyhemoglobin which may not be tolerated by persons with impaired cardio-pulmonary function. This may be aggravated by smoking.

NO: N-1918

FIRST AID: EYES: Flush eyes with large volumes of water for at least 15 minutes. Obtain medical attention.

SKIN: Flush affected area with clean cool water. Wash with soap and water. Rinse thoroughly. If irritation persists or blistering occurs, obtain medical attention.

INHALATION: Remove to fresh air. If breathing is difficult, administer oxygen. If breathing has stopped, apply artificial respiration. Obtain medical attention.

INGESTION: Do not induce vomiting except on advice of qualified medical personnel. If victim is conscious, dilute by giving large volumes of milk or water. Obtain immediate medical attention. Never attempt to induce vomiting or give anything by mouth to an unconscious person.

PRIMARY ROUTES OF ENTRY: INHALATION X SKIN CONTACT X OTHER _____

SECTION VI — REACTIVITY DATE:

STABILITY: STABLE X UNSTABLE _____ HAZARDOUS POLYMERIZATION WILL NOT OCCUR

CONDITIONS TO AVOID:
Contact with strong acids, strong oxidizing agents, open flame

HAZARDOUS DECOMPOSITION PRODUCTS: Carbon monoxide, carbon dioxide, phosgene, acid gases, other toxic volatile organic compounds.

SECTION VII — SPILL, LEAK AND DISPOSAL PROCEDURE:

SPILL OR RELEASE PROCEDURE: CONCENTRATE: Contain spillage. Stop leak at source, if this can be done safely. Ventilate area. Evacuate nonessential personnel. Pump liquid into DOT-approved drums for disposal. Absorb remaining liquid with inert material and place in DOT-approved drums. Wash area with water. Collect washing and place in DOT-approved drums. Keep concentrate and wash water from entering sewer or waterways.

USE SOLUTION:

Not applicable. This product is used as received.

DISPOSAL INFORMATION: CONCENTRATE: (1) Transfer to reclaiming center for recycling or solvent recovery. (2) Transfer to licensed hazardous waste treatment or disposal site for disposition under applicable local, state and regional regulations as hazardous waste.

SPENT SOLUTION AND RINSES: Dispose per (1) and (2) above. Treat rinse water as hazardous waste. Remove chromate by reduction and precipitation. Remove organics by oxidation and carbon treatment. Clarified rinse water may be released to sewer if local regulations permit.

SECTION VIII — SPECIAL PROTECTION INFORMATION:

RESPIRATORY PROTECTION: If TLV is exceeded, a NIOSH-approved self-contained breathing apparatus, positive pressure hose mask or air line mask is advised. These should have a full face piece and be operated in a positive pressure mode. Because of the short breakthrough time of methylene chloride and its poor warning properties, organic vapor cartridges or canisters are not recommended. If respirators are used, a formal training and screening program must be initiated. See 29 CFR 1910-134.

VENTILATION: Maintain sufficient mechanical ventilation to keep concentration below TLV.

PROTECTIVE EQUIPMENT: CHEMICAL FACE SHIELD OR GOGGLES: X GLOVES X BOOTS X APRON X PROTECTIVE SUIT ____ If required to avoid prolonged or repeated skin contact.
GLOVES, BOOTS, APRON AND SUIT MADE FROM: Neoprene or other impervious material

RECOMMENDED PERSONAL HYGIENE: Wash hands and face with soap and water before smoking or eating. Immediately remove contaminated clothing. Launder separately before reuse. Discard shoes that become contaminated on the interior.

SECTION IX — OTHER INFORMATION:

SPECIAL PRECAUTIONS — STORAGE AND HANDLING: Store in cool area protected from exposure to direct sunlight, rain or standing water. Use care in opening containers to avoid spurting. CAUTION: Vapors from this product are heavier than air and will travel along the ground to collect in low lying areas, such as sumps. Personnel entering such areas must be provided with respiratory protection and a safety line. They should be kept under observation while in the area by another man at a safe distance. Persons wearing contact lenses should wear vapor-proof well-fitting goggles. NOTE: (1) Methylene chloride has been found to cause an increase in some types of cancer and benign tumors in certain strains of some mammalian species. NOTE: (2) Do not use 1,1,1, trichloroethane, methylene chloride, perchloroethylene, or other halogenated solvents or solvent mixture containing solvents with pressurizable fluid handling equipment such as airless spray equipment containing aluminum or galvanized wetted parts. Direct contact between aluminum or galvanized metal and these or other chlorinated solvents could result in an uncontrollable chemical reaction and possible explosion.

MIXING: Not applicable

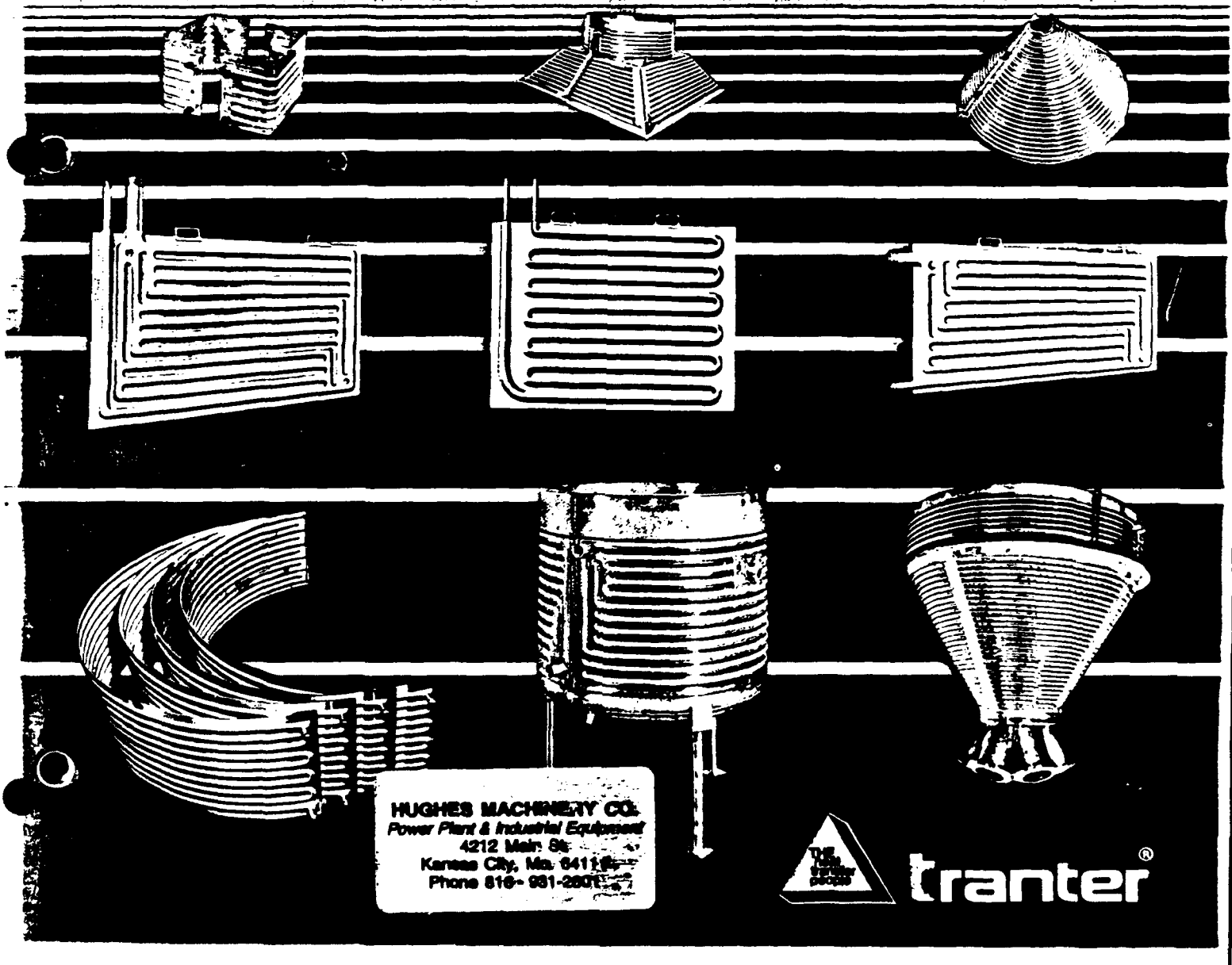
REPAIR AND MAINTENANCE OF CONTAMINATED EQUIPMENT: Relieve pressure. Cover openings to avoid spurting. Clean exterior and interior by flushing with water or solvent. Collect flushing for disposal. Use protective equipment for eyes, skin and inhalation.

DATE PREPARED: DATE REVIEWED:
APPROVED: JPJ 5/89 Q.C. DEPT.: MP R & D DEPT: JTC SAFETY & ENVIRON. EED

TMSDS 4-888

CATALOG NO. 5-63-6
PRODUCT DATA MANUAL

PLATECOIL®
for HEAT TRANSFER



HUGHES MACHINERY CO.
Power Plant & Industrial Equipment
4212 Main St.
Kansas City, Mo. 6411[illegible]
Phone 816- 931-2801

tranter®

Platecoil®
for HEAT TRANSFER

PLATECOIL is a very efficient and versatile prime surface type heat exchanger. Its unique design remains the key to both its high heat transfer efficiency and versatility for heating and cooling applications.

By providing the right answers to a broad range of heat transfer needs PLATECOIL heat transfer equipment has been saving thousands of engineering, fabrication, and installation man-hours in numerous industrial applications for over 30 years. Its continuing popularity is a direct result of its proven capability to satisfy an almost unlimited variety of requirements for size, shape, pressure containment, capacity, materials and surface finishes.

Every PLATECOIL product is backed by an experienced staff of sales representatives, engineers and modern production facilities. These resources are readily available to analyze and solve your specific heat transfer need, no matter how complex or complicated that may be.

In the event your heat transfer requirements are relatively uncomplicated, the information presented in this manual will allow you to specify the PLATECOIL that fits your specific application. Every effort has been made to present a selection of data that will be reliable and helpful, both from the standpoint of selecting the proper heat transfer surface and in determining heat transfer rates, fluid flow rates, etc.

Please remember that industrial heat transfer processes are not generally subject to rigidly controlled conditions. As a result, factors affecting heat transfer rates, material life and other items can vary from day-to-day. Therefore, the pertinency of the engineering data in this manual as applied to a specific application must be judged in relationship to the variables involved. Also, the information in this manual is subject to change without notice. The manufacturer reserves the right to change specifications at any time.

Whatever your heat transfer need may be, contact the PLATECOIL representative in your area. Put his experience and heat transfer know-how to work for you. He'll see to it that the PLATECOIL product you require is designed and built to exactly meet your specific application requirements and you will receive the best possible return on your PLATECOIL investment.

For further information, contact:

PLATECOIL • TEXAS DIVISION-Tranter, Inc. • P.O. Box 2289 • Old Burke Road • Wichita Falls, Texas 76307
Telephone: 817/723-7125 • Telex: 734-410

Distributed in Canada by: Tranter Canada Ltd., 6700 Finch Ave., West, Rexdale, Ontario, Canada M9W 5P5 (416) 675-1210

Tranter, Inc., 735 E. Hazel Street, Lansing, Michigan 48909, Telephone (517) 372-9410

Printed in USA

Platecoil Heat Exchangers

What is PLATECOIL...

PLATECOIL designates a group of heat transfer products fabricated from two metal sheets, one or both of which are embossed. When welded together, the embossings form a series of well-defined passages through which the heat transfer media flows. Two embossed sheets welded together form a *Double Embossed* PLATECOIL. One embossed sheet welded to a flat companion plate is known as a *Single Embossed* PLATECOIL.

MULTI-ZONE PLATECOIL

The passages formed by the embossings are designed to provide PLATECOIL users with a choice of two basic flow patterns, depending on the application. PLATECOIL's *Multi-Zone* flow configuration is ideal for use when steam is the heating medium. The *Serpentine* flow configuration finds wide application with liquid heat transfer media such as water, oil and liquid refrigerants.

With its zoned header design, *Multi-Zone* PLATECOIL provides far more heat transfer efficiency than pipecoil or units with straight headers in applications requiring the use of steam. The *Multi-Zone* headers and flow arrangement provide controlled distribution of the steam as it flows through the PLATECOIL. The rate of condensate removal from the passages or passes is significantly increased as compared to units with straight headers. Efficiency reducing condensate blocking is minimized. As a result, *Multi-Zone* PLATECOIL provides faster heat-up and better heat transfer rates.

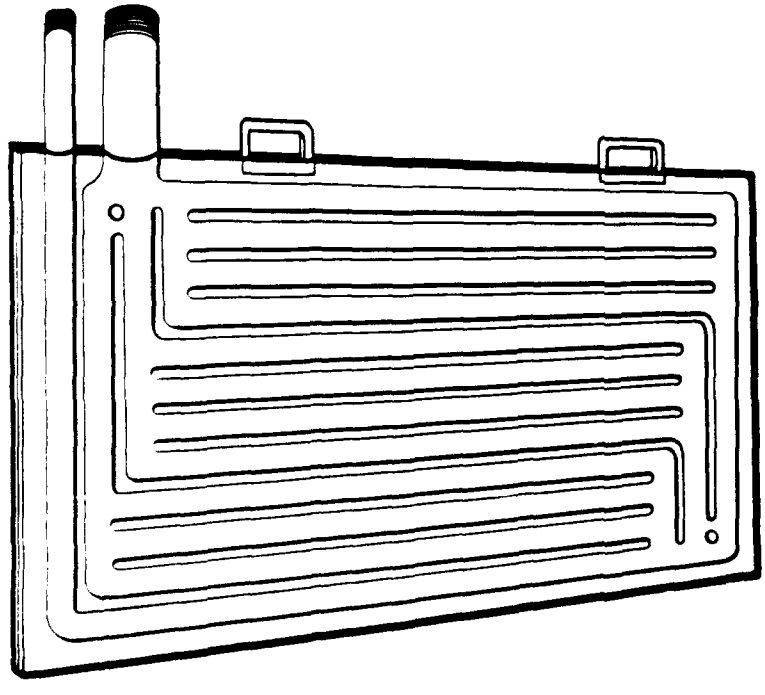


Fig. 2-1
Style 90 *Multi-Zone* PLATECOIL

Multi-Zone PLATECOIL—available in a wide range of widths, lengths and materials. An acknowledged standard wherever heat transfer is required in industry.

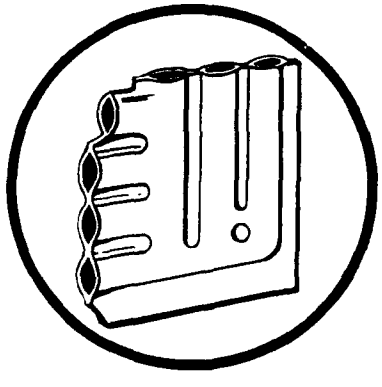
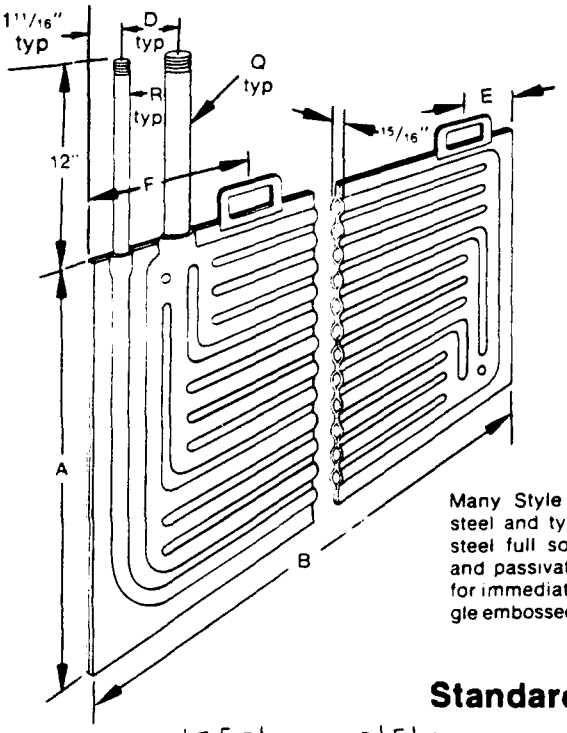


Fig. 2-2
Corner Cutaway

Standard Platecoil

PLATECOIL STYLE 90



Many Style 90D in carbon steel and type 316 stainless steel full solution annealed and passivated are available for immediate shipment. Single embossed are not stocked.

This is a general purpose style PLATECOIL used with steam or other condensing media in thousands of open tank heating applications. It readily installs on the side of tanks with specially designed hangers, page 15. With pipe unions installed above the liquid level, PLATECOIL may be easily removed without emptying the tank. See page 78 for Quick Selection Chart.

Platecoil Style 90

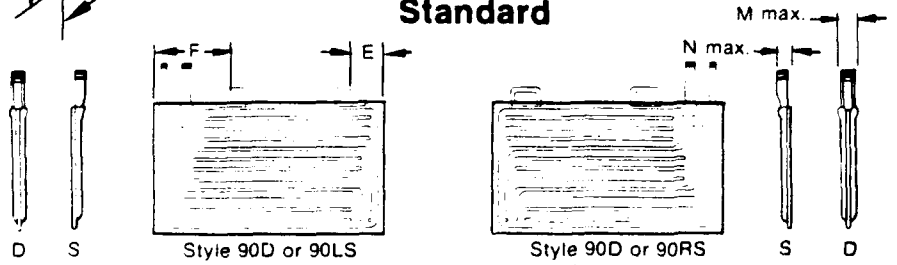
Dim. A (in)		No. of Passes	Dimension (in)						
Nominal	Actual		D	G	M	N	O	P	V
12	11 5/16	6	4	2 1/2	1 1/2	1 1/4	3 1/16	2 1/4	1 1/16
18	18 1/16	10	4	1 5/16	2 1/16	1 1/8	3 1/16	2 1/4	1 1/16
22	22 1/4	12	4	1 5/16	2 1/16	1 1/8	3 1/16	2 1/4	1 1/16
26	25 1/16	14	6	2 1/8	2 9/16	2 1/8	3 1/16	2 1/4	1 1/16
29	29 1/8	16	6	2 1/8	2 9/16	2 1/8	3 1/16	2 1/4	1 1/16
36	36	20	6	2 1/4	2 9/16	2 1/8	3 1/16	2 1/4	1 1/16
43	42 1/4	24	6	2 1/4	2 9/16	2 1/2	3 1/16	2 1/4	1 1/16

See page 12 for surface areas and weights. See page 14 for standard pass cross section.

Fitting Size Table for Double Embossed

Dim. A with Length B	Pipes—M P T		Coupling—FPT	
	Q (in)	R (in)	U (in)	T (in)
12"—All Lengths	1	3/4	1	3/4
18" & 22" Thru 47" Long	1	3/4	1	3/4
18" & 22" Over 47" Long	1 1/2	3/4	1 1/4	3/4
26", 29" 36", 43" All Lengths	2	1	1 1/2	1

Standard



Handles supplied on single embossed only on request.

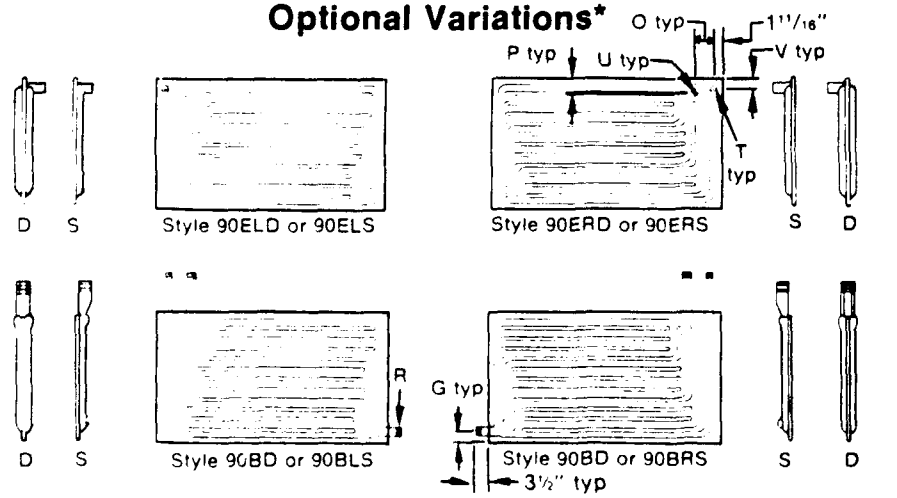
B, E & F Dimensions (in)

Furnished as standard in the following lengths:

B	E	F	B	E	F	B	E	F
23	3	11	59	3	13	107	3	13
29	3	11	71	3	13	119	3	13
35	3	13	83	3	13	131	3	13
47	3	13	95	3	13	143	3	13

B dimension is ½" shorter on PLATECOIL over 22" wide.

Optional Variations*



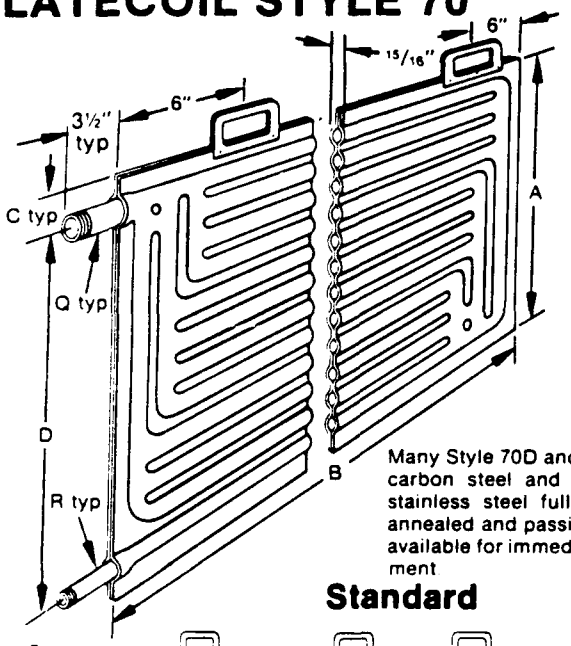
*Contact factory for other available variations.

