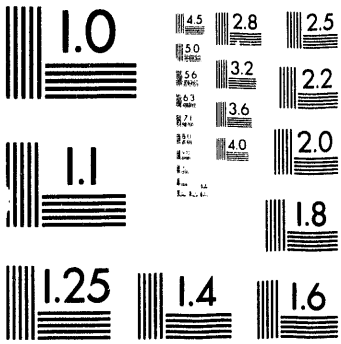
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3
7.1

1 of 1

Metrology Process Waste Assessment: Fluorinert Bath Temperature Calibration Z951-421-1

Kansas City Division

G. V. Mohr

KCP-613-5216

Published September 1993

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United States Department of Energy

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METROLOGY PROCESS WASTE ASSESSMENT: FLUORINERT BATH TEMPERATURE CALIBRATION Z951-421-1

G. V. Mohr

Published September 1993

G. V. Mohr, Project Leader

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W. E. Cundiff
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Technical Communications
Kansas City Division

AlliedSignal
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Contents

PWA Fluorinert Z951-421-1

Introduction

Fluorinert, FC-40 and FC-72, was chosen for this pilot Process Waste Assessment (PWA) because it is the most frequently used chemical in Metrology. Fluorinert has been used since 1986 as a substitute for trichloroethylene. Although it is much safer than trichloroethylene, it still has disadvantages. If Fluorinert is taken above its boiling point it will produce toxic chemicals, creating a health hazard rating of 4. To prevent this occurrence, over-temperature controls are installed on the bath and a fume hood is provided for the vapors.

Process Description

Fluorinert is used in a Rosemount Temperature Bath, CE 64138, as a stirred temperature medium which provides a stable temperature environment to compare readings of a Standard Platinum Resistance Thermometer to readings obtained from thermocouples, thermistors, and other types of thermometers. Fluorinert is used primarily to provide a safe liquid medium that can be varied from -120 to 200°F.

When temperature devices are removed from the bath, the excess Fluorinert is removed by wiping with a KayDry. Contaminated KayDrys are disposed of as step can waste. The process flow diagram is on Worksheet 4 (Appendix).

Process Assessment

A. The amount of Fluorinert placed in solid waste was determined by weighing a KayDry, dipping a SPRT in the temperature bath, wiping with a KayDry, re-weighing the KayDry, and recording the difference in weight. This amount was then multiplied by the number of calibrations performed in a year using this bath. The inventory was then checked to see how much Fluorinert was used over the same year. All of this amount was assumed to have evaporated or been deposited on the KayDrys. The amount evaporated was divided between point source and fugitive air emissions through an engineering estimation.

B. The mass balance is on Worksheet 5.

C. The waste stream summary is on Worksheet 6.

D. An activity production index was calculated for this process by dividing the mass of Fluorinert used per year by the number of calibrations performed each year.

Activity Production Index =

$$\frac{\text{Mass of Fluorinert (FC40 + FC72)}}{\text{Number of Calibrations}}$$

$$\frac{72 \text{ Pounds}}{198 \text{ Calibrations}}$$

$$\frac{0.39 \text{ Pounds Per Calibration}}{\text{PWA Fluorinert Z951-421-1}}$$

Option Summary and Analysis

The option generation portion of this PWA resulted in identification of four possible options. The options that were analyzed and determined not to be viable because of the small amount of step can waste generated were to reuse the KayDrys and to extend the calibration intervals. The use of a smaller bath would not minimize the waste generated because the stirring action enhances the evaporation and the bath is covered or the Fluorinert removed when calibrations are not being performed. There was also a concern that a smaller bath would result in a decrease in the temperature stability.

The use of isopropyl alcohol as a substitute was evaluated; however, the potential fire hazard was considered to be a much greater risk than the health hazard from heating Fluorinert above its boiling point. There are over-temperature limit switches on the bath in addition to the vented hood to assure operator safety.

It should be noted that the use of Fluorinert in this calibration process is the result of replacing trichloroethylene which was considered too hazardous to use.

Conclusion

The current process, which was established after identifying Fluorinert as a replacement for trichloroethylene, was determined to provide an excellent calibration medium with a minimal impact on the environment and to result in hazardous waste disposal costs of only $6.93 per year.

Recommendations

Fluorinert is the best working fluid for this process in spite of the health hazard associated with boiling the fluid because of the precautions available to prevent this from occurring. It is recommended that no additional effort be applied to minimization of waste for this process.

PWA CHECKLIST

PWA ID Number(s): Z951-421-1

Coordinator Review: _____

Date: February 26, 1992

Worksheets

x 1. Have the worksheets been completely filled out? Not all blocks required to be completed

x 2. Are the worksheets legible? (i.e. copies not too faint, handwriting too sloppy)

x 3. Are the issue dates and PWA ID codes at the top of each worksheet? (Recommend that the PWA title be placed, at a minimum, on worksheets 1 and 2.)

Worksheet 2 - Process Description

x 4. Does the process description answer the following questions: What materials are used? In what manner are they used (including equipment) ? For what result are the materials used? Was the post location and department number identified?