Fitting Size Table for Single Embossed

Dim. A with Length B	Pipes—M P T		Coupling—FPT	
	Q (in)	R (in)	U (in)	T (in)
12"—All Lengths	3/4	1/2	1	3/8
18" & 22" Thru 47" Long	3/4	1/2	1	3/8
18" & 22" Over 47" Long	1	1/2	1 1/4	3/8
26" 29" 36" 43" All Lengths	1 1/4	3/4	1 1/2	1

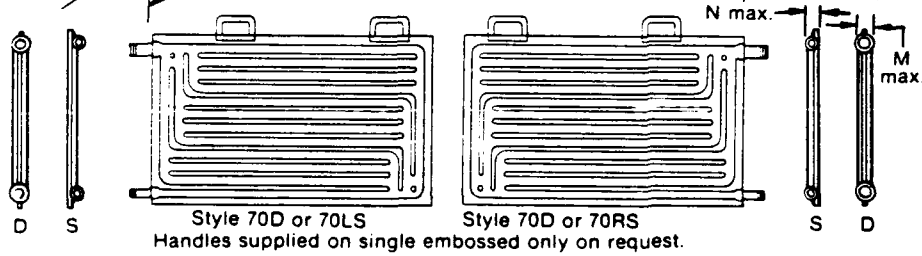
Standard Platecoil

PLATECOIL STYLE 70



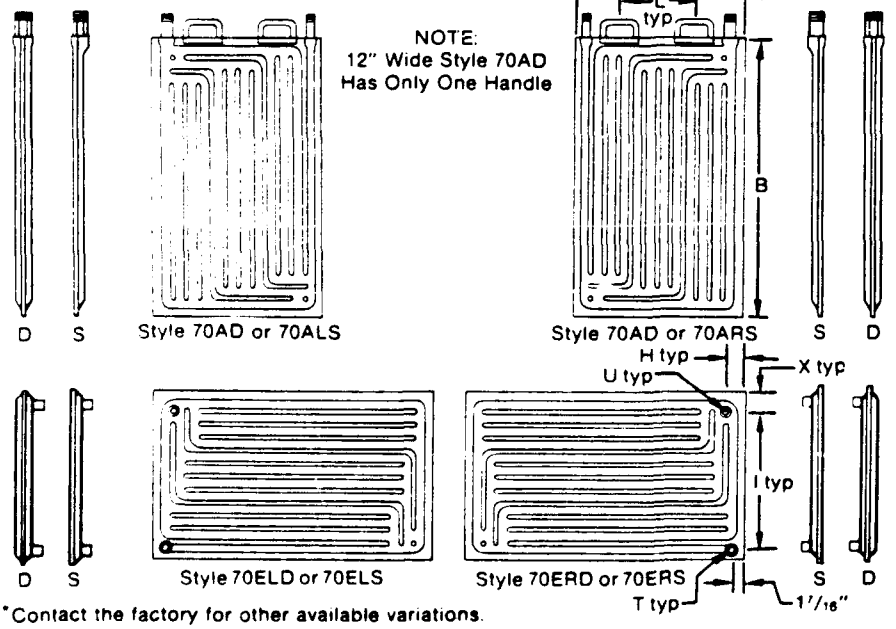
Many Style 70D and 70AD in carbon steel and type 316 stainless steel full solution annealed and passivated are available for immediate shipment.

Standard



Handles supplied on single embossed only on request.

Optional Variations*



*Contact the factory for other available variations.

Style 70 PLATECOIL are efficient for use with steam or other condensing media. Connections through the wall of a tank can be made conveniently or they can be installed vertically with handles on the end. For handles on end specify "Style 70A." 12" (A dim.) Style 70A are furnished with one end mounted handle, those over 12" have two handles.

For banking a number of Style 70 PLATECOIL to a common header, see page 48. See page 78 for Quick Selection Chart.

PLATECOIL Style 70

Dim. A (in)		No. of Passes	Dimension (in)								
Nominal	Actual		C	D	X	H	I	K	L	M	N
12	11 5/16	6	2 1/8	8 1/8	2 1/4	2 1/2	7 1/2	6		1 1/2	1 1/4
18	18 13/16	10	1 15/16	15 3/16	2 1/4	2 1/2	14 3/8	6 1/8	6 3/16	2 1/16	1 1/8
22	22 1/4	12	1 15/16	18 5/8	2 1/4	2 1/2	17 13/16	6 1/8	10	2 1/16	1 1/8
26	25 11/16	14	2 1/4	21 1/4	2 1/4	2 1/2	21 1/4	7 1/4	10 3/16	2	2 1/8
29	29 1/8	16	2 1/4	24 11/16	2 1/4	2 1/2	24 11/16	7 1/4	13 5/8	2 9/16	2 1/8
36	36	20	2 1/4	31 9/16	2 1/4	2 1/2	31 9/16	7 1/4	20 1/2	2 9/16	2 1/8
43	42 7/8	24	2 1/4	38 7/16	2 1/4	2 1/2	38 7/16	7 1/4	27 5/16	2 9/16	2 1/8

See page 12 for surface areas and weights. See page 14 for standard pass cross section.

Fitting Size Table for Double Embossed

Dim. A with Length B	Pipes—MPT		Coupling—FPT	
	Q (in)	R (in)	U (in)	T (in)
12"—All Lengths	1	¾	1	¾
18" & 22" Thru 47" Long	1	¾	1	¾
18" & 22" Over 47" Long	1½	¾	1¼	¾
26", 29" 36", 43" All Lengths	2	1	1½	1

B Dimensions (in)

Furnished as standard in the following lengths:

23	59	107
29	71	119
35	83	131
47	95	143

B dimension is ½" shorter on PLATECOIL over 22" wide.

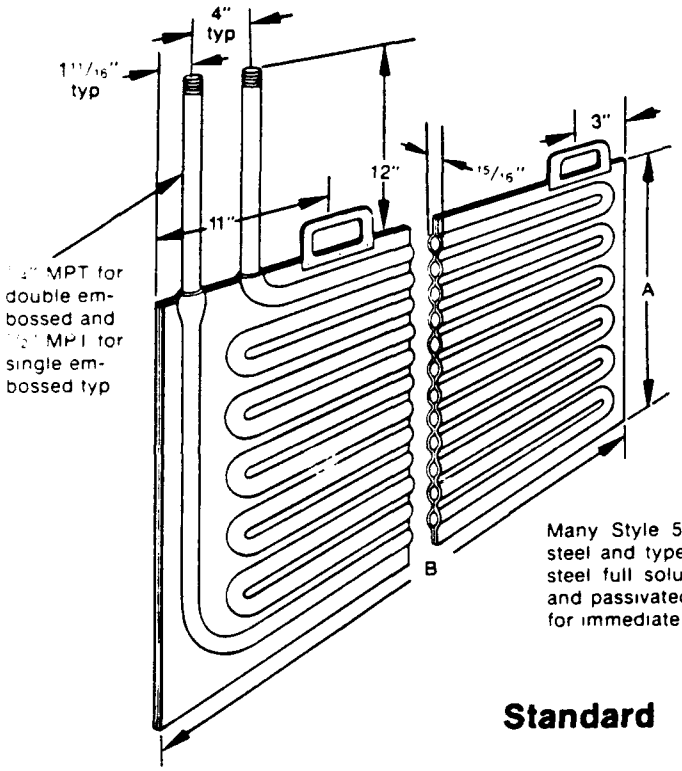
Fitting Size Table for Single Embossed

Dim. A with Length B	Pipes—MPT		Coupling—FPT	
	Q (in)	R (in)	U (in)	T (in)
12"—All Lengths	¾	½	1	¾
18" & 22" Thru 47" Long	¾	½	1	¾
18" & 22" Over 47" Long	1	½	1¼	¾
26", 29" 36", 43" All Lengths	1¼	¾	1½	1

Standard Platecoil

PLATECOIL STYLE 50

Style 50 *Serpentine* pass PLATECOIL is designed primarily for heating or cooling applications in open tanks when liquid heat transfer media are used. By merely breaking two connections the PLATECOIL can be removed without emptying the tank.



Many Style 50D in carbon steel and type 316 stainless steel full solution annealed and passivated are available for immediate shipment.

B Dimensions (in)

Furnished as standard in the following lengths:

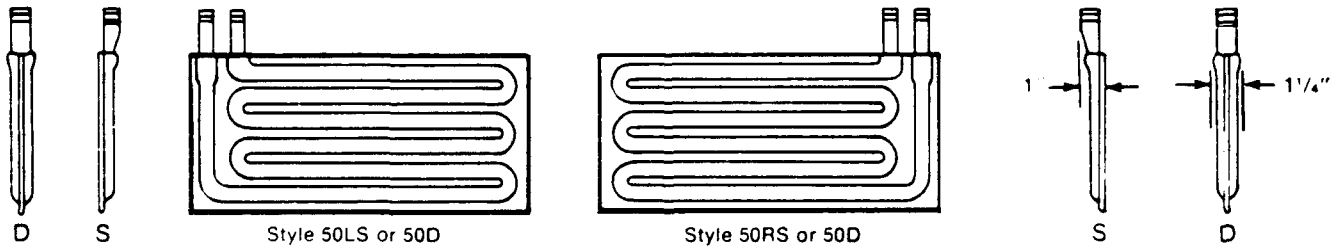
23	59	107
29	71	119
35	83	131
47	95	143

B dimension is 1/2" shorter on PLATECOIL over 22" wide

Dim. A (in)		No. of
Nominal	Actual	Passes
12	11 5/16	6
18	18 13/16	10
22	22 1/4	12
26	25 11/16	14
29	29 1/8	16
36	36	20
43	42 7/8	24

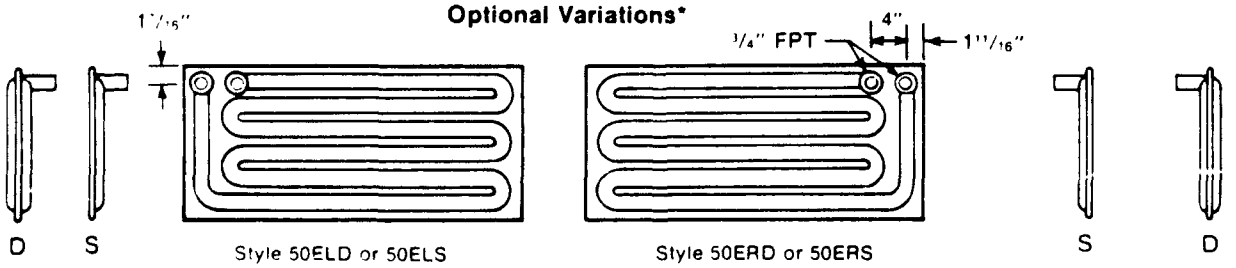
See page 12 for surface areas and weights. See page 14 for standard pass cross section.

Standard



Handles supplied on single embossed only on request

Optional Variations*

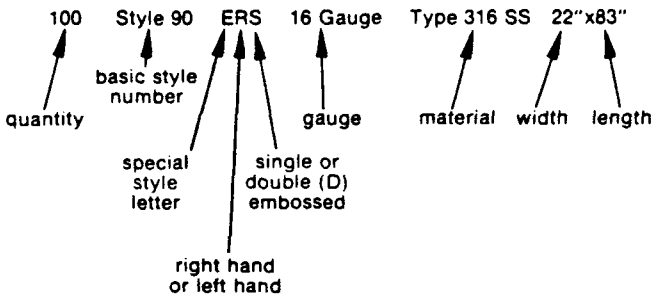


Contact the factory for other available variations

Standard Platecoil

ORDERING GUIDELINES

Faster and better service in filling orders for Standard Style PLATECOIL can be given if orders contain a complete description of the PLATECOIL required. The following illustrates the description for a typical order.



The letter codes which are used with the two digit Style numbers indicate the following:

Letter Code	Description
D	Double embossed
S	Single embossed
L	Left hand embossing for single embossed unit
R	Right hand embossing for single embossed unit
A, B, E, G K, M, etc.	Inlet/Outlet locations and configurations

Here are some other points to remember:

a. Call out gauge. For single embossed, this applies to both the embossing and the companion plate.

b. For special inlet/outlet pipe lengths, call out as "total pipe length."

c. If double embossed PLATECOIL are to be rolled or curved, call out right or left hand roll, (page 23) and whether the length or width dimension is to be curved.

d. Often a simple free-hand sketch accompanying the order, can clarify special details that would be difficult to describe otherwise.

MATERIAL SELECTION

For assistance in determining what material is best suited for your particular application, refer to the Material Selection Charts found on pages 27-30. Obviously, any material that has previously proven satisfactory in a particular application at your plant, would be a safe choice when the PLATECOIL is to be used for the exact same service.

The amount of surface area required to provide necessary heating or cooling, particularly when Standard Style PLATECOIL are to be used in open tank applications, can quickly be calculated by using the Quick Selection charts found on page 78 and 72. They save engineering time and offer a fast and reliable method for determining what is required to get the job done.

For more complex heat transfer requirements and data on other calculation methods, refer to the Heat Transfer and Fluid Flow Calculations Section beginning on page 64.

GAUGE SELECTION

Maximum recommended operating pressures for PLATECOIL in various gauges are shown on page 16. In addition to this, there are certain other factors that should be considered when selecting the gauge of PLATECOIL for a particular application.

1. 14 ga. stainless PLATECOIL are preferable for industrial spray washers and similar equipment having high continuous operating heat load requirements. This heavier gauge has proven very satisfactory for the cyclic operating conditions encountered in these machines.
2. Many metal processing and chemical solutions are corrosive and cause some attack. This is particularly true of a heating unit due to the higher temperatures encountered. Examples are aluminum bright dip and sulphuric acid steel pickling solutions. For such applications the use of 14 or 12 ga. PLATECOIL will extend equipment life.
3. If the PLATECOIL will be in contact with an abrasive slurry a heavier gauge material is preferable.
4. Heavier gauge companions for single embossed PLATECOIL improve flatness and general rigidity. See the flatness standards on page 18.
5. The flat side surfaces of single embossed PLATECOIL can be free of seam weld marks if the companion plate is 3/16" or heavier. These thicknesses are mig welded and this is done from the embossed side only.

Standard Platecoil

SELECTION & OPERATING DATA
Standard PLATECOIL (¾" Pass)
Surface Areas & Weight

Double Embossed Surface Areas

Fig. 12-1 ALL STYLES IN SQUARE FEET

Nominal Width Inches	LENGTH in INCHES											
	23	29	35	47	59	71	83	95	107	119	131	143
12	4.3	5.4	6.5	8.8	11.1	13.3	15.6	17.8	20.1	22.3	24.6	26.8
18	6.8	8.5	10.3	13.9	17.4	21.0	24.5	28.1	31.6	35.2	38.7	42.3
22	8.0	10.1	12.2	16.4	20.6	24.8	29.0	33.2	37.4	41.6	45.8	50.0
26	9.2	11.7	14.1	18.9	23.8	28.6	33.5	38.3	43.2	48.0	52.9	57.7
29	10.5	13.2	16.0	21.5	27.0	32.5	38.0	43.5	49.0	54.5	60.0	65.5
36	12.9	16.3	19.7	26.5	33.3	40.1	46.9	53.7	60.5	67.3	74.1	80.9
43	15.4	19.5	23.5	31.6	39.7	47.8	55.9	64.0	72.1	80.2	88.3	96.4

Areas of Flat Side Only for Single Embossed

Fig. 12-2 ALL STYLES IN SQUARE FEET

Nominal Width Inches	LENGTH in INCHES											
	23	29	35	47	59	71	83	95	107	119	131	143
12	1.9	2.4	2.9	3.9	4.9	5.9	6.9	7.9	8.9	9.9	10.9	11.9
18	3.0	3.8	4.6	6.1	7.7	9.3	10.8	12.4	14.0	15.5	17.1	18.7
22	3.6	4.5	5.4	7.3	9.1	11.0	12.8	14.7	16.5	18.4	20.2	22.1
26	4.1	5.2	6.2	8.4	10.5	12.7	14.8	16.9	19.1	21.2	23.4	25.5
29	4.7	5.9	7.1	9.5	11.9	14.4	16.8	19.2	21.6	24.1	26.5	29.0
36	5.7	7.2	8.7	11.7	14.7	17.7	20.7	23.7	26.7	29.7	32.7	35.7
43	6.8	8.6	10.4	14.0	17.6	21.1	24.7	28.3	31.9	35.4	39.0	42.6

Approx. Net Weights in Pounds; All Styles 14 ga. and 12 ga. Carbon Steel

Fig. 12-3

Nom. Width Inches	LENGTH in INCHES																							
	23		29		35		47		59		71		83		95		107		119		131		143	
	14 ga.	12 ga.	14 ga.	12 ga.	14 ga.	12 ga.	14 ga.	12 ga.	14 ga.	12 ga.	14 ga.	12 ga.	14 ga.	12 ga.	14 ga.	12 ga.	14 ga.	12 ga.	14 ga.	12 ga.	14 ga.	12 ga.	14 ga.	12 ga.
12	13	18	16	23	19	27	26	37	33	46	40	55	46	65	53	74	60	83	66	93	73	102	80	111
18	20	28	25	36	31	43	41	57	52	72	62	87	72	101	83	116	94	131	104	145	114	160	125	175
22	24	34	30	42	36	51	49	68	61	85	74	103	86	120	98	138	110	154	123	172	135	189	148	207
26	27	38	35	49	42	58	56	79	70	98	85	119	99	139	113	158	128	179	142	199	157	219	171	239
29	31	44	40	55	48	67	64	89	80	111	96	135	112	157	128	180	145	202	161	226	177	248	194	272
36	38	53	48	68	58	82	78	110	98	138	118	166	138	194	159	222	179	250	199	278	219	306	239	334
43	46	64	58	81	70	97	94	131	118	165	141	198	165	231	189	265	213	299	237	331	261	365	285	399

Approx. Net Weights in Pounds; All Styles, 16 ga. and 14 ga. Stainless Steel

Fig. 12-4

Nom. Width Inches	LENGTH in INCHES																							
	23		29		35		47		59		71		83		95		107		119		131		143	
	16 ga.	14 ga.	16 ga.	14 ga.	16 ga.	14 ga.	16 ga.	14 ga.	16 ga.	14 ga.	16 ga.	14 ga.	16 ga.	14 ga.	16 ga.	14 ga.	16 ga.	14 ga.	16 ga.	14 ga.	16 ga.	14 ga.	16 ga.	14 ga.
12	11	13	14	17	16	20	22	27	28	34	33	42	39	48	44	55	50	63	56	70	61	77	67	84
18	17	21	21	27	26	32	34	43	43	54	52	65	61	76	70	87	79	98	87	109	96	120	105	131
22	20	25	25	32	30	38	41	51	51	64	62	77	72	90	83	103	93	116	103	129	114	142	124	155
26	23	29	29	37	35	44	47	59	59	74	71	89	83	104	95	119	107	134	119	149	132	164	143	179
29	26	33	33	42	40	50	53	67	67	84	81	101	94	118	108	135	121	152	135	169	149	186	163	204
36	32	40	41	51	49	61	66	82	83	103	100	124	116	145	133	166	150	188	167	209	184	230	201	251
43	38	48	48	60	59	73	79	98	99	124	119	148	139	173	159	199	179	224	199	249	219	274	239	291

For stainless PLATECOIL approximate shipping weight: Add 50% to above for one PLATECOIL per crate, 30% for two or more per crate. Carbon steel PLATECOIL are not crated.

Standard Platecoil

SURFACE AREA AND WEIGHT CALCULATION

Calculation of Surface Area & Weight

The heat transfer surface area and total weight of any standard size, standard pass, single or double embossed PLATECOIL can be obtained readily from the tables on page 12. However, many applications may indicate the use of sizes other than those listed in the tables.

For standard pass PLATECOIL in sizes not included in the tables, the following equations permit quick calculation of surface area and weight.

Total Surface Area (sq. ft.)

$$\text{Area} = \frac{(A)\ (B)\ (2.26)}{144} = \text{sq ft}$$

where A = width in inches; B = length in inches.

NOTE: For single embossed PLATECOIL, use 2.13 as a multiplier instead of 2.26. This gives the area considering both sides of the PLATECOIL, as used in immersion applications where space limitations or other factors may require the use of single embossed construction. For external clamp-on installations or single embossed tank wall sections, only the flat side area should be considered; the heat transfer surface area becomes simply:

$$\frac{(A)\ (B)}{144} = \text{sq ft}$$

Approximate Weight of PLATECOIL (lb)

$$\frac{(A)\ (B)\ (2)\ (W)}{144} = \text{lbs}$$

W = Weight per sq ft of material used. (refer to table below)

For single embossed PLATECOIL with companion plate thicker than the embossing, or extending beyond the embossing, or both, the equation is:

$$\frac{(A_1)\ (B_1)\ (W_1)}{144} + \frac{(A_2)\ (B_2)\ (W_2)}{144} = \text{lbs}$$

where:
A_1, B_1, W_1 equate to embossing dimensions and weight per sq ft

A_2, B_2, W_2 equate to companion plate dimensions and weight per sq ft

Fig. 13-1 **Weights of Various Metals in pounds per square foot**

	U.S. STANDARD GAUGE REVISED, OR MANUFACTURERS' STANDARD GAUGE FOR SHEET STEEL								PLATE	
	18 (0.0478")	16 (0.0598")	14 (0.0747")	12 (0.1046")	11 (0.1196")	10 (0.1345")	8 (0.1644")	7 (0.1793")	3/16 (0.1875")	1/4 (0.2500")
CARBON STEEL	2.000	2.500	3.125	4.375	5.000	5.625	6.875	7.500	7.650	10.195

	U.S. STANDARD GAUGE							PLATE	
	18 (0.0500")	16 (0.0625")	14 (0.0781")	12 (0.1094")	11 (0.1250")	10 (0.1406")	8 (0.1719")	3/16 (0.1875")	1/4 (0.2500")
STAINLESS STEEL 18-8	2.100	2.625	3.281	4.594	5.250	5.906	7.219	7.985	10.646
MONEL	2.297	2.848	3.583	5.007	5.742	6.431	7.855	8.590	11.484
NICKEL	2.311	2.865	3.604	5.037	5.776	6.470	7.902	8.642	11.553
ALLOY 20Cb-3	2.304	2.88	3.60	5.04	5.76	6.48	7.92	8.64	11.52
ALLOY B-2	2.40	3.03	3.75	5.24	6.01	6.78	8.27	9.04	12.02
ALLOY C-276	2.33	2.93	3.63	5.07	5.81	6.56	8.00	8.74	11.63
ALLOY G	2.12	2.68	3.31	4.63	5.31	5.99	7.31	7.99	10.62
INCONEL	2.210	2.740	3.450	4.820	5.530	6.150	7.510	8.210	10.970

	STANDARD THICKNESS								
	0.0236"	0.032"	0.040"	0.045"	0.050"	0.056"	0.063"	0.080"	0.090"
TITANIUM	0.554	0.751	0.938	1.056	1.173	1.314	1.478	1.877	2.112
ALUMINUM* 5052-0	0.349	0.447	0.559	0.629	0.698		0.880	1.117	1.257

NOTE: FOR CLARIFICATION ALWAYS SPECIFY 7 GAUGE OR HEAVIER BY THEIR DECIMAL EQUIVALENT THICKNESS GIVEN IN INCHES.

*Not available as PLATECOIL. Included for reference only.

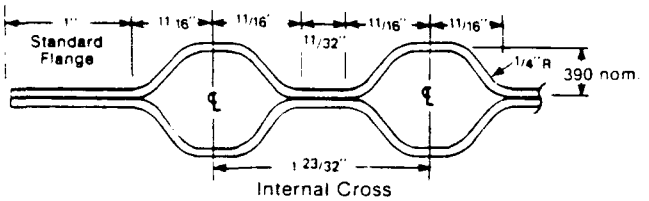
Standard Platecoil

PASS SIZE & HEADER DIMENSIONS

The embossings used for Standard Style PLATECOIL form what is termed a ¾" size passage, or pass. This pass size is approximately equivalent in area to ¾" steel pipe for double embossed units and ½" steel pipe for single embossed units. Refer to Fig. 14-1 and 14-2 for detailed dimensional information on pass configurations. Note Figure 14-3 concerning area data on headers. Large pass size Special PLATECOIL are also available. See page 21 for details.

Fig. 14-1

DOUBLE EMBOSSED

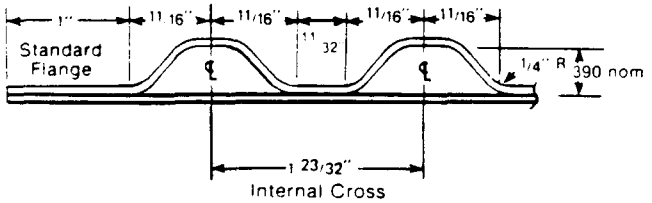


Internal Cross Sectional Area = 0.582 Sq. In. nom.

Actual area varies with gauge and material.

Fig. 14-2

SINGLE EMBOSSED



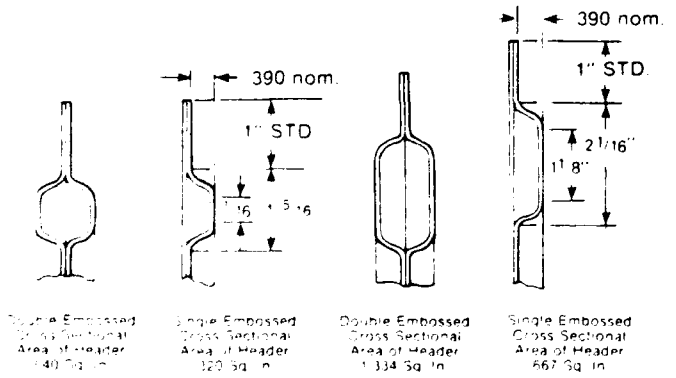
Internal Cross Sectional Area = 0.291 Sq. In. nom.

Actual area varies with gauge and material.

Fig. 14-3

Header Details

#320 Header #667 Header



Single Embossed Cross Sectional Area of Header 140 Sq. In.

Single Embossed Cross Sectional Area of Header 320 Sq. In.

Double Embossed Cross Sectional Area of Header 1.334 Sq. In.

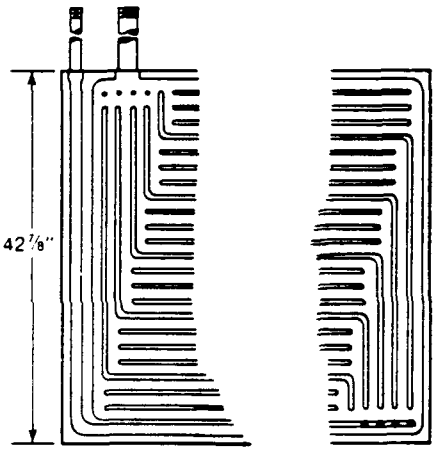
Single Embossed Cross Sectional Area of Header 667 Sq. In.

All areas vary with gauge and material

Number of Zones and Passes per Zone for Standard (¾" Pass) Multi-Zone PLATECOIL.

Fig. 14-4

Multi-Zone Data



43" Wide PLATECOIL
Depicting Zone and Pass Layout

Fig. 14-5

NUMBER OF ZONES AND PASSES PER ZONE FOR STANDARD MULTIZONE PLATECOIL

Nominal Width Inches	Number of Zones	Number of Passes Per Zone Counting From Top to Bottom of "Platecoil" ★	Total Number of Passes
12	2	3, 3	6
18	3	4, 3, 3	10
22	3	4, 4, 4	12
26	4	2, 4, 4, 4	14
29	4	4, 4, 4, 4	16
36	5	4, 4, 4, 4, 4	20
43	6	4, 4, 4, 4, 4, 4	24

★Last Zone includes condensate pass for Styles 90 and 70.

Standard Platecoil

Handles

One or two handles (Fig. 15-1) are furnished as standard on PLATECOIL Styles 90, 70 and 50. Unless specified, they are not furnished on Styles 80 or 60, or on Single Embossed PLATECOIL.

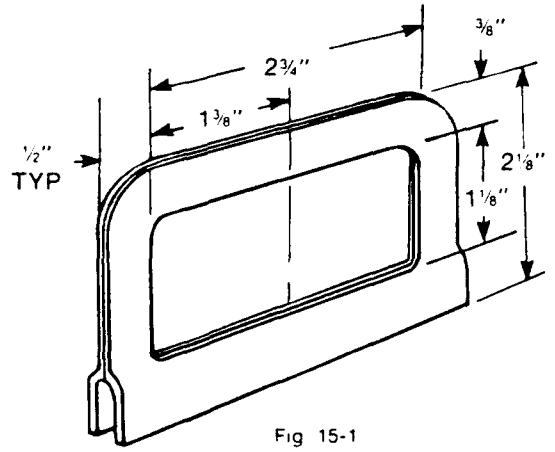


Fig 15-1
Standard Handle*

See pages 7 through 11 for locations on PLATECOIL.
*Normally furnished; however ROD TYPE may be specified at no extra cost. ROD TYPE are furnished whenever a perimeter seal weld is required. Dimensions are basically the same as standard handles.

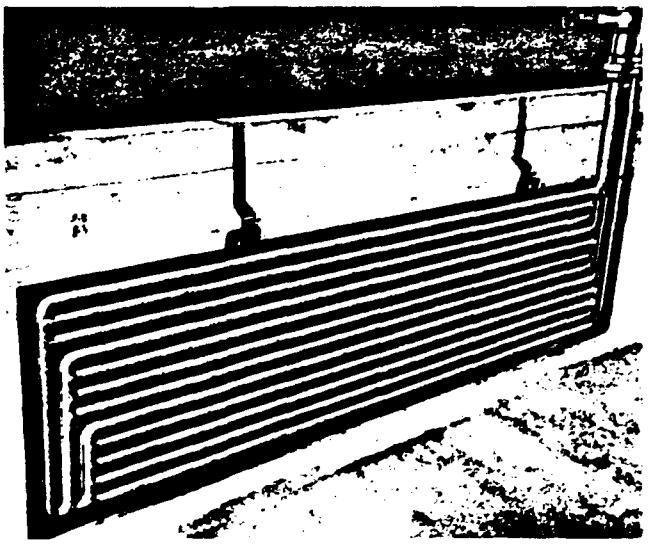


Fig 15-2
Typical installation in a tank showing the use of QUICK CHANGE PLATECOIL hangers with a Style 90

Hangers

PLATECOIL "Quick Change" hangers are designed as a convenient, economical means of supporting PLATECOIL at the proper distance from the tank wall. They are constructed of the same material as the PLATECOIL with which they are used.

Two standard hanger models are available. No. 5504 is for use with PLATECOIL of 22 inch width, or less. They are fabricated from 14 ga. carbon steel and 16 ga. stainless steel and other alloys.

No. 8804 is for use with PLATECOIL widths of 26 inches thru 43 inches. They are fabricated from 14 ga. carbon steel and 16 ga. stainless steel and other alloys.

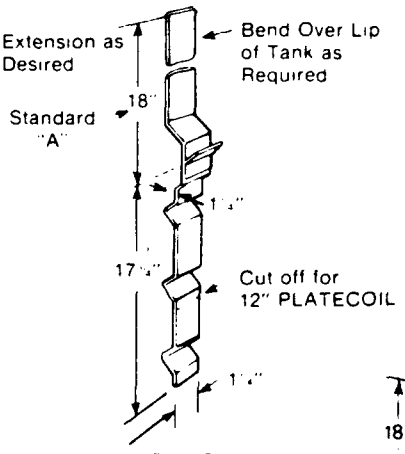


Fig 15-3
Hanger No. 5504-18

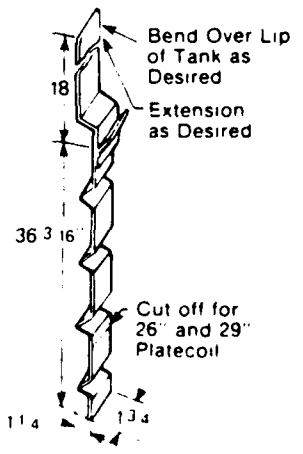


Fig 15-4
Hanger No. 8804-18

NOTE: The '-18' indicates the standard extension length. If longer extension is required, indicate by changing, i.e. -30 would indicate 12 inches longer than standard. Specify material when ordering.

Standard Platecoil

INTERNAL OPERATING PRESSURES FOR STANDARD (¾" Pass) PLATECOIL

Fig. 16-1

Gauge		CARBON STEEL	304, 304L, 316, 316L, MONEL
Double Embossed		PSI	PSI
16		180	250
14		300	330
12		400	400
Single Embossed			
Embossing	Companion	PSI	PSI
16	16	130	160
16	14	145	190
16	12	180	205
16	11	205	240
14	14	190	240
14	12	215	270
14	11 & over	265	290
12	12 & over	265	300

Applicable to Style 70, 80 & 90 MULTI-ZONE and 320 header and Style 50 & 60 serpentine pass.
ASME code pressure ratings are available from the factory upon request.

1 Standard test pressure is 250 psig air under water. For pressures above 250 psig hydrostatic tests are performed.
2 Ratings for carbon steel apply up to 650° F and are based on a 4 to 1 or greater safety factor without corrosion allowance.
3 Ratings for stainless steel and Monel apply up to saturated steam temperature for pressures shown with 5 to 1 or greater safety factor without corrosion allowance.
4 All pressures shown apply for resistance welding and for MIG welding when gauges permit.
5 For #667 header PLATECOIL use 50% of the operating pressures shown
6 FABRICATION TECHNIQUES MAY PERMIT HIGHER OPERATING PRESSURES IN CERTAIN CASES

EXTERNAL PRESSURE RATINGS FOR STANDARD (¾" Pass) PLATECOIL

For use in pressure vessels and other miscellaneous applications external pressure ratings become important considerations. The values shown in the chart are maximums at room temperature. No safety factor is included If elevated temperatures are involved, contact the factory.

Fig. 16-2 **External Pressure Ratings**

STYLE	CARBON STEEL		STAINLESS STEEL	
	Gauge	External PSI	Gauge	External PSI
Double Embossed	14/14	600	16/16	400
	12/12	1400	14/14	600
Single Embossed	14/12	800	16/14	400
	12/12	1000	14/14	400
	—	—	14/12	800

LEAK & PRESSURE TEST OPTIONS

All PLATECOIL receive an Air-Under-Water Leak Test. The PLATECOIL are immersed in a water filled tank which also contains a leak detection agent. Air pressure is applied internally and the water is watched for bubbles. This test has proven superior to a hydrostatic test, since leaks can be more easily detected. This test is effective in checking for leak rates as low as 1×10^{-4} air atmospheric cc/sec.

A variety of other leak test procedures, as may be required, are also available. The usage for which the PLATECOIL are intended will generally determine what combination of these tests should be used. They are described as follows:

Hydrostatic Test

The PLATECOIL is filled with water and a pump builds up pressure internally. The exterior surfaces are checked for leaks. This test is used for test pressures above 250 psig and at lower pressures when specified by the customer. In addition, it is always required for ASME code stamped PLATECOIL.

Halogen Leak Test

This test is sometimes referred to as a Freon test and is generally required for refrigeration applications. The test is performed in a special booth and the PLATECOIL is charged with R-12 at 80 to 90 psig. A special gun is passed over external surface to check for leaks. This test is effective in checking for leak rates as low as 1×10^{-5} air atmospheric cc/sec.

Mass Spectrometer Test

This is the most sensitive leak test procedure used and is required for PLATECOIL for cryogenic service. The PLATEOCOIL is sprayed with helium or placed in a helium filled enclosure and a vacuum pulled on the PLATECOIL passes. Any helium that can leak into the passes is picked up by the machine and shows up as a leak rate on the indicator. Leak rates as low as 1×10^{-9} helium atmospheric cc/sec. can be detected.

Analysis of Sensitivity of Tests

A Halogen test at 10^{-5} air atmospheric cc/sec. is 10 times as sensitive as the 10^{-4} air under water test. The mass spectrometer test at 10^{-9} helium atmospheric cc/sec. is one hundred thousand times as sensitive as the 10^{-4} air under water test.

NOTE. Dye penetrant tests can be made to check welds for surface porosity, slag or cracks.

Standard Platecoil

ASME CODE STAMPED PLATECOIL

PLATECOIL and PLATECOIL products can be code stamped with the ASME "U" stamp, "UM" stamp, or "H" stamp.

The "U" stamp signifies that the product has been manufactured in compliance with the ASME Boiler and Pressure Vessel Code Section VIII, Div. 1 and that it has been inspected by an authorized inspector.

The "UM" stamp also signifies that the product has been manufactured in compliance with the ASME Boiler and Pressure Vessel Code but was exempted from code inspection.

The "H" stamp signifies that the product has been manufactured in compliance with the ASME Boiler and Pressure Vessel Code, Section IV, "Hot Water Heating Boilers", and that it has been inspected by an authorized inspector. (Carbon steel only)

On PLATECOIL and PLATECOIL products code stamped with the "U" stamp (not "UM" or "H" stamp) a National Board Number will be supplied if required by State and Local Boiler Codes, and registered with the National Board of Boiler and Pressure Vessel Inspectors (NB). National Board registration can also be provided in those cases where registration is not required by local or state codes but has been requested by the customer.

Code stamping of any type should be requested at the time of order if it is required. Please check State and Local Boiler Codes before specifying a code stamp.

Resistance welded and mig welded PLATECOIL are code stamped in accordance with the ASME Code Section VIII Division 1, appendix 14.

Other PLATECOIL fabrications can be code stamped if assembled by conventional processes covered by Section VIII Division 1 of the ASME Unfired Pressure Vessel Code or Section IV Hot Water Heating Boilers.

Shipment

Generally, any Code Stamped PLATECOIL product will be processed in a special manner and may require one to two weeks longer than normal fabrication times.

Applications

PLATECOIL can be code stamped per the limitations below when used for the containment of substances other than those defined as lethal substances by Section VIII, Div. 1, Par. UW-2(a).

Code Stamp Marking Data

All PLATECOIL furnished with the code stamp will be marked by metal stamps on the flange between the fittings (whenever possible—otherwise the most appropriate flange or location). Markings will be as noted below with pressure, temperature, and serial number blanks filled in.

U-1A certificates are furnished with the "U" stamp and U-3 certificates with the "UM" stamp. U-2 certificates are supplied with components that will be incorporated into completed products by other manufacturers. H-3 certificates are supplied with the "H" stamp. These forms are supplied in triplicate.

Fig. 17-1 **ASME NAMEPLATE**

"PLATECOIL" Manufactured by Texas Division, Tranter, inc., Wichita Falls, TX	Max. Allow. Working P.S.I. AT ° Year 19 Mfg. Ser. Nat. Bd. Ser.	U UM H

"U", "UM" or "H" symbol shown above is applied as required. They are the official symbols of the stamp to denote the American Society of Mechanical Engineers Standard.

Fig. 17-2 **ASME MATERIALS FOR PLATECOIL**

WELDING METHOD	GAUGES	MATERIALS
Resistance Welded: Per ASME Sec VIII Div 1 Appendix 14	.045" minimum "t" nominal-maximum or any combination not exceeding this min or max	CARBON STEEL: SA-414 (0.15% C Max.) STAINLESS STEELS: SA—240 Types 302, 304, 304L, 316, 316L NONFERROUS METALS: Monel 400, Nickel 200, Inconel 600, Incoloys 800 & 825, Alloys B-2, X, 625, C-20Cb-3, C-4, C-276, G, 904L
MIG Welded: Per ASME Sec VIII Div 1 Appendix 14	Embossing .045 min .130 max Companion .130 min no max	CARBON STEELS: SA-414 (0.15% C Max.), SA-515 (0.25% C Max.), SA-516 (0.25% C Max.) STAINLESS STEELS: SA-240 Types 302, 304, 304L, 316, 316L, 309S, 310S, 317, 317L, 321, 347, 348, XM15 NONFERROUS METALS: Inconel 600, Incoloy 800, Incoloy 825, Alloys B-2, X, 625, C-20Cb-3, C-4, C-276, G, 904L

Standard Platecoil

FLATNESS STANDARDS FOR STANDARD (¾" Pass) SINGLE EMBOSSED PLATECOIL

The table below shows normal flatness standards for resistance welded single embossed PLATECOIL with standard 1" wide perimeter flanges. These measurements are made by laying the PLATECOIL on a flat surface with the flat side down. The fractions shown represent the maximum distance that any part of the flat side of the PLATECOIL, in a free state, will be from the flat surface.

These figures are maximum deviations from the flat surface and are not ± tolerances.

By holding all 4 corners and the sides down these tolerances will be reduced to approximately ½ of the amounts shown. A similar result can be obtained by affixing the PLATECOIL to a flat framework at installation.

Contact factory if closer flatness tolerances are needed. Heavier gauge companions, special processing and/or stiffener bars are methods used.

Flatness Standards (¾" Pass)
16/16 STAINLESS STEEL ANNEALED AND 14/14 CARBON STEEL

Fig. 18-1

	Width						
Length	12"	18"	22"	26"	29"	36"	43"
23	3/16	1/4	1/4	1/4	1/4	5/16	5/16
29	1/4	1/4	1/4	5/16	5/16	3/8	7/16
35	1/4	1/4	5/16	5/16	3/8	7/16	7/16
47	5/16	5/16	3/8	7/16	7/16	1/2	9/16
59	5/16	3/8	7/16	1/2	1/2	9/16	5/8
71	3/8	7/16	1/2	9/16	9/16	11/16	3/4
83	7/16	1/2	9/16	5/8	11/16	3/4	7/8
95	1/2	9/16	5/8	11/16	3/4	7/8	1
107	9/16	5/8	11/16	3/4	13/16	1	1-1/16
119	9/16	11/16	3/4	7/8	7/8	1	1-1/8
131	5/8	3/4	13/16	1	1	1-1/8	1-1/4
143	11/16	13/16	7/8	1	1-1/16	1-1/8	1-5/16

VOLUMETRIC DISPLACEMENT AND INTERNAL VOLUME OF PLATECOIL

Fig. 18-2

	cu in/sq ft nom.	gal/sq ft nom.
Internal Volume		
Double embossed	46	.20
single embossed	23	.10
Displacement		
Double embossed	64	.28
Single embossed	41	.18

These values are for one sq ft of PLATECOIL based on length x width (do not use total of both side areas) and apply to standard pass PLATECOIL of 14 or 16 gauge construction.

PRESSURE DROP DATA FOR STANDARD (¾" Pass) PLATECOIL

Details on pressure drop involving all Styles of PLATECOIL, single and double embossed, standard units can be obtained from the charts appearing on page 82 and 83 of the PLATECOIL Heat Transfer Design Data Section.

ACCESSORIES & OPTIONAL FEATURES

A variety of accessories such as mounting lugs, special fittings, and tie-rod assemblies can be ordered for use with PLATECOIL. These are described on pages 22 and 25.

PLATECOIL can also be made available with special surface finishes and coatings. Stainless Steel units, for instance, can be provided with an electropolished finish. PLATECOIL can also be rolled or curved, specially welded and tested. All these options are described on page 23.

In addition, PLATECOIL is available on a special order basis in a variety of gauges and materials other than carbon steel and stainless steel. A complete list of optional materials is shown on page 26.

Platecoil Accessories and Optional Features

MOUNTING LUGS

PLATECOIL mounting lugs are used extensively for mounting purposes. Standard lugs are illustrated in Fig. 22-1 and adaptations and attachment locations are shown in Fig. 22-2. These lugs are generally used as follows:

L-1E—Used on end or side of PLATECOIL for clamping them tightly to tanks or vessels. the usual lug spacing on the side is 30 inches. Generally the PLATECOIL are single embossed and rolled.

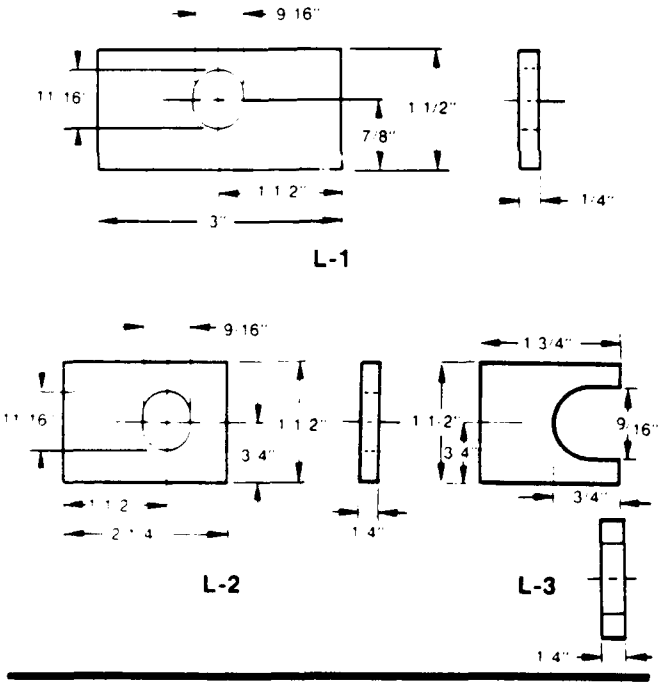
L-2F—Foot type support for PLATECOIL installed on end.

L-2FX—Same as L-2F except a 3 inch leg is added (height can be varied) to provide clearance above tank bottoms, especially in agitated tanks.

L-3S—Generally used to attach flat PLATECOIL to flat surfaces.

L-3S—Generally used to attach PLATECOIL to dished heads.

Fig. 22-1 **Lug Dimensions**



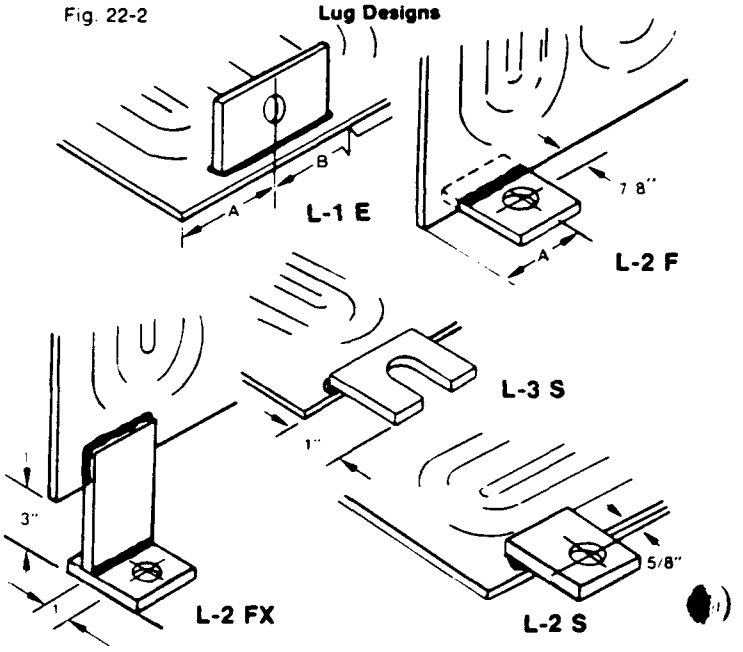
Standard Mounting Dimensions for All Lugs on Ends of PLATECOIL

Fig. 22-5

PLATECOIL width	A Dim. See Fig 22-2	B Dim. C/L of Lugs
12" 2 Lugs/End	3½	5
18" 2 Lugs/End	4⅛	10½
22" 2 Lugs/End	4⅛	14
26" 2 Lugs/End	4⅛	16
29" 2 Lugs/End	5⁹/₁₆	18
36" 3 Lugs/End	5	13*
43" 3 Lugs/End	5⁷/₁₆	16*

*Three lugs on these widths, third lug on C/L of PLATECOIL. B dim. doesn't apply to lugs on sides.

Fig. 22-2 **Lug Designs**



TIE ROD ASSEMBLIES

Standard tie rod assemblies are available with or without springs. In cases where thermal expansion or contraction may be appreciable, the spring loaded tie rods help maintain maximum contact.

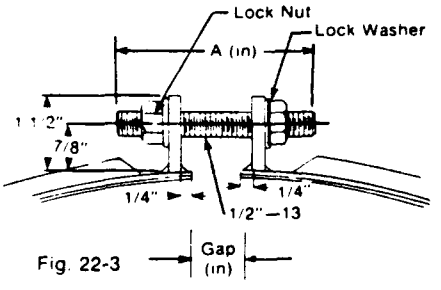


Fig. 22-3

A	GAP
4	1.5
6	3.5
8	5.5
10	7.5
12	9.5
14	11.5
16	13.5

Installed View L-1 E Lugs with Tie Rod Assembly

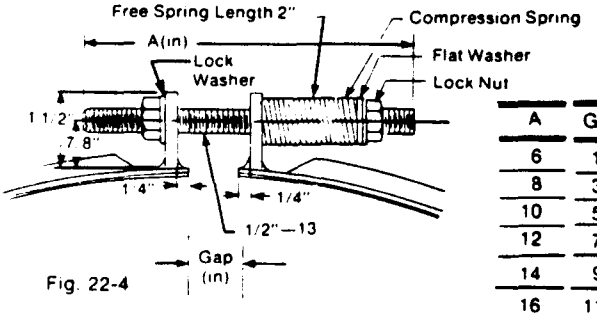


Fig. 22-4

A	GAP
6	1.5
8	3.5
10	5.5
12	7.5
14	9.5
16	11.5

Installed View L-1 E Lugs with Spring Loaded Tie Rod Assembly

Platecoil Accessories and Optional Features

ROLLING AND CURVING

PLATECOIL's unique design versatility allows it to be curved and/or rolled to specific radii. Both single and double embossed units can be furnished with either dimension curved. Standard terminology is:

"length curved to ..." + ¼" – 0" (usually inside radius)"
"width curved to ..." + ½" – 0" (usually inside radius)"
In some cases closer tolerances can be held for radii.

Standard ¾" Pass PLATECOIL Curving Limits
Fig 23-1 (Minimum Radii)

Style	Single Embossed*	Double Embossed
50 & 60 Serpentine	4"	8"
Multi-Zone & No. 320 Header	6"	9"
No. 667 Header	8"	10"

*Companion plate may be on either inside or outside of curvature. Specify when ordering.

In some cases it is important to define curving with regard to right hand or left hand. This is particularly true when double embossed PLATECOIL are formed to go in a cylindrical tank. When viewed from the concave side (inside of the curvature) the location of the fittings determines the hand. See Fig. 23-2.

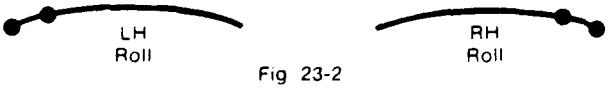


Fig 23-2
LH & RH Rolling

PERIMETER SEAL WELD

When fabricating PLATECOIL, a slight separation may occur between the outside edges of the two metal plate components. If necessary, these outside edges can be sealed utilizing the following processes:

a. #160 PERIMETER WELD. The edge is sealed by means of a bead weld. The bead weld is wire brushed, but not ground or polished. Handles are rod type.

b. #180 PERIMETER WELD. This is basically the same as the #160, but in addition, all welds are ground to eliminate sharp edges, burrs and sharp depressions. Handles are rod type.

c. CRYOGENIC EDGE WELD. This process includes a skip seam structural weld, plus a fillet bead weld. See page 61 for further details.

SURFACE FINISH OPTIONS

A variety of surface finishes can be provided on PLATECOIL units to comply with specific application requirements. These include the following:

A. Electropolish. This is an economical chemically applied finish for stainless steel. The finish is bright and generally considered to provide an emissivity of about .1. It is generally equivalent to a 2B finish, but does not entirely eliminate seam and spot weld marks. Electropolished PLATECOIL are regularly used in phosphatizing solutions to reduce scaling and permit easier cleaning. It is also used in some food processes, white water heating, and for reflective surfaces on cryogenic shrouds.

B. Paint. PLATECOIL are occasionally painted for surface protection, prime coats, or for reflective or absorptive purposes. Baking facilities are available.

C. Galvanizing and Zinc Metalizing. These protective coatings are frequently used with carbon steel PLATECOIL, particularly where rusting is objectionable. Of the two, galvanizing is a denser, smoother finish. A #160 perimeter seal weld is required for PLATECOIL that are to be galvanized. Tranter does not normally furnish these coatings but will ship direct to an applicator.

D. Coatings. Various concerns throughout the country apply lead, plastic or glass enamel coatings to PLATECOIL. A perimeter weld and rod handles are required for PLATECOIL which are to be coated. Such coatings can be damaged by rough handling or use and users should be careful to guard against such damage. Plastic and enamel coatings are used more to reduce fouling than for corrosion resistance. Tranter, inc. prepares PLATECOIL for coating by others and each is individually leak tested before shipment. BECAUSE OF DAMAGE THAT MAY OCCUR TO THE COATING DURING HANDLING OR OPERATION, TRANTER, INC. ACCEPTS NO RESPONSIBILITY FOR ANY COATED PLATECOIL OR THE COATING.

PLATECOIL FOR REFRIGERATION

A. INTERNAL CLEAN, DRY AND SEAL is generally desirable for PLATECOIL being used with a refrigerant. Sealing is by means of plastic caps.

B. HALOGEN (FREON) leak testing is often desirable. See page 16.

Both A and B above are recommended and should be specified for PLATECOIL to be used in refrigeration service.

Platecoil Materials Selection & Fabrication Techniques

OPTIONAL PLATECOIL MATERIALS

In addition to carbon and stainless steels, PLATECOIL can also be fabricated from the materials listed below. The nominal compositions are shown as well as the most common applications. Consult the Material Selection Chart (pages 27-30) for detailed application data. The evaluations shown below are general and are not specific recommendations.

Monel 400 (SB-127)

This nickel-copper alloy is most commonly used for medium-concentration caustic solutions, and for miscellaneous applications in the chemical and other industries. Composition: 67% nickel, 30% copper, 1.4% iron, 1% manganese, .1% silicon, .15% carbon.

Nickel 200 (SB-162)

Nickel 200 can be used with concentrated caustics over a wide temperature range as well as other industrial usages.

Inconel 600 (SB-168)

Resists corrosion by many inorganic and organic compounds throughout wide ranges of acidity and alkalinity. Remains bright under exposure to sulfur compounds in the atmosphere, provides resistance to oxidizing atmospheres at elevated temperatures. Composition: 72% nickel, 14 to 17% chromium, 6 to 10% iron, 1% manganese, small amounts of copper, silicon, carbon, and sulfur.

Alloy B-2 (SB-333)

A nickel base alloy developed primarily for corrosion resistance to hydrochloric acid. However, the presence of ferric and cupric salts can cause rapid corrosion. All potential applications should be checked with coupons, which are available from the factory. Also possesses valuable high temperature properties. Composition: 60% nickel, 1% chromium, 26 to 30% molybdenum, 4 to 7% iron and a maximum of 1% silicon, 1% manganese, .12% carbon.

Alloy C-276 (SB-575)

One of the more universally corrosion-resistant alloys and has excellent high temperature properties. Particularly useful where parts are either highly stressed or subject to repeated thermal shock at high temperatures. Composition: 50% nickel, 15 to 17% chromium, 16 to 18% molybdenum. The balance consists of iron.

Alloy G (SB-582)

It can handle both acid and alkaline solutions and will resist pitting and stress-corrosion cracking in chloride solutions. Composition: 44 to 47% nickel, 2½% cobalt, 21 to 23% chromium, 5 to 7% molybdenum, 1% tungsten, about 18% iron and small amounts of silicon, manganese, and carbon.

Titanium (SB-265)

A highly corrosion resistant material for use in many chemical solutions, especially those containing chlorides. See page 97 and our separate Bulletin on titanium heating and cooling coils. (Available only in ECONOCOIL construction.)

Alloy 20Cb-3 (SB-463)

Primarily used in sulfuric acid pickling solutions. Composition: 35% nickel, 3% copper, 20% chromium, 2% molybdenum. The balance consists of iron and small amounts of silicon, manganese, carbon and columbium.

PLATECOIL fabricated from Alloy 20Cb-3 is a logical choice for highly corrosive applications such as sulfuric acid steel pickling. However, slight variations in operating conditions can cause severe adverse effects with regard to corrosion rates of this alloy.

Alloy 20Cb-3 PLATECOIL, as shipped, are full solution annealed, passivated and in their most corrosion resistant condition, and are of 14 ga. for extra life.

Sulfuric acid pickling solutions and other formulations for which Alloy 20Cb-3 PLATECOIL are used are almost always very corrosive. Corrosion rates increase greatly with temperature so longer life will be obtained by using low steam pressures. 15 psig is a desirable maximum for corrosive duty. In addition, the PLATECOIL should be sized for a one hour heat-up period or less, so that the steam will be on less. Traps and controls should be kept in good working order and set at as low a temperature as possible. Keep chloride content below 100 ppm and dissolved iron content below 8% by weight. Dip type systems should be aerated.

To alert all concerned to the need for careful attention to Alloy 20Cb-3 PLATECOIL installations, *the following precautionary clause is made a part of all quotations and is on all order acknowledgements for PLATECOIL of this alloy:*

PRECAUTIONARY CLAUSE - IMPORTANT

"Because Alloy 20Cb-3 PLATECOIL are normally used in very corrosive solutions in which small variations in operating conditions can substantially affect the corrosion rates of these PLATECOIL, Tranter, inc. assumes no responsibility for corrosion resistance or life span of these PLATECOIL in any solution. We warrant the PLATECOIL to be free from defects in material and workmanship for a period of twelve months from installation or eighteen months from shipment, whichever occurs first. Please refer to Technical Data Manual 5-63, page 26, for sizing and operating suggestions."

Platecoil Materials Selection and Fabrication Techniques

PLATECOIL MATERIAL SELECTION CHARTS

Material selection charts are presented here to assist in determining the most suitable material for various environments.

The first chart (Fig. 27-1) is a practical listing of Common Metal Finishing Solutions. Many of these involve complex mixtures of chemicals so they are presented separately. The materials shown are generally used for the solutions shown.

Some ratings shown in the general material selection chart are the result of laboratory tests conducted by suspending samples of the material in the solution. Therefore, they are not subject to the high temperatures often encountered when heating with PLATECOIL. In addition, operating conditions present many variables such as aeration, solution contaminants, and galvanic action which may alter the ratings given. The metallurgical departments of each of the suppliers of the materials listed have either given or approved the ratings assigned, but because of the points mentioned above, the ratings should be considered as only a guide.

In no instance, for either chart, should the ratings be considered as the basis for a guarantee of PLATECOIL life.

Fig 27-1
Material Selection Guide for Common Metal Finishing Solutions

SOLUTION	PREFERRED MATERIAL	POSSIBLE
1. Aluminum Bright Dip	316 SS	347SS
2. Aluminum Anodizing Hot Seal Tank	316SS	304SS
3. Brass Plating	Carbon Steel	
4. Bronze Plating	Carbon Steel	
5. Caustic or Alkali Cleaning (low conc.)	Carbon Steel	
6. Caustic or Alkali Cleaning to 15%	Monel	Stress relieved Carbon Steel

(Material Selection Guide for Common Metal Finishing Solutions, Cont'd)

SOLUTION	PREFERRED MATERIAL	POSSIBLE
7. Caustic Paint Stripper 15-30%	Nickel or Monel	Stress relieved Carbon Steel
8. Chromic Acid Anodizing	Carbon Steel	
9. Chromic Acid Rinse	Carbon Steel	
10. Sulphate Type Chromium Plating	Titanium	
11. Cyanide Cadmium Plating	Carbon Steel	
12. Cyanide Zinc Plating	Carbon Steel	
13. Cyanide Copper Plating	Carbon Steel	316 SS
14. Dichromate Seal Tank	Carbon Steel	
15. Dye for Coloring Anodized Aluminum	316 SS	
16. Dye Seal Tank	316 SS	
17. Fluoborate Copper Plating	None	
18. Galvanizing Flux (Zinc Ammonium Chloride)	Titanium	
19. Nickel Plating (all but high Fluorine types)	Titanium	
20. Phosphatizing	316 SS (electro-polished)	
21. Sulphuric Acid Anodizing 72F	316 SS	Cathodically Connected (see Fig. 51-2)
22. Sulphuric Acid Copper Plating	Alloy 20Cb-3 or Alloy 825	316 SS
23. Sulphuric Acid Pickling (no chlorides) Steel parts	Alloy 20Cb-3 or Alloy 825 (with caution)	
24. Sulphuric Acid Pickling with Copper Sulphate (non-ferrous parts)	316 SS or Alloy 20Cb-3	
25. White Brass Alloy Plating	Carbon Steel	

Platecoil Materials Selection and Fabrication Techniques

GENERAL MATERIALS SELECTION CHART

Fig. 28-1

Corrosive Media	Temperature Degrees F	Fully Resistant	Satisfactorily Resistant	Slightly Resistant	Non Resistant
Acetic Acid 80 100%	Boiling	3.6.8.9	2.7	4.5	1
Alcohol-Ethyl		2.3.4.5.9	1		
Aluminum Chloride	70	7	3.4.5.6.8.9	2*	1
Aluminum Hydroxide Saturated		2.3.4.5	9		
Aluminum Sulphate 10%	Boiling	3.6.8	2.4.9	5	1
Saturated	Boiling	3.6.8	2.4.9	5	1
Ammonium Hydroxide		2.3.5.6.7.8.9	1		4
Ammonia (All Conc.)	Boiling	1.2.3.9	5		4
Dry	Boiling	2.3.9	4.5.7.8		
Ammonium Sulphate 10%	Boiling	3.6.8.9	2*.4	5	1
Saturated	Boiling	3.6.8.9	2*.4	5	1
Ammonium Sulphate (Conc.)	Boiling	2*.3.6	4.8.9	5	1.7
Aniline 3%	70	2.3.6.7.8.9	1.5		
Conc. Crude	70	2.3.6.7.8.9	5		
Asphalt		2.3.4.5.9	1		
Barium Chloride 5%	70	3.6*.8.9	2*.4.5.7		1
Saturated	70	3.6*.7	2*.4.5.8.9		1
Beer (All Conc. & Temp.)		2.3.5.7.8.9	4		1
Benzene	70	2.3.4.5.9	1.7.8		
Borax 5%	Hot	2.3.4.9	1.5.7.8		
Boric Acid (Conc.)	Boiling	2*.3.6.7.8	4.5		1
Calcium Brine Adulterated with Sodium Chloride	70	2*.3.5.6*.7.9	4.8		1
Calcium Chloride Dilute	70	2*.3.4.5.6*.7.8.9			1
Conc	70	2*.3.5.6*.7.8.9	4		1
Saturated	212	2*.3*.6*.7.8	4.5.9		1
Calcium Hydroxide 50%	Boiling	2.3.4.5.7.8.9			1
Carbolic Acid Phenol	72	2.3.5.9			
CP	Boiling	2.3.5	4		
Raw	Boiling	2.3.5	4		1
Carbon Dioxide Dry		2.3.4.5.7.8.9			
Wet		2.3.9	4.5		
Carbonated Water		2.3.4.5.6.7.8.9			
Carbon Disulphide		2.3.9	4.5		
Carbon Tetrachloride Pure (dry)	Boiling	2.3.4.5.6.7.8.9	1		
Aqueous Solution 5 10%	70	3.4.5.9			
Chlorinated Water Saturated	70	8.9	2.6	3*.4.5	1.7
Chlorine Gas Dry	70	2.3.4.5.6.7.8	1		9
Moist	70	8.9		2	1.3.4.5.6.7
Moist	212	9	8		2.3.4.5.6.7
Chromic Acid CP 10% free of SO_3	70	3.8.9	2	6	1.4.5.7
CP 10% free of SO_3	Boiling	9		3.6	1.2.4.5.7.8
CP 50% free of SO_3	70	3.8.9	2	6	1.4.5.7
CP 50% free of SO_3	Boiling			3.6	1.2.4.5.7.8
Commercial 50%	70	3.8.9	2	6	1.4.5.7
(contains SO_3)	Boiling			3.6	1.2.4.5.7.8
Citric Acid 10%	Boiling	2.3.6.7.8.9	4.5		1
50%	Boiling	2.3.6.7.8.9	4.5		1
Copper Chloride 10%	Boiling	8.9			2.3.4.5
Copper Cyanide 5%		9	1		
Saturated	Boiling	2.3.6.7.8.9	4.5		
Copper Nitrate 50%	Hot	2.3.6.9			1.4.5.7
Copper Sulphate (Sat.) (Blue Vitriol)	Boiling	2.3.6.8.9		4	1.5
Creosote (coal tar)	Hot	2.3.9	1.5	4	
Cupric Chloride		9	2*.8		1.3.4.5.6.7
Dowtherm	Hot	2.3.4.5	1		
Dyes	190	2	4.5		
Esters		2.3.4.5.9			
Ether	70	2.3.4.5.7.8.9	1		
Ethylene Glycol Conc.	70	2.3.4.5.7.8.9	1		
Fats	to 500	2.3.6.9	4.5		1
Ferric Chloride 1%	70	9	2*	3*.5.8	1.4.6.7
1%	Boiling	9		2.8	1.3.4.5.6.7
5%	70	8.9		2.3*	1.4.5.6.7
Ferric Nitrate to 5% Aerated	70	2.3.8.9			1.4.5.7
Ferrous Chloride Saturated	70	7.8.9	3.4.5	2	
Fluorine	70	5 dry only	3.4 dry only. 7.8		1.2.9
Fluoborate Plating Sol.			3.6	2.5	
Formaldehyde 40%	70	2*.3.5.6.7.8.9	1.4		
	Boiling	2*.3.6.9	1.4.5.7.8		

Key to Metals

1. **Carbon Steel**
2. **316 Stainless Steel**
3. **Alloy 825**
4. **Monel**
5. **Nickel**
6. **Alloy 20Cb-3**
7. **Alloy B-2**
8. **Alloy C-276**
9. **Titanium**

NOTE: Pitting may occur particularly if scale is allowed to build up

CP=Chemically Pure

Fully resistant is less than .0044 inches per year

*Coupon testing important to check for possible presence of ferric or cupric ions.

(a) Aeration will have very detrimental effect on Monel.
(b) May be fully resistant when oxidizing inhibitors are present.
(c) Both 316 SS and Alloy 20Cb-3 may be subject to stress corrosion cracking.
(d) Titanium may be subject to Hydrogen embrittlement under certain conditions.
(e) Titanium may be fully resistant under certain conditions while it may react violently with others. Consult Manufacturer and USE CAUTION IN TESTING.
(f) Small traces of chlorides, particularly in sulphuric acid steel pickling solutions may cause excessive pitting.
(g) Titanium may be fully resistant when traces of oxidizing inhibitors are present.
(h) Provided no moisture is present.

In no instance should the ratings be considered as the basis for a guarantee of PLATECOIL life.

Platecoil Materials Selection and Fabrication Techniques

GENERAL MATERIALS SELECTION CHART — continued

Corrosive Media	Temperature Degrees F	Fully Resistant	Satisfactorily Resistant	Slightly Resistant	Non Resistant
Freon		2,3,4,5,9	1		
Fruit Juices	Hot	2,3,5,9	4		1
Fuel Oil	Hot	2,3,4,5,7,8,9	1		
Glue	Hot	2,3,4,5,7,8,9			1
Glucose	70	3,5,9	4		
Hydrochloric Acid 1:85	70	7*,8*,9	2,4(a),5		1,3,6
	Boiling	7*	8 to 122*,9(b)	4(a),5	1,2,3,6
Diluted 1:10	70	7*,8*	4(a),5	2,9(b)	1,3,6
Diluted 1:10	Boiling	7	8 to 122*	9(b)	1,2,3,4(a),5,6
Vapors	70		4(a),5	2	1,3,6
Vapors	212		4(a),5		1,2,3,6
Hydrofluoric Acid	70		3,4,5	2,6,7,8	1
Vapors	212		4	3,5	1,2,6,7,8,9
Hydrogen		2,3,4,5,7,8,9(d)			
Hydrogen Peroxide	70	2,3,6,8	5,7	4,9	1
	Boiling	8	2,3,5,6,7	9	1
Hydrogen Sulphide Dry	70	2,3,6,9	1,4,5,7,8		
Wet	70	3,6,9	2,4,5,7,8		1
Iodine Dry	70	2,3,5,6	8		1
Moist	70		8		1,2,3,4,5,6
Lacquers & Lacquer Solvents		3,4,5,9			1
Magnesium Chloride 1 & 5%	70	2*,3,6*,7,8 to 122*,9	4,5		1
1 & 5%	Hot	7,8 to 122*,9	3*,4,6*(c)	2(c),5	1
Magnesium Chloride 10-50%	Boiling	6*(c),7,8 to 122*,9	2*(c),3*	4,5*	
Magnesium Sulphate	70	2,3,6,7,8,9	1,4,5		
	Hot	2,3,6,7,8,9	4	5	1
Mercury (liquid)	70&125	2,3,9	5,7,8	4	
Methyl Alcohol (Methanol)	70	2,3,4,5,7,8,9	1		
	Hot	2,4,5,7,8,9			1
Milk (Fresh or Sour)		3,7,8,9		4,5	1
(Hot or Cold)		2,3,7,8,9		4,5	1
Molasses		2,3,4,5,7,8,9	1		
Mixed Acids % by wt.					
50% Sulphuric +50% Nitric	140	2,3,9			1,4,5
	200		2,9	3	1,4,5
75% Sulphuric +25% Nitric	140	2,3,9			1,4,5
	200		2,3,9		1,4,5
	Boiling			2,3,9	1,4,5
	315		9		
70% Sulphuric +10% Nitric					
+20% Water	140	2,3,9			1,4,5
	200		2,3,9		1,4,5
	Boiling			3,9	1,2,4,5
	335		9		
Naphtha	70	2,3,4,5,7,8,9	1		
Nickel Chloride Solutions	70	2*,3,7,8,9		5	1,4
Nickel Sulphate Solution	70	2*,3,9	4,5,8		1
Diluted	70				
Nitric Acid	70	2,3,6,9	8		1,4,5,7
Diluted	Boiling	2,3,6,9	8 to 150*		1,4,5,7
Diluted 1:10	70	2,3,6,9	8		1,4,5,7
Diluted 10%	Boiling	2,3,6,9	8 to 150*		1,4,5,7
Conc.	70	2,3,6,9			1,4,5,7
	Boiling	9	2,3,6		1,4,5,7
Fuming	70	2,3,6,9		5	1,4
	Boiling	9(e)	6	2,3	1,4,5
Nitrous Acid 5%	70	2,3,9	8		1,4,5,7
Oil Crude, Asphalt Base	Hot	2,3,4,9	1,5	1	
Paraffin Base	70	2,3,4,5,9	1	1	
Oil Lubricating, Lt. or Hvy.		2,3,4,5,9	1		
Oil Mineral, Hot or Cold		1,2,3,4,5,9			
Oil Vegetable, Hot or Cold		2,3,4,5,9	1		1
Oxalic Acid	70	2,3,4,6	5,7,8		1
	Boiling		3,4,7,8	2,5,6	1,9
25%	Boiling		3,4,7,8	2,5,6	1,9
50%	Boiling		3,6,7,8	2,4,5	1,9
Paraffin, Hot or Cold		2,3,4,5,7,8,9	1		
Petroleum		2,3,4,5,7,8,9		1	
Phosphoric Acid 1%	70	2,3,6,7,8,9	4,5		1
1%	Boiling	2,3,6,7,8		4,5	1
10%	Boiling	2,3,6,7,8	9	4,5	1
45%	Boiling	2,3,6,7,8		4,9	1,5
80%	140	2,3,6,7,8		9	1,4,5
80%	230	3,6,7,8		2,9	1,4,5
Photographic developers all have reducing properties, hydroquinone, amidol, ferrous, potassium, oxalate	70	2*,3,7,8,9	5	4	
	Boiling	2*,3,7,8,9	5	4	
Potassium Chloride 1%	70	2*,3,5,6*,7,8,9	4		1
	Boiling	2*,3,6*,8,9	4,5,7		1
5%	70	2*,3,5,6*,7,*,9	4		1
	Boiling	2*,3*,6*,8,9	4,5,7		1
Potassium Dichromate 25%	Boiling	2*,3,6,9	8	5	1,4
Potassium Hydroxide					
(Caustic Potash) 27%	Boiling	2,3,4,5,6	7,8,9		1
50%	Boiling	3,4,5,6	2,7,8,9		1
	Melting				
	675	4,5,6	3,7,8		1,2
Potassium Nitrate (Salt Peter) 50%	70	2,3,6	4,5,8		
50%	Boiling	2,3,6	4,5,8		

Key to Metals

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5. Nickel
6. Alloy 20Cb-3
7. Alloy B-2
8. Alloy C-276
9. Titanium

NOTE: Pitting may occur particularly if scale is allowed to build up.

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Platecoil Materials Selection and Fabrication Techniques

GENERAL MATERIALS SELECTION CHART — continued

Corrosive Media	Temperature Degrees F	Fully Resistant	Satisfactorily Resistant	Slightly Resistant	Non Resistant
Potassium Sulphate 1%	70	2.3.6.7.8	1.4.5		
5%	70	2.3.6.7.8	1.4.5		
Rosin (molten)		2.3.4.5.7.8.9			1
Salt Brine 3%	70	2*.3.6*.7.8.9	4.5		1
Sea Water	70	2*.3.4*.5*.6*.7.8.9			1
Silver Chloride		8.9			1.2.7
Shellac		2.3.4.5.9		1	
Silver Nitrate 10%		2.3.9	7.8	4.5	1
Soap	70	2.3.4.5.7.8.9	1		
Sodium Bicarbonate Baking Soda all Conc	70	2.3.5.6.7.8.9	4	1	
5%	150	2.3.5.6.7.8.9	4	1	
Sodium Carbonate (Soda Ash) 5%	Boiling	2.3.5.7.8.9	1.4		
50%	Boiling	2.3.5.7.8.9	1.4		
Sodium Chloride (Salt) Cold	70	2*.3.4.5.9	6.7.8		1
	Boiling	2*.9	3.4.5.6.7.8		1
at 212	Hot	9	2*.3.4.5.6.7.8		1
Sodium Cyanide	70	2.3.9	1.4.5		
Sodium Hydroxide 20%	70	2.3.4.5.6.7.9	1.8		
	240	2.3.4.5.6.9	7.8		1
34%	212	2.3.4.5.6	7.8.9		1
34%	Boiling	3.4.5.6	2.7.8.9		1
Sodium Sulphate (Glauber's Salt) all Conc	Hot	2.3.6.7.8.9	4.5		1
Starch Solution		2.3.5.9	1.4		
Stearic Acid	70	2.3.5.6	4	1	
	350	3.5.6.7.8.9	2.4		1
Sugar Solution	Hot	2.3.5.9	4		1
Sulphur Molten	265	1(h).9	4.5		
Sulphur Dioxide Gas Moist	70	2.3.6.8 to 158.9			1.4.5
Sulphuric Acid Diluted 1-20	70	2.3.6.7.8	4.5.9(g)		1
	Boiling		3.7	2.4.6(f).8.9(g)	1.5
1-10	70	2.3.6.7*.8*	4	5.9(g)	1
	180		3(f).6(f).7*	4.8*.9(g)	1.2.5
	Boiling		7*	3(f).4.8*.9(g).6(f)	1.2.5.
1-3	70	2.3.6.7*.8*	4	5.9(g)	1
	Boiling		7*	3(f).4.8*.9(g)	1.2.5.6(f)
Conc (93-98%)	70	2.3.6.7*.8*	1.5	4.9(g)	
	212			2.3(f).5.6(f).9(g)	1.4.7*.8*
	300			9(g)	1.2.3(f).4.5.6(f).7*.8*
Fuming (11% free SO_3)	212		2		1.4.8*
(20% free SO_3)	70	2.8*		1	4
(20% free SO_3)	160	2	8*	1	4
Sulphurous Acid Saturated	70	2.3.6.8		5	1.4.7
Sweet Water	Hot	2.3.5			
Tartaric Acid 10%	70	2.3.6.7.8.9	4.5		1
Toluene or Toluol	70	2.3.4.5		1	
Trichlorethylene Dry	70	2.3.4.5.6.8.9	7		
	Boiling	2.3.4.5.6.8.9	1.7		
Tri Sodium Phosphate 35%	70	2.3.7.8.9	4.5	1	
Turpentine Oil	95	2.3.4.5.7.8	1		
Varnish	70	2.3.4.5.7.8			
	Hot	2.3.4.5.7.8			1
Vegetable Juices		2.3.5.6.7.8.9	4		
Vinegar	Hot	2.3.6.9	4.5		1
Water	Hot	2.3.5.7.8.9	1.4		
	Oily	2.3.5.9	1.4		
	Salt	3.5.7.8.9	2*.4		
Whiskey		2.3.5.9		4	1
White Liquor		2.3.6	5	1	
Wood Pulp		2.3.9	8.10.5*	1	
Wort		2.3.5			1
Yeast		2.3.5			
Zinc Chloride Solution	100				
Sp. Grav. 2.05	100	6*.7.9	2*.3*.4.5.8		1
1.09	Boiling	6*.7.9	2*.3*.4.8	5	1
28° Be	95	6*.7.9	2*.3*.4.5.8		1
Zinc Cyanide Solution	70	2.3	1.5		
Zinc Sulphate (White Vitriol) to 50%		2.3.6	4.7.8	5	1

Key to Metals

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3. Alloy 825
4. Monel
5. Nickel
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7. Alloy B-2
8. Alloy C-276
9. *Titanium*

NOTE: Pitting may occur particularly if scale is allowed to build up.

CP: Chemically Pure

F: Fully resistant is less than .0044 inches per year

*Coupon testing important to check for possible presence of ferric or cupric ions.

(a) Aeration will have very detrimental effect on Monel.

(b) May be fully resistant when oxidizing inhibitors are present.

(c) Both 316 SS and Alloy 20Cb-3 may be subject to stress corrosion cracking.

(d) Titanium may be subject to Hydrogen embrittlement under certain conditions.

(e) Titanium may be fully resistant under certain conditions while it may react violently with others. Consult Manufacturer and USE CAUTION IN TESTING

(f) Small traces of chlorides, particularly in sulphuric acid steel pickling solutions may cause excessive pitting.

(g) Titanium may be fully resistant when traces of oxidizing inhibitors are present.

(h) Provided no moisture is present.

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Platecoil Materials Selection and Fabrication Techniques

WELDING METHODS USED TO FABRICATE PLATECOIL

Resistance Welding. PLATECOIL embossings are normally joined by resistance welding wherein the work pieces are part of an electrical circuit and the weld is made by the heat produced by the resistance of the work to the current, plus the application of pressure. Spot welding is a resistance welding process using rod shaped electrodes and is normally used at the end of passes and other restricted areas. Seam welding is a series of overlapping spot welds produced by using circular, rotating electrodes and is used between the passes and to seal the perimeter. If flatness is critical, stitch or roll spot seam welding can be used to reduce the heat, with about 1 nugget per inch.

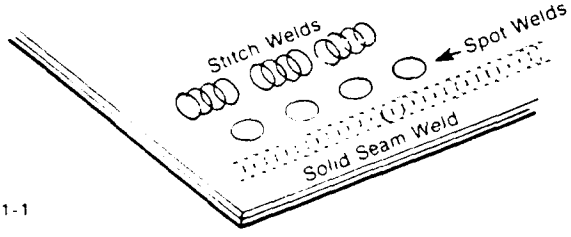


Fig. 31-1

Examples of resistance welds.

The principal methods used to join heavier sections, to seal edges, to attach fittings, and for general assembly work are: Tungsten Inert Gas (TIG) (uses non-consumable Tungsten electrodes to maintain an arc which is shielded by an inert gas, usually Argon or Helium) and Metal Inert Gas (MIG) Consumable Electrode Process (bare wire is fed from a spool through a gun type device which provides contact with the power source and introduces the shielding medium, usually carbon dioxide).

Fig. 31-2

Section showing heavy gauge companion plate with MIG seam and spot welds welded by the MIG process

This latter process is known either as MIG seam welding, (which has a continuous weld) or MIG spot welding, (which can be used to reduce warpage from heat). For spot type MIG welding, the top (or penetrated) work piece can normally be from a minimum of 18 gauge to a maximum of 10 gauge. The bottom work piece can be 3/16" thick or any heavier material.

Some typical uses are for fabricating heavy wall PLATECOIL tanks, platens or other units that must be flat on one side with no weld marks or discoloration on the flat side.

Manual Metal Arc (MMA), often called "open arc," is the most widely used method for applying filler metal. Normally used to join fittings to PLATECOIL embossings and other general fabrication welding.

POST WELD TREATMENT OF PLATECOIL

Annealing

Stainless steel PLATECOIL are full solution annealed at 1900 to 2100F, principally for the removal of forming and welding stresses and as a safety precaution against chromium carbide precipitation (sensitization). Annealing dissolves any carbides that may have formed. The full anneal includes a quick water quench and is followed by a special scale removal and passivating process. This restores the metal to its maximum corrosion resistant condition.

Stresses set up by cold working can cause premature failure due to stress corrosion cracking. Annealing, however, relieves these stresses and produces a homogeneous structure.

Stainless steel PLATECOIL are fabricated from standard carbon content type 316, generally considered to be the most corrosion resistant grade. Also, using yield strength as a guide, it is about 20% stronger than an equivalent gauge in the low carbon content grade, which was developed primarily for weldments too large to be annealed. Authorities agree that only by full annealing is the structure of stainless steel returned to its maximum austenitic condition. PLATECOIL, therefore, incorporate both the original strength and corrosion resistance of the standard carbon grade. PLATECOIL fabricated from other alloys, such as Alloy 20Cb-3, are annealed and passivated as required.

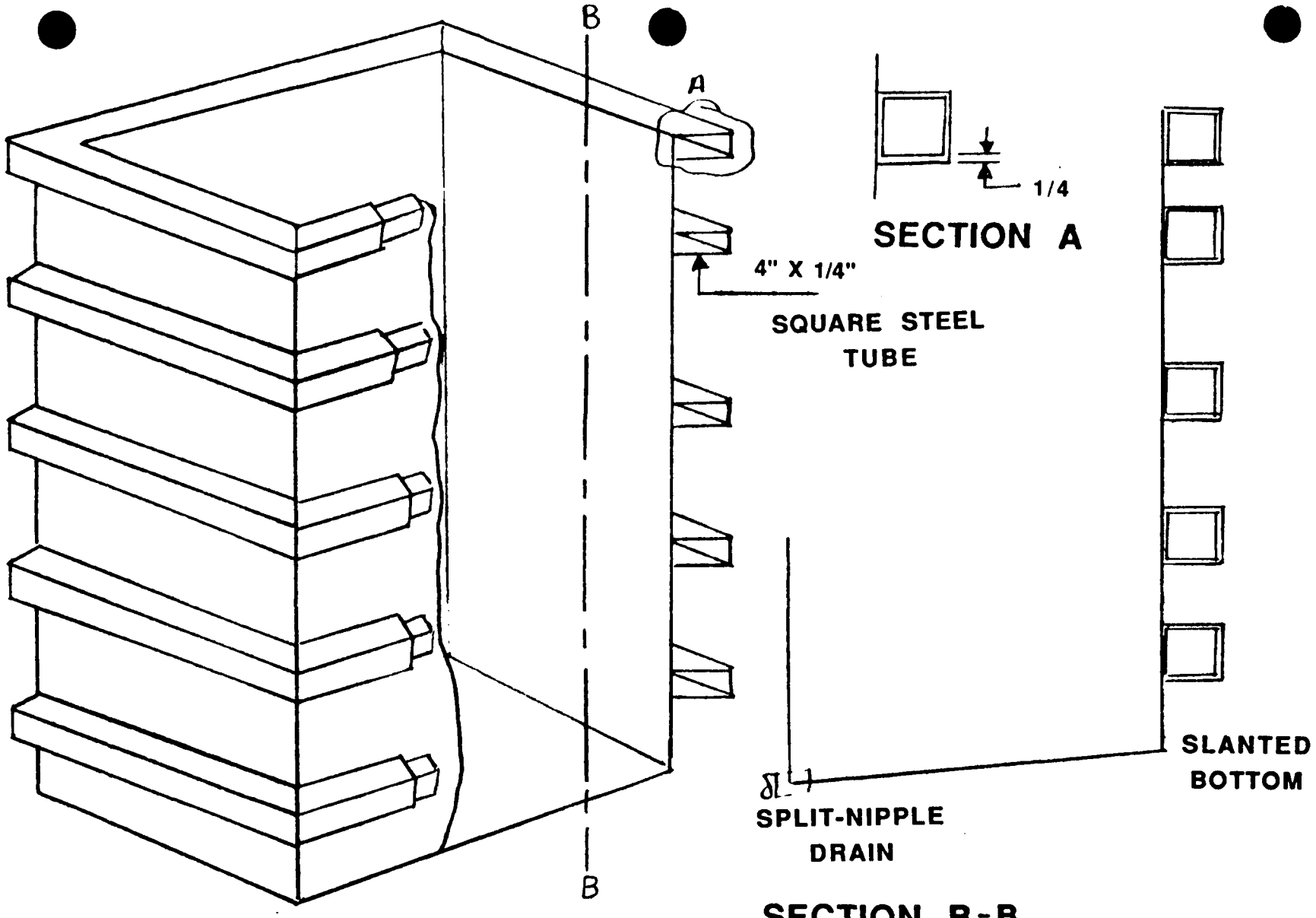
In certain instances, such as cooling processes or where corrosive conditions are very mild, annealing may be unnecessary and stainless PLATECOIL can be supplied passivated only.

STRESS RELIEVED CARBON STEEL PLATECOIL

Carbon Steel PLATECOIL can be stress relieved on a special order basis. The service life of carbon steel can often be extended substantially, particularly in caustic applications, by stress relieving at 1100F. Contact your sales representative or the factory for addition information.

APPENDIX G

SUPPORTING DATA



TANK WITHOUT OUTER SHELL

300M Steel

Nickel- 1.8- 2.0 %

Chromium - 0.7- 0.95%

Manganese - 0.6- 0.9 %

Silicon - 1.5- 1.7 %

Molybdenum - 0.3 - 0.5 %

Vanadium - 0.05- 0.10 %

Carbon - 0.38- 0.43

Sulfur - 0.04 max.

Iron - Remainder

Sept 13, 1989

QUESTION

WHAT PARTS ARE MADE FROM SERIES 300 M. STEEL?

ANSWER

ALL C5 PARTS, C 141 AXLES, INNER AND OUTER CYLINDERS. & KC 135 AFT AXLES.

QUESTION

WHAT PARTS HAVE INTERNAL PLATING?

ANSWER.

C5A NOSE, INNER AND OUTER CYLINDER, TRUNNION PIN AND AXLE ASSEMBLY.

C 141 NOSE OUTER CYLINDER

C 5 MAIN INNER AND OUTER CYLINDER.

Larry Goad and Company
260 Old State Road. Ellisville, (St. Louis) Missouri 63021
314/394-6334
BRANCH: INDEPENDENCE, MO

March 21, 1989

McDonnell Douglas Missile Systems Co.
P. O. Box 516
St. Louis, MO 63166

Mail Code 0922272

Attn: Mary Cuthill

Dear Mary:

The following are prices for the tank styles 1-10 with a breakdown of six (6) different types of tank's linings.

Style #1 - 3' wide x 3' long x 3 1/2' deep	
304 Stainless Steel	$ 2,100.00
304 Stainless Steel Fligid lined	$ 3,000.00
304 Stainless Steel Koroseal lined	$ 2,600.00
304 Stainless Steel PVDF lined	$ 5,700.00
304 Stainless Steel Lead lined	$ 3,300.00
Polypropylene	$ 1,300.00
Insulation Adder	$ 600.00
Style #2 - 2 1/2' wide x 8' long x 3 1/2' deep	
304 Stainless Steel	$ 3,800.00
304 Stainless Steel Fligid lined	$ 5,400.00
304 Stainless Steel Koroseal lined	$ 4,800.00
304 Stainless Steel PVDF lined	$10,400.00
304 Stainless Steel Lead lined	$ 6,100.00
Polypropylene	$ 2,300.00
Insulation Adder	$ 1,100.00
Style #3 - 2 1/2' deep x 6' long x 5 1/2' deep	
304 Stainless Steel	$ 4,400.00
304 Stainless Steel Fligid lined	$ 6,300.00
304 Stainless Steel Koroseal lined	$ 5,500.00
304 Stainless Steel PVDF lined	$12,000.00
304 Stainless Steel Lead lined	$ 7,000.00
Polypropylene	$ 2,500.00
Insulation Adder	$ 1,200.00
Style #4 - 2 1/2' wide x 16' long x 5 1/2" deep	
304 Stainless Steel	$ 9,600.00
304 Stainless Steel Fligid lined	$13,700.00
304 Stainless Steel Koroseal lined	$12,000.00
304 Stainless Steel PVDF lined	$26,400.00
304 Stainless Steel Lead lined	$15,400.00
Insulation Adder	$ 2,600.00

Style 4A - 2 1/2' wide x 26' long x 5 1/2' deep	
304 Stainless Steel	$15,200.00
304 Stainless Steel Fligid lined	$21,600.00
304 Stainless Steel Koroseal lined	$19,000.00
304 Stainless Steel PVDF lined	$41,800.00
304 Stainless Steel Lead lined	$24,300.00
Insulation Adder	$ 4,180.00
Style #5 - 2 1/2' wide x 3' long x 9' deep	
304 Stainless Steel	$ 4,300.00
304 Stainless Steel Fligid lined	$ 6,100.00
304 Stainless Steel Koroseal lined	$ 5,400.00
304 Stainless Steel PVDF lined	$11,800.00
304 Stainless Steel Lead lined	$ 6,900.00
Insulation Adder	$ 1,200.00
Style #6 - 2 1/2' wide x 8' long x 9' deep	
304 Stainless Steel	$ 8,400.00
304 Stainless Steel Fligid lined	$12,000.00
304 Stainless Steel Koroseal lined	$10,500.00
304 Stainless Steel PVDF lined	$23,100.00
304 Stainless Steel Lead lined	$13,500.00
Insulation Adder	$ 2,300.00
Style #7 - 2 1/2' wide x 10' long x 10' deep	
304 Stainless Steel	$11,000.00
304 Stainless Steel Fligid lined	$15,700.00
304 Stainless Steel Koroseal lined	$13,800.00
304 Stainless Steel PVDF lined	$30,300.00
304 Stainless Steel Lead lined	$17,600.00
Insulation Adder	$ 3,000.00
Style #8 - 3' wide x 6' long x 9' deep	
304 Stainless Steel	$ 7,200.00
304 Stainless Steel Fligid lined	$10,300.00
304 Stainless Steel Koroseal lined	$ 9,000.00
304 Stainless Steel PVDF lined	$19,800.00
304 Stainless Steel Lead lined	$11,500.00
304 Stainless Steel Halarlined	$19,800.00
Insulation Adder	$ 2,000.00
Style #9 - 3' wide x 10' long x 9' deep	
304 Stainless Steel	$10,600.00
304 Stainless Steel Fligid lined	$15,100.00
304 Stainless Steel Koroseal lined	$13,300.00
304 Stainless Steel PVDF lined	$29,200.00
304 Stainless Steel Lead lined	$17,000.00
Halar	$29,200.00
Insulation	$ 2,900.00

Style #10	3' wide x 10' long x 3 1/2' deep	
	304 Stainless Steel	$ 7,700.00
	304 Stainless Steel Fligid lined	$10,900.00
	304 Stainless Steel Koroseal lined	$ 9,600.00
	304 Stainless Steel PVDF lined	$21,070.00
	304 Stainless Steel Lead lined	$12,300.00
	Polypropylene	$ 2,900.00
	Insulation	$ 2,100.00

Drip Shields made of:	1/4" PVC	11 gauge	304 Stainless Steel
For: 3' Tank 4' long	$ 85.00	$100.00	
6' Tank 7' long	95.00	175.00	
8' Tank 9' long	115.00	225.00	
10' Tank 11' long	155.00	275.00	
16' Tank 17' long	200.00	425.00	
26' Tank 27' long	315.00	675.00	

Thank you for the opportunity to quote on your requirements. If I can be of any further assistance, please do not hesitate to call.

Sincerely,

Tom Perkins
Sales Engineer

TP/pt

	ORGANISOLS/ CHLORINATED SOLVENTS	ORGANISOLS/ TOLUENE SOLVENTS	PLASTIC	WAX
FLASH POINT	NONE	40°F	455°F	560°F
MAXIMUM OPERATING TEMPERATURE	ROOM 110°F	ROOM 110°F	370°F	250°F
DIFFERENCE	N/A	-70°F	85°F	310°F
MASKANT USE PER ALC	SA-ALC SM-ALC WR-ALC	OC-ALC OO-ALC	OO-ALC	OC-ALC SA-ALC SM-ALC WR-ALC

FLAMMABILITY COMPARISONS OF MASKANTS AT THE ALCs

NO TECH DATA WAS AVAILABLE FOR CH 12 DEGREASER
THE FOLLOWING CRITERIA WAS USED TO DEVELOP AN ESTIMATE OF THE YEARLY UTILITY COSTS FOR OPERATION.

1. 75 LBS/HR STEAM USING 75% OF FULL OPERATING DATA OBTAINED BY FINDING THE DATA ON A SIMILAR SIZED DEGREASER.
2. ASSUME 24 HR/DAY 7 DAY/WEEK OPERATION
3. STEAM COST AS PROVIDED FROM CIVIL ENGINEERING IS $2.0105/1000 LBS.

$$\frac{75}{1000} \times 24 \times 365 \times 2.0105 = 1.321 \times 10^{3}$$

UTILITY COSTS ARE $1321.00/YEAR

PM OR ID NO.	REF. NO.	GRID NO.	CONN. AMPS	%DIV.	EST. AMPS	
		AC	270.0	40	108.0	
PM5780	CR12	B1	1.5	.1	.0	
		B1	1.5	1	.0	
		B1	1.5	1	.0	
		B1	1.5	1	.0	
		B1	1.5	1	.0	
		B1	1.5	1	.0	
PM5360	16B	B1	61.0	1	.5	
PM5361	16A	B1	61.0	1	.5	
	14A	B1	61.0	1	.5	
	14B	B1	61.0	1	.5	
PM5354	13B	B1	61.0	1	.5	
PM5358	15A	B1	61.0	1	.5	
PM6419	CR35C	B1	50.0	1	.5	
PM5756	CR13A	B1	61.0	1	.5	
PM5414	CR41	B1	28.0	1	.7	
PM5884		B1	270.0	40	108.0	WAX TANK

577

Mission: 5 Memory: 170 Last Col/Row: I606 ? for HELP

1

F1=Help F2=Cancel F9=Plot F10=View

270 A IS THE CONNECTED LOAD

108 A IS THE AVERAGE CURRENT DRAW.

ASSUME UNITY POWER FACTOR SO

AVERAGE CURRENT DRAW 108 A.

POWER AVERAGE $\approx (108)(480)(\sqrt{3}) = 90\,KW$

ASSUME 50% REDUCTION ON WEEKEND : HOLIDAYS = 45 KW

TO: Bob Bishoff
FROM: Dee Mackliet

Subject: Utility Costs for CA 12 Vapor Degreaser

1. Attached is the information on utility costs to operate the vapor degreaser in building 505. The price for steam seems to be quite low and probably should be in the 5 to 6 dollar range; however, $2.0105/1000 lbs is the number that civil engineering gave us.

2. Point of Contact is Dee Mackliet, MANEF, 72341.

Attachment

1. Utility cost calculations

NO TECH DATA WAS AVAILABLE FOR CA 12 DEGREASER
THE FOLLOWING CRITERIA WAS USED TO DEVELOP AN
ESTIMATE OF THE YEARLY UTILITY COSTS FOR
OPERATION.

1. 75 LBS/HR STEAM USING 75% OF FULL
OPERATING DATA OBTAINED BY FINDING THE DATA ON
A SIMILAR SIZED DEGREASER.
2. ASSUME 24 HR/DAY 7 DAY/WEEK OPERATION
3. STEAM COST AS PROVIDED FROM CIVIL
ENGINEERING IS $2.0105/1000 LBS.

$$\frac{75}{1000} \cdot 24 \cdot 365 \cdot 2.0105 = 1.321 \cdot 10^{3}$$

UTILITY COSTS ARE $1321.00/YEAR

Products Finishing
6600 Clough Pike
Cincinnati, Ohio 45244
(513) 231-8020
Telex 214132

PF finishing clinic

By LARRY DURNEY

Engineering Plating and Processing, Inc.
P.O.Box 3122
Kansas City, KA 66103
Att: Mr. Ronald Lee

August 4, 1989

Dear Mr. Lee:

If your maskant is being degraded by the chromium solution, this could be producing either particles or an excess of trivalent chromium immediately adjacent to the part. Either or both of these could possibly cause pitting.

It is possible that agitation, or increased agitation will keep these products away from the area in question and eliminate the problem. Since you indicate that the problem is intermittent, the condition causing the problem is apparently marginal, and it may not take too great a change to prevent the occurrence of the trouble.

Thanks for writing to Finishing Clinic.

Larry Durney

Larry Durney

Designation: D 127 – 87

Designation: 133/79

AMERICAN SOCIETY FOR TESTING AND MATERIALS
1916 Race St. Philadelphia, Pa. 19103
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If not listed in the current combined index, will appear in the next edition

An American National Standard
Technical Association of Pulp and Paper Industry
Tentative Method T 834pm-84

Standard Test Method for Drop Melting Point of Petroleum Wax Including Petrolatum[1]

This standard is issued under the fixed designations D 127, the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This test method is sponsored jointly by the Technical Association of Pulp and Paper Industry and the American Society for Testing and Materials.

This test method was adopted as a joint ASTM-IP standard in 1964.

This test method has been adopted for use by government agencies to replace Method 1401 of Federal Test Method Standard No. 791b.

1. Scope

1.1 This test method covers the determination of the drop melting point of petroleum wax. It is used primarily for petrolatums and other microcrystalline wax.

NOTE 1—Additional methods used for petroleum waxes are Test Method D 87 and Test Method D 938. Results obtained may differ, depending on the method used. For pharmaceutical petrolatum, Test Method D 127 usually is used.

1.2 The values stated in SI units are to be regarded as the standard. The values in parentheses are for information only.

1.3 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards*

D 87 Test Method for Melting Point of Petroleum Wax (Cooling Curve)[2]

D 938 Test Method for Congealing Point of Petroleum Waxes, Including Petrolatum[2]

E 1 Specification for ASTM Thermometers[3]

3. Definition

3.1 *drop melting point of petroleum wax*—The temperature at which material becomes sufficiently fluid to drop from the thermometer used in making the determination under definite prescribed conditions.

4. Summary of Test Method

4.1 Specimens are deposited on two thermometer bulbs by dipping chilled thermometers into the sample. The thermometers bearing the specimens are placed in test tubes and heated by means of a water bath until the specimens melt and the first drop falls from each thermometer bulb. The average of the temperatures at which these drops fall is the drop melting point of the sample.

5. Significance and Use

5.1 Melting point is a wax property that is of interest to most wax consumers. It can be an indication of the performance properties of the wax. Drop melting point, Test Method D 127, is often used to measure the melting characteristics of petrolatums and other high viscosity petroleum waxes.

6. Apparatus

6.1 *Test Tubes*—Standard test tubes, 25 mm (1 in.) in outside diameter and 150 mm (6 in.) long. The test tubes shall be supplied with corks grooved at the sides to permit air circulation and bored in the exact center to receive the thermometer.

6.2 *Bath*—A transparent container of not less than 1500-mL capacity, that will permit the immersion of the test tubes to a depth of at least 100 mm and still leave a depth of 15 mm of water below the bottoms of the test tubes.

6.3 *Thermometer*, having a range as shown below and conforming to the requirements as prescribed in Specifications E 1 or in specifications for IP Standard Thermometers:

	Thermometer Number	
Thermometer Range	ASTM	IP
32 to 127°C	61C	63C
90 to 260°F	61F	

6.4 *Bath Thermometer*, any suitable type, accurate to 1°F (0.5°C) throughout the required range.

7. Procedure

7.1 Secure a sample of sufficient size that is representative of the material under inspection. Use a fresh portion of the sample for each set of two determinations. Melt the sample slowly until the temperature reaches 200°F (93°C), or about 20°F (11°C) above the expected drop melting point, which-

[1] This test method is under the jurisdiction of ASTM Committee D-2 on Petroleum Products and Lubricants and is the direct responsibility of subcommittee D02.10 on Properties of Petroleum Wax.

In the IP, this method is under the jurisdiction of Standardization Committee.

Current edition approved Oct. 30, 1987. Published December 1987. Originally published as D 127 – 22. Last previous edition D 127 – 63 (1982).

In 1963, the title, scope, and definition were changed to define the determination of "drop melting point." Sections on procedure, report, and precision were [illegible]

In 1964 [illegible]

[2] *Annual Book of ASTM Standards*, Vol 05.01.

[3] *Annual Book of ASTM Standards*, Vols 14.03 and 14.01.

ever is higher. Place sufficient sample in a flat bottom container to give a sample depth of 12 ± 1 mm. Adjust the temperature of the sample to 10 to 20°F (6 to 11°C) (Note 2) above its drop melting point using any general laboratory thermometer for measurement. Chill one of the test thermometer bulbs to 40°F (4°C). Wipe dry, and, quickly but carefully, immerse the chilled bulb vertically into the heated sample until it touches the bottom of the container (12 mm submerged) and withdraw it immediately. Hold the thermometer vertically away from the heat until the surface dulls, and then place it for 5 min in water having a temperature of 60°F (16°C). Prepare another specimen from the same sample using this procedure.

NOTE 2—A dipping temperature of 20°F (11°C) above the congealing point in accordance with Test Method D 938 usually will be 10 to 20°F (6 to 11°C) above the actual drop melting point.

7.2 Securely fix the thermometers in the test tubes by means of corks so that the tip of each thermometer is 15 mm above the bottom of its test tube. Insert the test tubes in the water bath which is at 60°F (16°C) and adjust the height of the test tubes so that the immersion marks on the thermometers are level with the top surface of the water. Raise the temperature of the bath at a rate of 3°F (1.7°C)/min to 100°F (38°C), then at a rate of 2°F (1°C)/min until the first drop of material leaves each thermometer. Record in each case the temperature at which the first drop falls from the thermometer.

8. Report

8.1 Report the average of the two determinations as the drop melting point of the sample under test.

9. Precision and Bias

9.1 *Precision*—The precision of this test method as determined by statistical examination of interlaboratory results is as follows:

9.1.1 *Repeatability*—The difference between two test results, obtained by the same operator with the same apparatus under constant operating conditions on identical test material, would in the long run, in the normal and correct operation of the test method, exceed the following values only in one case in twenty:

1.4°F (0.8°C)

9.1.2 *Reproducibility*—The difference between two single and independent results obtained by different operators working in different laboratories on identical test material would, in the long run, in the normal and correct operation of the test method, exceed the following values only in one case in twenty:

2.4°F (1.3°C)

NOTE 3—The following information on the precision of this test method has been developed by the Institute of Petroleum (London) and is being investigated:

(a) Results of duplicate tests should not differ by more than the following amounts:

Repeatability	*Reproducibility*
2°F (1°C)	2.2°F (1.2°C)

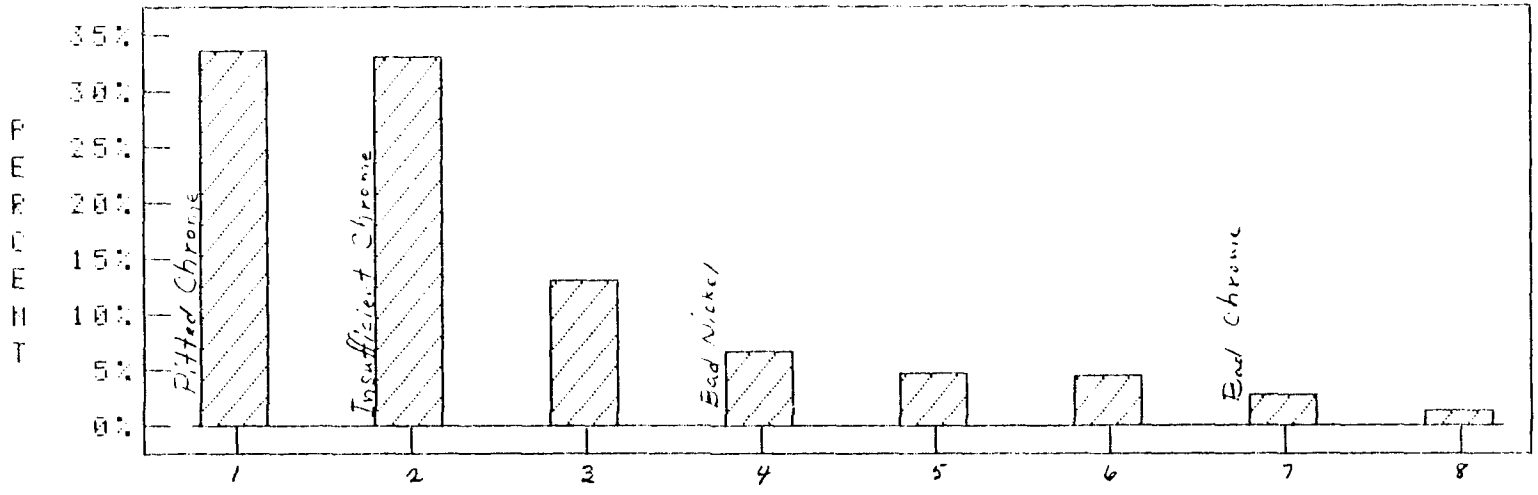
(b) These precision values were obtained in 1954 by statistical examination of interlaboratory test results.

9.2 *Bias*—The procedure in this test method has no bias because the value of drop melting point can be defined only in terms of a test method.

OVERLAYS MANPRB (GRINDING)

6 MONTH PERIOD 1 DEC 88-JUNE 89

TOTAL 657

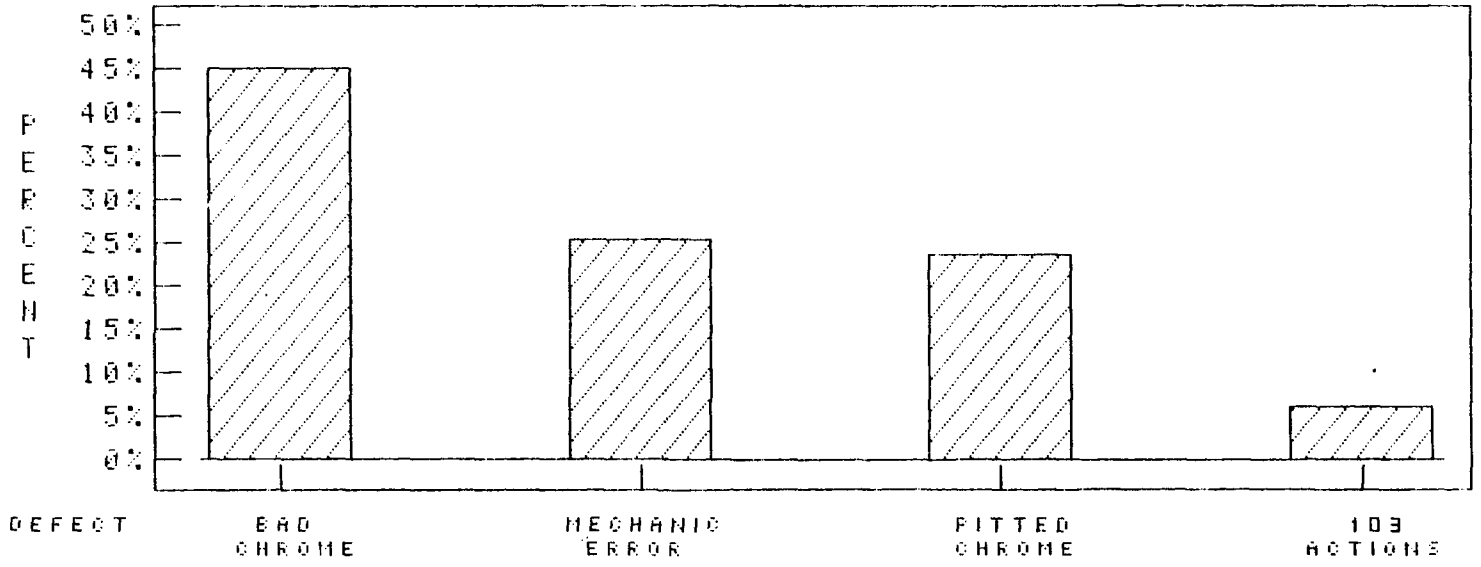


DEFECT	# DEFECTS	% DEFECTS
1 PITTED CHROME	154	33.7
2 INSUFFICIENT CHROME	151	33
3 MECHANIC ERROR	60	13.1
4 BAD NICKEL	30	6.6
5 CHIPPED CHROME	22	4.8
6 103 ACTIONS	20	4.4
7 BAD CHROME	13	2.8
8 BAD CENTERS	7	1.5

OVERLAYS MNPRC (PLATING)

6 MONTH PERIOD 1 DEC 88-JUNE 89

TOTAL 102



DEFECT	#	%
BAD CHROME	46	45.1
MECHANIC ERROR	26	25.5
PITTED CHROME	24	23.5
103 ACTION	6	5.9

MILITARY SPECIFICATION

PLASTIC COATING COMPOUND, STRIPPABLE, FOR ELECTROPLATING

This specification is approved for use by the Naval Air Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the requirements for one type of hot-dip, stop-off, srippable plastic coating intended for masking metallic areas not to be plated during an electroplating process (see 6.1).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

PPP-B-576	-	Box, Wood, Cleated, Veneer, Paper Overlaid.
PPP-B-585	-	Boxes, Wood, Wirebound
PPP-B-591	-	Boxes, Fiberboard, Wood-Cleated
PPP-B-601	-	Boxes, Wood, Cleated-Plywood
PPP-B-621	-	Boxes, Wood, Nailed and Lock-Corner
PPP-B-636	-	Boxes, Shipping, Fiberboard

STANDARDS

MILITARY

MIL-STD-105	-	Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129	-	Marking for Shipment and Storage.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Engineering Specifications and Standards Department (Code 93), Naval Air Engineering Center, Lakehurst, NJ 08733, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1436) appearing at the end of this document or by letter.

(Copies of specifications, standards, handbooks, drawings, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and supplement thereto, if applicable.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 92-78 - Flash and Fire Points by Cleveland Open Cup.
ASTM D 2240 - Rubber Property - Durometer Hardness.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

UNIFORM CLASSIFICATION COMMITTEE, AGENT

Uniform Freight Classification Rules

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 First article. When specified, a sample shall be subjected to first article inspection (see 4.4 and 6.2.1).

3.2 Material. The plastic coating compound shall consist of 100 percent solids, hot-melt cellulose acetate butyrate in combination with plasticizers and stabilizers. Waxes, foreign resins, migrating plasticizers, chlorinated or toxic materials shall not be present.

3.2.1 Appearance. The appearance of the compound as received shall be in cake form, pink to red in color, visibly free of contaminants and exudation.

3.3 Chemical and physical properties. The cellulose acetate butyrate compound shall conform to the requirements specified in table I.

3.4 Workmanship. The plastic coating compound shall be manufactured by such processes as to meet all the requirements of this specification.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. First article inspection (see 4.4).

b. Quality conformance inspection (see 4.5).

4.3 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in the applicable test paragraph herein.

4.4 First article inspection. First article inspection shall consist of all the inspection procedures of this specification (see 4.7). The responsibility for the performance of the first article inspection shall be as specified in the contract or order (see 6.2).

4.4.1 First article sample. Unless otherwise specified, first article test samples shall consist of two cakes of plastic coating compound.

4.4.2 Prior approval. When a contractor has previously delivered plastic coating compound in accordance with the requirements of this specification and his product has been found to be satisfactory, the requirements for a first article sample and first article inspection for any subsequent contract or order may be waived at the discretion of the acquiring activity (see 6.2).

4.5 Quality conformance inspection.

4.5.1 Lot formation. A lot shall consist of all plastic coating compound manufactured by the same process, in the same production run, and offered for delivery at one time.

4.5.2 Sampling and inspection.

4.5.2.1 Chemical and physical property inspection. Samples shall be selected in accordance with inspection level II of MIL-STD-105 and examined to the properties specified in table II. The AQL shall be 2.5 percent defective. The sample unit shall be one cake of plastic coating compound.

4.5.2.2 Packaging. The lot size for this inspection shall be the total number of shipping containers. The sample unit shall be one container fully prepared for delivery just prior to closure. The inspection level shall be S-2 and the AQL shall be 4.0 defects per 100 units. Inspection shall be in accordance with 4.8 and section 5 of this specification.

4.6 Standard conditions. Unless otherwise specified, tests shall be conducted at a temperature of 75° ± 5°F (24° ± 3°C) with a relative humidity of 50 ± 5 percent.

4.7 Inspection procedures.

4.7.1 Visual examination. Each cake of plastic coating compound shall be examined to verify conformance with 3.2 and 3.4, and all other requirements which do not involve tests.

4.7.2 Life. A 5 pound sample of the coating compound shall be placed in a closed pot, heated to, and then operated continuously at 350° ± 5°F (177° ± 3°C) for a period of 500 hours. The pot shall be opened for 2 hours each 24 hour period to reflect shop conditions. The method of heating the pot shall not produce "hot" spots. The coating compound shall be mechanically agitated. After the 500 hour period, the coating compound shall be examined for conformance to the flexibility, odor, sealing and adhesion, contaminants, workability, strippability and corrosion requirements specified in table I.

4.7.3 Flexibility. An aluminum panel, 3 by 6 inches, shall be submerged vertically in the plastic coating compound for 3 to 5 seconds, and then removed from the compound. After the coating has hardened (60 seconds minimum), it shall be stripped from the panel, and placed in a cold box at -30° ± 1°F (-34.4° ± 0.5°C) for one hour. While at this low temperature, the plastic coating shall be bent through an angle of 180° over a 1/8 inch diameter rod. Evidence of fracture shall be cause for rejection.

4.7.4 Odor. The "as received" plastic coating compound shall have a characteristic butyric odor and the compound shall not develop an obnoxious odor after being heated as described in 4.7.2.

4.7.5 Weight. The material snall be weighed on an accurate scale, calibrated in pounds and ounces.

4.7.5 Fire point. The fire point of the material shall be determined in accordance with ASTM D 92-78, except that the melted compound in the cup shall be continuously stirred with the thermometer during the test. The thermometer shall be hung in tne specified position and then given a circular motion of 2 cycles per second. The stirring motion shall be interrupted momentarily for every 5 degree rise in temperature to permit passage of the test flame across the surface of the compound.

4.7.7 Hardness. Type A hardness shall be determined in accordance with ASTM D 2240. Hardness shall be the average of 5 instantaneous readings.

4.7.8 Operating temperature. A piece of coating compound, weighing approximately 16 ounces, shall be placed in a thermostatically controlled heating vessel. The temperature shall be slowly raised to 350° ± 5°F (177° ± 3°C), at which temperature all of the compound shall be in the liquid phase.

4.7.9 Sealing and adhesion. A chromium bath, self regulating high speed (SRHS), or equivalent, shall be used. After plating and removal of the strippable mask-off compound, plating solution seepage shall not be evident.

4.7.10 Contaminants. A sample of the compound shall be placed in boiling water. After the water has been allowed to cool there shall be no evidence of scum or ther contaminants on the surface of the water.

4.7.11 Re-use. The used compound from 4.7.10, after rinsing in a hot alkaline solution, followed by rinsing in clear hot water, and allowed to dry, shall be suitable for re-use without danger of contaminating plating solutions (see 6.3). A sample of this compound shall be subjected to the test described in 4.7.10 to determine if contaminated.

4.7.12 Weight loss. Approximately 10 grams of compound shall be accurately weighed on a tared 4 inch pyrex watch glass. The sample shall be heated at 350° ± 5°F (177° ± 3°C) for 5 hours in a gravity convection oven. After cooling to room temperature, the sample and watch glass shall be re-weighed. The heat loss shall be calculated as follows:

$$\text{Weight loss, (\%)} = \frac{\text{Wt. compound (initial) - Wt. compound (after heating)}}{\text{Wt. compound (initial)}} \times 100$$

4.7.13 Immersion time. The metals to be coated shall be immersed 3 to 5 seconds in the melted compound, at a temperature of 350° ± 5°F (177° ± 3°C). Only one immersion shall be permitted. The plastic compound shall then be subjected to the examinations specified in 4.7.14, 4.7.15 and 4.7.16.

4.7.14 Hardening time. After the immersion operation, the coating on the metals shall harden and be ready to trim in 60 seconds.

4.7.15 Workability. The hardened compound from 4.7.14 shall be easily trimmed with a sharp knife.

4.7.16 Strippability. The hardened compound (see 4.7.14) shall be easily removed by stripping or peeling, after cutting with a sharp knife.

4.7.17 Corrosion. One weighed panel, each 2 inches square, of brass, lead, steel and zinc shall be immersed in the plastic compound for 8 hours at 350° ± 5°F (177° ± 3°C). The panels shall be removed, and the hardened plastic coating stripped. The panels shall be weighed after stripping to determine conformance with the corrosion requirements specified in table I.

4.8 Preservation, packing and marking. Packaging shall be examined for conformance with Section 5.

5. PACKAGING

5.1 Preservation. Unless otherwise specified, no preservation/packaging is required.

5.2 Packing. The plastic coating compound shall be packed level A, B, or C, as specified in the contract or order (see 6.2).

5.2.1 Level A. Compound shall be packed in overseas type or class boxes conforming to any of the following specification: PPP-B-585 (class 3), PPP-B-591, PPP-B-601, PPP-B-621 and PPP-B-576. Box closure and strapping shall conform to the box specification and the appendix thereto.

5.2.2 Level B. The plastic compound shall be packed as specified for level A, except that domestic type of class boxes shall be used, and fiberboard boxes conforming to weather-resistant class of PPP-B-636 may be used. Closure shall be in accordance with the appendix thereto.

5.2.3 Level C. Cakes of plastic coating compound shall be packed in containers of the type, size and kind commonly used for the purpose, in a manner that will insure acceptance by common carrier and safe delivery at destination. Shipping containers shall comply with the Uniform Freight Classification Rules, or regulations of other carriers as applicable to the mode of transportation.

5.3 Marking. In addition to any special marking required ty the contract or order, shipping containers shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. The plastic coating compound covered by this specification is intended for masking metallic areas not to be plated during an electroplating process. It is suitable for chromium, copper, cadmium, nickel and all common plating solutions. It is not suitable for use in electroless nickel, and has limited use in hot electro-cleaners, strong hot caustic solutions, and specified chemical milling solutions.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number and date of this specification.

b. Quantity required.

c. Responsibility for performance of first article inspection (see 4.3 and 6.2.2).

d. Whether first article inspection is required (see 4.4.2 and 6.2.2).

e. Level of packing (see Section 5).

6.2.2 First article. Contracts or purchase orders shall specify the following requirements for first article inspection:

a. Where first article inspection is to be conducted when it it is required (contractor's plant, Government or commercial facility).

b. Method of reporting results.

c. Whether first article inspection is required. Paragraph 4.4.2 establishes procedures for waiving first article inspection.

6.3 Restrictions on re-use of compound. The plastic coating compound shall not be re-used after exposure to chromic acid.

6.5 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing activity:
Navy - AS
(Project No. 8030-N077)

TABLE I. Chemical and physical properties.

Property	Requirement	Test paragraph
Life, hours	500	4.7.2
Flexibility	No evidence of fracture	4.7.3
Odor	Butyric	4.7.4
Weight, lb	7 ± 0.25	4.7.5
Fire point, min	500°F (260°C)	4.7.6
Hardness, points, min	77	4.7.7
Operating temperature	Completely fluid at 350° ± 5°F (177° ± 3°C)	4.7.8
Sealing and adhesion	No seepage of plating solution under compound	4.7.9
Contaminants	No evidence of scum or or contaminants	4.7.10
Re-use	No evidence of scum or contaminants	4.7.11
Weight loss, percent, max	5	4.7.12
Immersion time, seconds	3 to 5	4.7.13
Hardening time, seconds, min	60	4.7.14
Workability	Hardened compound shall be easily trimmed with sharp knife	4.7.15
Strippability	Hardened compound shall be easily removed by stripping or peeling	4.7.16
Corrosion, weight change, milligrams per sq cm, max:		4.7.17
Brass	2.0	
Lead	22.0	
Steel	0.2	
Zinc	8.0	

TABLE II. Quality conformance inspection.

Property	Paragraph	
	Requirement	Test
Visual examination	3.2 and 3.4	4.7.1
Flexibility	Table I	4.7.3
Sealing and adhesion	Table I	4.7.9
Contaminants	Table I	4.7.10
Immersion time	Table I	4.7.13
Hardening time	Table I	4.7.14
Workability	Table I	4.7.15
Strippability	Table I	4.7.16

☆U.S. GOVERNMENT PRINTING OFFICE: 1982—605-022/1943

MIL-W-12465C

10 June 1968
SUPERSEDING
MIL-W-12465B (GL)
8 September 1965

MILITARY SPECIFICATION

WAX, MICROCRYSTALLINE. (ELECTRICAL, INSULATING)

This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 This specification covers one type of electric insulating microcrystalline wax with fungistatic properties (see 6.1).

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein:

SPECIFICATION

FEDERAL

SS-R 406 - Road and Paving Materials, Methods of Sampling and Testing.
PPP-B-636 - Box Fiberboard.
PPP-F-320 - Fiberboard· Corrugated and Solid, Sheet Stock (Container Grade), and Cut Shapes.

STANDARDS

FEDERAL

Fed. Test Method Std. No. 791 - Lubricants, Liquid Fuels, and Related Products; Methods of Testing.

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129 - Marking for Shipment and Storage.

FSC 9160

(Copies of specifications and standards required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications.- The following document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials (ASTM Designation):

D176-59 - Testing Solid Filling and Treating Compounds Used for Electrical Insulation.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103).

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3. REQUIREMENTS

3.1 Materials.- The wax shall be made from such material as to insure compliance with the requirements of this specification. The wax shall not contain mercury in any form and shall be made fungistatic by the addition of a suitable solubilized copper-8-quinolinolate formulation (see 3.10).

3.2 Chemical and physical properties.- The wax shall conform to the requirements of table I when tested as specified in 4.3.6.

TABLE I.- Chemical and physical properties

	Minimum	Maximum
Melting point, °F.	180	185
Viscosity at 210°F., S.U.S.	70	95
Flash point, Cleveland O.C. °F.	500	---
Fire point, Cleveland O.C. °F.	550	---
Acid number, mg. KOH per g.	---	1.5

TABLE I.- Chemical and physical properties (cont'd)

	Minimum	Maximum
Specific gravity at 60°/60°F.	0.850	---
Loss on heating, percent by weight	---	1.0
Dielectric strength at 86°F., kilovolts per 0.1 inch	80	---

3.3 Stability.- The wax shall show no evidence of sludging or tendency to separate after being heated for 72 hours at 210°F. as specified in 4.3.5.

3.4 Corrosive effect.- Steel, aluminum, and brass shall show no evidence of discoloration or corrosion by the wax, when tested as specified in 4.3.6.

* 3.5 Penetration.- The wax shall have the following needle penetration when tested as specified in 4.3.6.

Total load, g.	Time, sec.	Temperature, °F.	Penetration range, 0.1 mm
100	5	77	2 to 10
50	5	115	25 max.

3.6 Adhesion to metal at low temperatures.- There shall be no evidence of cracks or separation at -5°F. when tested as specified in 4.3.6.

3.7 Water absorption.- The wax shall not absorb more than 0.2 percent of water by weight when tested as specified in 4.3.6.

3.8 Electrolytic corrosion.- The wax shall not corrode bare copper electrodes when tested as specified in 4.3.6.

3.9 Fungus resistance.- There shall be no visible mold growth on the waxed filter paper when tested as specified in 4.3.6.

3.10 Copper-8-quinolinolate content.- The wax shall be made fungistatic by the addition of a suitable solubilized copper-8-quinolinolate formulation. The addition of the fungistatic agent shall be such that the wax contains a concentration of 0.20 to 0.25 percent of copper-8-quinolinate when tested as specified in 4.3.6. (The required concentration of 0.20 to 0.25 percent refers to the active ingredient, copper-8-quinolinolate, and does not include the solubilizing vehicle.) (See 6.3).

3.11 Workmanship.- The finished wax shall be clean, free from foreign matter and homogeneous in appearance.

4. QUALITY ASSURANCE PROVISIONS

* 4.1 Responsibility for inspection.- Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

* 4.1.1 Certificate of compliance.- Where certificates of compliance are submitted, the Government reserves the right to check test such items to determine the validity of the certification.

4.2 Inspection.- Sampling for inspection shall be performed in accordance with MIL-STD-105, except where otherwise indicated hereinafter.

4.2.1 Component and material inspection.- In accordance with 4.1 above, components and materials shall be inspected and tested in accordance with all the requirements of referenced specifications, drawings, and standards unless otherwise excluded, amended, modified or qualified in this specification or applicable purchase document.

4.3 Inspection of the end item.-

4.3.1 Examination of the end item.- The end item shall be examined for the defects in the applicable sub-paragraphs at the inspection levels and acceptable quality levels (AQLs) set forth in 4.3.5. The lot size shall be expressed in units of 5 to 15 pound cakes of wax as applicable for examination in 4.3.2 and 4.3.3 and in units of shipping containers for examination in 4.3.4.

4.3.2 Examination of the end item.- The sample unit for this examination shall be one cake.

Examine	Defect
Workmanship	Not homogeneous
	Not clean
	Not free of foreign matter

4.3.3 Examination of the end item for defects in net weight.- The sample unit for this examination shall be one cake of wax as applicable. The lot shall be unacceptable if the average net weight per cake is less than indicated or specified.

* 4.3.4 Examination of preparation for delivery.- An examination shall be made to determine that packaging, packing and markings comply with the requirements of Section 5 of this specification. The sample unit for this examination shall be one shipping container, fully packed, selected just prior to the closing operation shipping containers, fully prepared for delivery shall be examined for closure defects.

Examine	Defect
Packaging	Not level specified; not in accordance with contract requirements
	Wax not individually wrapped or bagged
	Package not restrained from becoming undone
Packing	Not level specified; not in accordance with contract requirements
	Interior packages not snugly packed within the container
	Inside of shipping container not fitted with taped liner as specified
	Weight of contents of shipping container exceeds 65 pounds
	Container material not as specified; closures not accomplished by specified or required methods or materials
	Bulged or distorted container

Examine	Defect
Marking	Incorrect; illegible; omitted; incomplete; of improper size, location, sequence or method of application

4.3.5 Inspection levels and acceptable quality levels (AQL's) for examinations.- The inspection levels and acceptable quality levels (AQLs) expressed in defects per 100 units shall be as follows:

Examination paragraph	Inspection level	AQL
4.3.2	I	1.5
4.3.3	S-3	N.A
4.3.4	S-2	2.5

* 4.3.6 Testing of the end item.- The methods of testing specified in Fed. Test Method Std. NO. 791, where applicable, and as listed in table II shall be followed for each lot. For purposes of sampling, the lot shall be expressed in pounds of wax manufactured as a single batch. The sample unit for testing shall be a 3-pound composite obtained by combining equal portions from samples selected at random throughout the lot. The sample size shall be as indicated below. The portions selected for the composite sample shall be melted at a temperature not exceeding 235°F and the mixture subjected to continuous stirring while being cooled to ambient temperature. The composite shall be placed in a clean, dry, sealed container. Care shall be exercised to prevent contamination or alteration of the composite during sampling, compositing, storage and testing. All test reports shall contain the individual values utilized in expressing the final results. The lot shall be unacceptable if the composite fails to meet any test requirement specified.

Lot size (pounds)	Sample size
800 or less	2
801 up to and including 22,000	3
22,001 or more	5

INSTRUCTIONS FOR TESTING

END ITEM

TABLE II

CHARACTERISTIC	Specification Reference		Requirements Applicable To		Number Determinations Per Unit	Results Reported As		Inspect Level	AQL
	Requirement	Test Method	Samp. Unit	Comp. Samp.		Pass or Fail	Numerically to Nearest		
Material	3.1	1/							
Melting point	Table I	1401 2/		X	Average of 2		0.5°F.		
Viscosity	Table I	304 2/		X	Average of 2		1.0 sec.		
Flash point, Cleveland O.C.	Table I	1103 2/		X	Average of 2		5.0°F.		
Fire point, Cleveland O.C.	Table I	1103 2/		X	Average of 2		5.0°F.		
Acid number	Table I	4.4.1		X	Average of 2		1 mg.		
Specific gravity	Table I	4.4.2		X	1		.01		
Loss on heating	Table I	4.4.3		X	Average of 2		0.1 percent		
Dielectric strength at 86°F., kilovolts	Table I	4.4.4	X		Average of 10		1 kilovolt		
Stability	3.3	4.4.5		X	1	X			
Corrosive effect	3.4	4.4.6		X	1	X			
Penetration	3.5	4.4.7		X	Average of 2		1.0		
Adhesion to metal at low temperatures	3.6	4.4.8		X	3	X			
Water absorption	3.7	4.4.9		X	Average of 2		0.1 percent		
Electrolytic corrosion	3.8	4.4.10		X	1	X			
Fungus resistance	3.9	4.4.11	X		4	X			
Copper-8-quinolinolate	3.10	4.4.12		X	Average of 2		.01 percent		

1/ Certificate of compliance.- The supplier shall submit to the contracting officer a certificate of compliance that the finished product does not contain mercury in any form, and that the copper fungistatic agent is solubilized copper-8-quinolinolate.

2/ Indicate Fed. Test Method Std. No. 791.

MIL-M-12969C

AMXRE Form 598
8 February 1965

4.4 Test procedure.-

4.4.1 Acid number.- The acid number shall be determined in accordance with Method 5105 of Fed. Test Method Std. No. 791, except that the weighed sample shall be dissolved in 50 milliliters (ml.) of hot xylene before starting the test. If difficulty is encountered in observing the end point of titrations, the electrometric method designated as Method 5106 of Fed. Test Method Std. No. 791 shall be used with the above modification.

4.4.2 Specific gravity.- The specific gravity of the wax shall be determined in accordance with Method 209 of SS-R-406 (displacement method).

4.4.3 Loss on heating.- A representative sample of about 200 g. shall be weighed accurately in a clean porcelain dish permitting an exposed area of the compound of 12 to 15 square inches (about 4 inches in diameter). The dish containing the compound shall be placed in a forced draft oven maintained at 300° ± 5°F. for 4 hours. Calculate and report the percent loss in weight

4.4.4 Dielectric strength test.- The dielectric strength test shall be determined in accordance with ASTM Designation D176-59.

4.4.4.1 Number of tests.- Unless otherwise specified, 10 tests shall be made at 86° ± 2°F. The average value of breakdown voltage per one-tenth of an inch thickness of material obtained from the specimens tested from each sample unit shall be taken as the dielectric strength of the sample unit.

4.4.5 Stability.- A 200 g. sample of the wax shall be placed in a 400 ml. heat-resistant glass beaker and heated for 72 hours in an oven maintained at 210° ± 5°F. At the end of the heating period, the wax shall be removed and examined visually for evidence of separation of components and sludge.

(Examination may be facilitated by pouring the molten wax into a second beaker and examining the bottom and sides of the first beaker for separated material).

4.4.6 Corrosive effect.- Polished strips of steel, aluminum and brass, each measuring approximately 1/2 by 3 by 1/8 inches, shall be placed separately in three clean test tubes. The test tubes shall be placed in a water bath maintained at 212° ± 2°F. and the melted wax added slowly to each tube until the strips are covered. A vented stopper shall then be used to close each test tube. After remaining in the water bath for 3 hours, the metal strips shall be removed from the test tubes, the wax completely wiped off the strips, and the strips examined visually for discoloration and corrosion. Slight etching shall not be considered as evidence of corrosion.

4.4.7 Penetration.- The penetration of the wax shall be determined in accordance with Method 214 of SS-R-406.

4.4.8 Adhesion to metal at low temperatures.- A thin coating of the compound, 0.0025 ± 0.0005 inch thick, shall be applied to a clean metal panel of low carbon steel of about 30 gauge. The clean panel shall be heated to 245° ± 5°F. in an oven maintained at that temperature. While at that temperature, the panels shall be immersed in the molten compound maintained at 245° ± 5°F. The panel shall be withdrawn from the molten wax and tilted to one side to allow the excess wax to drip off one corner of the panel. The coated panel shall be set aside to cool to room temperature and then placed in a cold room maintained at minus 5°F ± 0.5°F. for 2 hours. The panel shall be removed and immediately bent through 180 degrees over a half-inch mandrel which had also been maintained at that temperature. This test shall be run in triplicate.

4.4.9 Water absorption.- A sufficient quantity of the compound shall be melted and poured into a mold so that on cooling, a block of material approximately one inch by one inch by two inches is obtained. The sample shall be allowed to solidify and cooled in a desiccator for at least six hours. A block showing any crack after cooling shall not be used for test. The sample shall be accurately weighed and immersed in a liter of distilled water for 24 hours at a temperature of 77° ± 2°F. The sample shall be removed from the water, wiped dry of surface water with a soft rag and weighed accurately. Calculate the percent of water absorbed.

4.4.10 Electrolytic corrosion.- A glass rod approximately 1/4 inch in diameter and 8 inches long shall be flash dipped into the molten material maintained at 15°F. above its complete melting point. Two electrodes, each consisting of a single turn of bare copper wire of 100.5 circular mils area (30AWG), shall be looped around the center of the material and spaced 1/4 ± 1/16 inch apart. Each electrode shall be brought out to opposite ends of the glass rod by winding 3 to 4 turns per inch around the rod. Two such samples shall be placed in a humidity chamber at 70° ± 2°F., and a humidity of above 90 percent for seven days. A potential of 200 to 250 volts D.C. shall be placed on the electrodes while in the humidity chamber. The sample shall be examined at the end of this test and the electrodes shall show no evidence of green corrosion products.

4.4.11 Fungus resistance.- The fungus resistance of the wax shall be determined following the procedure prescribed hereinafter.

4.4.11.1 Preparation of cultures.-

4.4.11.2 Test organisms.- The following fungi shall be used for testing the fungistatic effectiveness of the wax (see 6.4).

Name of Organisms	American Type Culture Collection No.	Quartermaster Culture Collection No.
Aspergillus niger	9642	QM 386
Aspergillus flavus	9643	QM 380
Penicillium funiculosum	9644	QM 391
Trichoderma sp	9645	QM 365

4.4.11.3 Maintaining stock cultures.- Cultures of the fungi listed in 4.4.11.2 shall be maintained separately on an appropriate medium, such as potato-dextrose agar. The stock cultures shall be kept not more than four months in a refrigerator at a temperature from 3° to 10°C. Subcultures incubated at 28° to 30°C. for 7 to 20 days shall be used in preparing spore suspensions.

4.4.11.4 Spore suspension.- Prepare a spore suspension of each of the four fungi by pouring into one subculture of each fungus a sterile 10-ml portion of water or of a sterile solution containing 0.05 g per liter of a nontoxic wetting agent such as sodium dioctyl sulfosuccinate. Use a sterile platinum or nichrome inoculating wire to scrape gently the surface growth from the culture of the test organism. Pour the spore charge into a sterile 125 ml glass-stoppered Erlenmeyer flask containing 45 ml of sterile water. Filter the suspension through a thin layer of sterile glass wool in a glass funnel into a sterile flask in order to remove mycelial fragments. Centrifuge the filtered spore suspension aseptically, and discard the supernatant liquid. Resuspend the residue in 50 ml of sterile water and centrifuge. Wash the spores obtained from each of the fungi in this manner three times. Dilute the final washed residue with the sterile mineral-salts solution in such a manner that the resultant spore suspension shall contain 1,000,000 ± 200,000 spores per ml as determined with a counting chamber. Repeat this operation for each organism used in the test and blend equal volumes of the resultant spore suspension to obtain the final mixed spore suspension. The spore suspension may be prepared fresh each day or may be held in the refrigerator at 3° to 10°C. (37.4° to 50°F.) for not more than 4 days.

Preparation of mineral-salts solution.- The solution shall contain the following:

Potassium dihydrogen orthophosphate (KH_2PO_4)	0.7 g
Potassium monohydrogen orthophosphate (K_2HOP_4)	0.7 g
Magnesium sulfate ($MgSO_4 \cdot 7H_2O$)	0.7 g
Ammonium nitrate (NH_4NO_3)	1.0 g
Sodium chloride (NaCl)	0.005 g
Ferrous sulfate ($FeSO_4 \cdot 7H_2O$)	0.002 g
Zinc sulfate ($ZnSO_4 \cdot 7H_2O$)	0.002 g
Manganous sulfate ($MnSO_4 \cdot 7H_2O$)	0.001 g
Distilled water	1000 ml

4.4.11.5 Test medium.- The previously sterilized and molten medium shall be poured into sterile 90 mm diameter petri dishes with approximately 25 ml of medium placed in each dish, and allowed to solidify. The test medium shall be the same as specified in 4.4.11.4, except that 15.0 grams agar shall be added.

4.4.11.6 Preparation of test specimens.-

4.4.11.6.1 Conditioning of wax.- Place approximately 300 ml of wax in a low form 600 ml beaker. Heat the container with the wax in a well-ventilated oven maintained at $115^{\circ} \pm 5^{\circ}C$. for 24 hours. Remove the container with the wax from the oven and place it on a hot plate, maintaining the wax at $100^{\circ} \pm 5^{\circ}C$.

4.4.11.6.2 Test specimens.- A sheet of Whatman No. 2 filter paper or approved equal shall be dipped into the molten wax. The impregnated filter paper shall be withdrawn and held under a heating lamp to drain off the excess wax, and cooled to room temperature. The wax coating shall be not greater than 3 mils on each side of the paper. A total of 4 test specimens, each one inch square, shall be cut or punched from the wax coated filter paper for each wax sample tested.

4.4.11.6.3 Inoculation and incubation.- Each of the 4 test specimens prepared as in 4.4.11.6.2 shall be placed on the center of the set agar in separate petri dishes (see 4.4.11.7). The surface of the medium as well as that of the test specimen shall then be inoculated with the composite spore suspension either by spraying the suspension from an atomizer so that the entire surface is moistened by the suspension, or by delivering 0.5 to 1.0 ml of the suspension from a pipette,

and tilting the dish from side to side in order to moisten the entire surface of the medium and the specimen. With each daily group of tests, each of 3 pieces of filter paper, 1-inch square, shall be placed on set agar in separate petri dishes. These shall be seeded with the spore suspension, the manner indicated above, to serve as controls. The petri dishes shall be incubated at a temperature of 25° to 30°C. at a relative humidity over 90 percent and shall be examined after 14 days incubation.

4.4.11.7 Evaluation of results.-

4.4.11.7.1 Fungus growth in control dishes.- There shall be copious fungus growth on the uncoated filter paper squares in each of 3 control dishes. Absence of such growth requires repetition of the test, and shall not be construed as constituting a failure on the part of the wax.

4.4.11.7.2 Fungus growth in test dishes.- There shall be no visible mold growth on any of the test specimens, as observed with the naked eye. If mold growth is present on only one of the test specimens, the test may be repeated. In order for the wax to be considered fungistatic, all of the test specimens shall pass the test.

4.4.12 Copper-8-quinolinolate determination.- Transfer a 5 g sample to a 400-ml beaker and heat at highest heat of hot plate until the wax is melted. Continue heating at highest heat without a cover glass (to allow free access of air) and add an 11 cm filter paper that has been folded twice and set aflame. The burning part of the filter paper should protrude above the melt. The wax will ignite and burn. After the burning is complete, remove the beaker from the hot plate and allow to cool. Add 30 ml of concentrated nitric acid and 10 ml of perchloric acid (70 percent). Cover with a watch glass and boil down at moderate heat to about 5 ml to destroy the residual organic matter. Allow to cool, and add 300 ml of distilled water and 3 ml of concentrated nitric acid. Electrolyze for copper with stirring for 1 hour at 2 amp. per sq. dm., using a platinum anode and a tared platinum gauze cathode. Without interrupting the current, lower the beaker while washing the cathode with a stream of water from a wash bottle. Dip the cathode in distilled water and then in 95 percent ethyl alcohol. Dry the cathode in an oven at 105°C. for 5 minutes, cool, weigh the deposit as metallic copper.

Calculate as follows:

$$\text{Copper-8-quinolinolate, percent} = \frac{553.5 \times \text{grams of copper}}{\text{grams of sample}}$$

5. PREPARATION FOR DELIVERY

5.1 Packaging.- Packaging shall be level A or C as specified (see 6.2).

* 5.1.1 Level A.- Wax, put up in cake form of 5 to 15 pounds, shall be individually wrapped or bagged in glassine paper or other grease resistant material that is compatible with the product. The package shall be restrained from becoming undone.

5.1.2 Level C.- Wax shall be packaged to afford adequate protection against physical damage during shipment from the supply source to the first receiving activity. The supplier may use his standard practice when it meets this requirement.

5.2 Packing.- Packing shall be level A, B or C as specified (see 6.2).

* 5.2.1 Level A.- Wax, packaged as specified in 5.1, shall be packed in a snug-fitting fiberboard shipping container conforming to style RSC-L, grade V2s of PPP-B-636. The inside of each shipping container shall be fitted with a taped liner conforming to type CF, class weather-resistant variety DW, grade V15c of PPP-F-320. Each shipping container shall be closed, waterproofed and reinforced in accordance with the appendix of the container specification. The weight of the contents of each shipping container shall not exceed 65 pounds.

* 5.2.2 Level B.- Wax, packaged as specified in 5.1, shall be packed in a snug-fitting fiberboard shipping container conforming to style RSC-L, type CF (variety SW) or SF, class domestic, grade 275 of PPP-B-636. The inside of each shipping container shall be fitted with a taped liner conforming to class domestic, variety DW, grade 275 of PPP-B-636. Each shipping container shall be closed in accordance with method II as specified in the appendix of the container specification. The weight of the contents of each shipping container shall not exceed 65 pounds.

* 5.2.2.1 When specified (see 6.2), the shipping container shall be a grade V3c or V3s fiberboard box fabricated in accordance with PPP-B-636 and closed in accordance with the appendix of the box specification. The shipping container material may also be grade V4s of PPP-F-320.

* 5.2.3 Level C.- Wax, packaged as specified in 5.1, shall be packed in a manner to insure carrier acceptance and safe delivery to destination at the lowest transportation rate for such supplies. Containers shall be in accordance with rules or regulations of carriers applicable to the mode of transportation.

5.3 Marking.- In addition to any special marking required by the contract or order, shipping containers shall be marked in accordance with MIL-STD-129.

6. NOTES

* 6.1 Intended use.- The wax covered by this specification is intended for the treatment of electrical equipment to protect against fungus attack and visible fungus growth. It is not suitable for coating printed circuit board assemblies. It is not intended for use where temperatures exceed 165°F.

* 6.2 Ordering data.- Procurement documents should specify the following:

a. Title, date and number of this specification

b. Selection of applicable levels of packaging and packing (see 5.1 and 5.2).

c. When weather-resistant grade fiberboard shipping containers are required for level B packing (see 5.2.2.1).

6.3 Copper-8-quinolinolate.- The specified test is for the purpose of ascertaining that the fungicide is properly blended with the wax and is not to be considered a performance test for evaluating fungus resistant agents.

6.4 Test organisms.- Cultures of the fungi listed under 4.4.11.2 may be obtained from the American Type Culture Collection, 12301 Parklawn Drive, Rockville, Maryland 20852, or for service use from the Pioneering Research Laboratory, U. S. Army Natick Laboratories, Natick, Massachusetts 01762.

6.5 The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and suppliers are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodian:

Army - GL

Air Force - 68

Review activities:

Army - GL, EL, MI. MD

Air Force - 68

User activities:

Army - WC

Navy - MC

Preparing activity:

Army - GL

Project No. 9160-0030

MIL-W-12465C
AMENDMENT-1

9 August 1972

MILITARY SPECIFICATION

WAX, MICROCRYSTALLINE (ELECTRICAL INSULATING)

This amendment forms a part of Military Specification MIL-W-12465C, dated 10 June 1968, and is approved for use by all Departments and Agencies of the Department of Defense.

PAGE 1

2.1, under listing of Federal Specifications.- Delete "Box Fiberboard" and substitute "Boxes, Shipping, Fiberboard." Delete "PPP-F-320 - Fiberboard, Corrugated and Solid, Sheet Stock (Container Grade), and Cut Shapes."

PAGE 2

2.2, line 2.- Delete "otherwise indicated" and substitute "a specific issue is identified."

At the end of the paragraph, add the following:

"National Motor Freight Traffic Association, Inc., Agent

National Motor Freight Classification

(Application for copies should be addressed to the American Trucking Associations, Inc., Tariff Order Section, 1616 P Street, N.W., Washington, D.C. 20036.)

Uniform Classification Committee, Agent

Uniform Freight Classification

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Reverside Plaza, Chicago, Illinois 60606.)"

PAGE 3

3.5, under "Penetration range, 0.1 mm".- Delete "2 to 10" and substitute "10 to 20".

PAGE 5

4.3.4, line 4, after "operation".- Add a period.

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PAGE 5 (cont'd)

Lines 5 and 6.- Delete and substitute, "Shipping containers fully prepared for delivery shall be examined for closure defects as listed below."

PAGE 13

5.2.1, line 4, after "taped".- Insert "box".

Line 5.- Delete "PPP-F-320", and substitute "PPP-B-636".

5.2.2, line 4, after "taped".- Insert "box" and after "to" insert "type CF".

5.2.2.1, line 2.- Delete "V3c, V3s". Also, delete last sentence entirely.

PAGE 14

5.2.3 Last sentence.- Delete and substitute "Containers shall be in accordance with Uniform Freight Classification Rules or National Motor Freight Classification Rules, as applicable".

Custodians:

Army - GL
Air Force - 68

Review activities:

Army - EL, MD

User activities:

Army - WC
Navy - MC

Preparing activity:

Army - GL

Project No. 9160-0042

☆ U. S. GOVERNMENT PRINTING OFFICE: 1972-714-536/874

MIL-W-12465C
AMENDMENT-2

11 June 1975
SUPERSEDING
Amendment-1
9 August 1972

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"National Motor Freight Traffic Association, Inc., Agent

National Motor Freight Classification

(Application for copies should be addressed to the American Trucking Associations, Inc., Tariff Order Section, 1616 P Street, N.W., Washington, DC 20036.)

Uniform Classification Committee, Agent

Uniform Freight Classification

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)"

FSC 9160

PAGE 3

3.5, under "Penetration range, 0.1 mm". Delete "2 to 10" and substitute "10 to 20".

PAGE 5

4.3.4, line 4, after "operation". Add a period.

Lines 5 and 6. Delete and substitute "Shipping containers fully prepared for delivery shall be examined for closure defects as listed below."

PAGE 13

5.2.1, line 4, after "taped". Insert "box".

Line 5. Delete "PPP-F-320" and substitute "PPP-B-636".

5.2.2, line 4, after "taped". Insert "box" and after "to" insert "type CF".

5.2.2.1, line 2. Delete "V3c, V3s". Also, delete last sentence entirely.

PAGE 14

5.2.3, last sentence. Delete and substitute "Containers shall be in accordance with Uniform Freight Classification Rules or National Motor Freight Classification Rules, as applicable."

6.4 Test organisms. Delete "Pioneering Research Laboratory, US Army Natick Laboratories, Natick, Massachusetts 01762" and add "Natick Development Center Culture Collection of Fungi (QM), Department of Botany, University of Massachusetts, Amherst, MA 01002."

Custodians:

Army - GL
Air Force - 68

Review activities:

Army - EL, MD

User activities:

Army - WC
Navy - MC

Preparing activity:

Army - GL

Project No. 9160-0048

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MEMO FOR THE RECORD 5 Dec 88

The statement in paragraph 2(b) must be deleted from the survey letter because it is false. There is no HEPA filter attached to the autoclave. I contacted the manufacturer to confim Mr Hutchinson's suspicion that there was no HEPA filter on the autoclave. The manufacturer said what looked like a filter or scrubber was actually a muffler. We regret the incorrect statement.

An O.I. for respiratory protection has been incorperated in the shop as of 2 Dec 1988.

Mark Johnson, SRA
Bioenvironmental Engineering Technician

DEPARTMENT OF THE AIR FORCE
UNITED STATES AIR FORCE HOSPITAL HILL (AFLC)
HILL AIR FORCE BASE, UTAH 84056-5300

REPLY TO
ATTN OF: SGE (SrA Johnson/74358)

NOV 23 1988

SUBJECT: Annual Bioenvironmental Engineering Survey, Bonding Shop, bldg 265

TO: MANPSA

1. An annual Bioenvironmental Engineering Survey was accomplished in the Bonding Shop during August 1988. This survey was accomplished IAW AFR 161-35 and AFOSH Std 161-17. The Union was contacted prior to the initial visit to the shop.

2. The following is a summary of items identified that need to be addressed. Details of the survey can be found in attachment 1.

a. Past discrepancies not corrected:

(1) The Bonding shop must have a Respiratory Protection Operating Instruction (O.I.), specifically for that shop. This is a requirement stipulated in "The Code of Federal Regulations-29 CFR 1910.134."

(2) At the time of the survey the ventilation system in the Chemical Milling area was still substandard. We understand that during the interim of the survey and this report, some work has been done on the system.

b. Current discrepancies: Hepa Filter should be replaced on the large autoclave.

3. This survey is applicable to the following PHOENIX zones: 22t511, 22t5E2, 2265E3 and 2265E4. See attached survey discussion for more specific descriptions of these areas. PHOENIX is a computerized program for tracking personnel, where they work, and the exposures they receive. It is important that you let us know about any changes in these areas e.g. personnel changes, chemical changes, etc.

4. This information must be made available to each affected worker. In addition, employees should have available information on all the chemicals that they use. Bioenvironmental Engineering case files are available for worker review. Please maintain a copy of this survey in the work area until next year's survey is received. For further assistance or questions regarding this survey, please contact SrA Johnson at extension 74358 or myself at 71185.

Reginald R. Childs

REGINALD R. CHILDS
Bioenvironmental Engineering Svcs.

1 Atch: Survey Discussion

cc: MAN
MAN Safety
MAQVS (w/atch)
SEG
SGPO
SGPM

SGB OFFICIAL FILE COPY

SURVEY DISCUSSION

The following is a discussion of the survey performed in Bonding Shop during August 1988. Particular details such as instrumentation used and calibration records are maintained in the shop case file in the Bioenvironmental Engineering office, Bldg 249.

1. Description of zones in shop: Z265B1-Supervisors; Z265B2-Honeycomb Repair area; Z265B3-Chemical Milling area; and Z265B4-swing shift personnel.

2. Potential hazards and associated controls:

HAZARD	CONTROL
Potential exposure to Alkaline and Acid mists	Local ventilation and respirators
Potential exposure to Organic Vapors from Toluene, MEK, Acrolein, Diethylene triamine, 1,1,1-Trichloroethane, and Epoxies/ Hardeners.	Elaboration of control methods will be addressed in applicable portions of this report.
Potential exposure to particulates generated during Sanding, Grinding, and Sawing cured Epoxy, Metals and Composites.	Local/Central exhaust ventilation and respirators.
Potentially hazardous noise exposures	Ear muffs or plugs and education.

3. Current findings and recommended corrections:

a. Illumination: There were no complaints concerning the lighting in the Bonding shop work areas, so we presumed that it is adequate for the type of tasks performed there.

b. Noise: Previous noise measurements demonstrate that employees that work in the Honeycomb Repair area (zones Z265B2 and Z265B4) are exposed to hazardous noise above the 84 decibel A-weighted (dBA) eight hour Equivalent Continuous Level. They are routinely exposed to hazardous noise sources. Please insure that employees wear hearing protectors when working in the Honeycomb Repair area.

c. Sampling: We sampled for Sodium Hydroxide, Sulfuric Acid and Hydrogen in the Chemical Milling shop (Z265B3) and dust in the Honeycomb Repair area (Z265B2).

Task/Source	Contaminant	Exposure(mg/m3)
Chemical Milling of aluminum parts	Sodium Hydroxide	0.015-0.3 (Personal) 0.63-2.5 (Area)
	Hydrogen	Less than 400 (Area)
Dip Tank	Sulfuric Acid	None detected
Honeycomb Repair Grinding/Sanding	Dust (Respirable)	0.1-0.3 (Personal)

(1) Sampling results demonstrate that contaminants (the ones we sampled for) are adequately controlled in the Honeycomb Repair area.

(2) Although all of the personal samples in the Chemical Milling area were below the Permissible Exposure Limits (PEL), the area samples signal that there is a potential to expose workers to Airborne contaminant levels above the PEL (See 3.d. for further elaboration).

a. Ventilation:

(1) Air sampling for respirable particulate (formed by sanding) in the Sanding room of the Honeycomb Repair area show that the Low Volume High Velocity System is an effective technique for controlling dust.

(2) In the Chemical Milling area the ventilation system on the Sodium Hydroxide Tank was not working as effectively as it should. As indicated in paragraph 3.c.(2) there is a real potential to expose workers to Airborne levels of Sodium Hydroxide Mist above the PEL. The effectiveness of the system is temperature dependent; that is, during cool weather the ventilation system works better than it does in hot weather. The poor performance of the ventilation system is likely due to a combination of things, such as, deterioration of the system, and competitors to capture velocity (cooling fans and wind blowing through open windows). Please bear in mind that the objective of the hood is emission capture. If the hood fails in its mission here, then it matters not what the rest of the system can do. Your process engineering section should look into this problem. This office will be glad to assist in this matter. Another aspect regarding milling and cleaning aluminum with Sodium Hydroxide and Sulfuric Acid is the production of Hydrogen. Our measurements indicate that Hydrogen Gas concentrations were well below the lower explosive limit, and conditions that would be dangerous are not likely to occur, but remember its presence. Failure of the ventilation system, a foam blanket on the surface of the liquid (any circumstance causing Hydrogen and air to become trapped) plus a source of heat (autoignition temperature 560 degrees C.), may result in an explosion.

e. Personal Protective Equipment (PPE):

(1) PPE includes goggles, rubber gloves, faceshield, rubber apron (Chem Mill). Faceshields in chem mill area were very scratched up, but functional.

(2) Respiratory Protection: Currently air samples show that respiratory protection is required for operations performed in this area. Air purifying reusable MSA organic vapor/high efficiency cartridges in Chem Mill area and Honeycomb Repair areas. Disposable dust respirators are also used for dust. An individual having a beard was observed wearing a full face reusable respirator. He cited the need for the beard because of medical reasons and therefore needed a full face respirator. Under no circumstances should this person be allowed to wear a respirator while wearing a beard. Someone else should accomplish the work requiring the respirator. An individual was also seen wearing a disposable dust respirator. While this may not seem important, OSHA recognizes it as a respirator and therefore requires fit testing. OSHA mandates engineering controls to reduce worker exposure be used where feasible. If employees use respirators, even if there is no requirement, they must comply with all the requirements of the Hill AFB respiratory protection program to include annual medical qualification, training and fit-testing. In addition, the shop must have a written respiratory protection operating instruction.

f. Eyewash/shower Units: Eyewash/shower units were inspected for cleanliness, location and operation in accordance with AFOSH Std 127-32. These units do meet the requirements of this standard.

g. Hazardous Materials: Acids stored in locked building next to Chem mill Epoxy and cleaning compounds are stored in cabinets for flammable liquids. Sodium hydroxide and Turco 9H stored in 55 gallon drums outside.

Licensed chemicals	License number	Expiration Date
Sodium Hydroxide	85-159	28 Oct 88
Cleaning compound	" -180	19 Nov 88
1625 Epoxy	86-002	10 Jan 89
Turco 9H	" -014	5 Feb 89
Hydrochloric Acid	" -020	20 Feb 89
Hydrochloric Acid	" -021	"
Pasa-gel 105	" -022	"
MEK Peroxide	87-090	7 Apr 90
Resin 4110	" -092	"
Sealant	" -095	"
2partepoxy resin	" -096	"
Sealing compound	" 97	"
Sealant Type VA1	" 98	"
Epoxy resin B/1 EF	" 99	"

Diethyline Triamine	" 100	"
Cleaning compound	" 101	"
Powdered Alodine	" 102	"
Errosion Resistant Coating	" 103	"
Prepregnated graphite tape	" 104	"
Sealing compound	" 109	8 Apr 90
Sealing compound	" 117	9 Apr 90
Manganese dioxide slurry	" 125	10 Apr 90
Turco 4215 Alkaline Clean	" 154	12 May 90
Sodium Dichromate	88-035	19 Feb 91
Epoxy Coating	" 036	"
Potting compound	" 037	"
Sulfuric Acid	" 038	"

h. Pollution Control: 1,1,1 Trichloroethane tank drained and disposed with 505 chem lab. All other tanks in Chem mill disposed by 505 chem lab. Epoxys, sealants and 1,1,1 Trichloroethane squeeze bottles used in-process.

i. Potential Carcinogens in Shop: The International Agency for Research on Cancer (IARC) has listed known and probable human carcinogens. The following list has been developed using information you have provided concerning materials used in your shop. Association with these materials does not necessarily mean an individual will develop cancer. You may want to research the availability of materials containing less hazardous substances. Lead Chromate - In Epoxy Coating - NSN 8010-00-082-2450; Asbestos - In Adhesive - NSN 8040-00-016-8662, Epoxy Resin 1751, Epoxy Resin 1046; Chromic Acid - In Pasa-gel 105, Corrosion Resistant Coating; Strontium Chromate - Epoxy Coating same as Lead Chromate; Sodium Chromate - In Turco 3878, and Turco 4215, in Cleaning compound 6850-00-946-1464; Sodium Dichromate - In 6810-00-281-2680 and 6810-00-262-8566; Zinc Chromate - In 8010-00-899-5754.

4. The Aerospace Medicine Council will make a determination regarding occupational health examination requirements for these workers. Any questions concerning this subject should be directed to Occupational Medicine, SGPC.

5. Occupational Health Training:

a. Annual health related OSHA training for employees conducted by the supervisor IAW AFR 127-12 should include:

(1) Proper use and care of protective equipment.

(2) Proper respirator use in accordance with written shop OI.

(3) Effects of drinking and eating in work area.

(4) Effects of acids, caustic soda, epoxies, sealers, solvents, dust and Hydrogen.

(5) Effects of hazardous noise.

b. The Occupational Health Nurse Educator (ext 71170) should be contacted by the supervisor for technical assistance in completing the required health training.