Worksheet 3 - Process Layout

x 5. Have post locations and direction indicator been included on the layout?

Worksheet 4 - Process Flow Diagram

x 6. Are the waste streams properly identified on the flow diagram?

Worksheet 5 - Material Balance

x 7. Were the chemical components, percentages, and CAS #s correctly identified for each material? Are the waste streams consistent with those identified on worksheet 4?

x 8. Is the component information listed on the worksheet? If not, review the MSDS(s). If the components or their percentages were not listed on the MSDS and the MSDS was issued (by the manufacturer) earlier than 1/89, was an updated MSDS pursued from D/932 or the manufacturer? Is the component information, or lack thereof, acceptable?

x 9. Does the input component quantity = the output component quantity?

x 10. Was scrap product considered as a waste stream out of the process? No

Worksheet 6 - Waste Stream Summary

x 11. Are the materials which have components expressed by their components in the left column?

x 12. Do the quantities from worksheet 5 appear on worksheet 6 with the corresponding release code?

Worksheet 8 - Option Generation

x 13. Was research done to identify pollution prevention options (i.e. source reduction, recycling) for the process?

x 14. Are the reasons for not considering an option reasonable?

Instructions: Use the column to the left to verify that a positive response can be given to the questions.

PWA CHECKLIST

Worksheet (continued)

Worksheet 12 - Regulatory Reporting Requirements

x 15. Are the MFL storage areas completed?

x 16. Does the storage code meet the definition on the back of worksheet 12 and not the code that appears on the material container label?

x 17. Is the component information consistent and accurate with the information previously recorded on worksheet 5 and found on the MSDS(s)?

x 18. If point source emissions occurred, was the stack number completed for each component? If not, is a reason given for why it is not available?

Worksheet 14 - Waste Management Reporting Requirements

x 19. Is the Industry/EPA Hazardous Waste Number identified for each waste stream? If not, was Waste Management, D/161, contacted to identify the number? MSDS states None

x 20. If this worksheet is sent to Waste Management without the complete report, was all of the requested information filled out (PWA ID#, Dept., Name, Date, etc..)?

Report

The quality of the PWA report is more important than the quantity of the report. The major goals of the report content should be:

1.) to describe a comprehensive assessment (readers should not be left with questions),

2.) to point out the most important follow-on actions needed for evaluation and implementation of pollution prevention options, and

3.) to exude a positive approach to all of the details surrounding the assessment.

x 21. Did the report format include all of the requirements listed on KCD 2745,O - PWA Final Report?

x 22. Does the final report contain a title page which includes a line for department coordinator approval?

x 23. Does the report provide sufficient detail to ensure that the PWA could be repeated with similar results?

x 24. Were the appropriate options identified and discussed in the report?

x 25. If a carcinogen, CHC, CFC, or extremely hazardous material is involved in the process, was an alternate material discussed in the report?

x 26. Were all wastes envisioned by the reader addressed in the worksheets or was rationale given in the report to explain why it was omitted?

x 27. Did the report indicate that the team would pursue the pollution prevention options identified as reasonable? If not, is there a justification why the team did not pursue the options?

Instructions: Use the column to the left to verify that a positive response can be given to the questions.

Appendix

Worksheets

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WORKSHEET 1
ISSUE DATE 2-26-92
REVISED

PROCESS WASTE ASSESSMENT

PWA TEAM

PWA TITLE Fluorinert Bath Temperature Calibration

PWA ID CODE(S) Z951-421-1

NAME	EMP. #	DEPT.	MAIL CODE	EXT.

*Team Leader

ADDITIONAL RESOURCES:

DEPT.	NAME	EXT.

ENVIRONMENTAL PROTECTION
ENVIRONMENTAL PROTECTION
EMISSION FACTORS
WASTE WATER PRETREATMENT

FIRE PROTECTION
INDUSTRIAL HYGIENE
FACILITIES ENGR(COST ENGR)
WASTE MANAGEMENT
SAFETY
MAINTENANCE(EQUIPMENT)
ANALYTICAL LAB TESTING

Allied Signal

WORKSHEET 2
ISSUE DATE 2-26-92
REVISED____

PROCESS WASTE ASSESSMENT

PROCESS DESCRIPTION

PWA TITLE Fluorinert Bath Temperature Calibration

PWA ID CODE(S) Z951-421-1

PROCESS LOCATION D/421 Temperature/Humidity Lab Post B031

PROCESS DESCRIPTION

Two types of Fluorinert are placed in the Rosemont Temperature Bath, CE 64138, to provide a stable temperature medium for calibration of temperature measuring devices such as thermometers, thermocouples, thermistors and other temperature sensors. The temperature bath is set at required temperatures, a temperature standard and a device to be calibrated are placed in the bath and their readings compared at either a single temperature or multiple temperatures. When temperature measuring devices are removed from the bath, excess Fluorinert is removed with a KayDry.

MAJOR PRODUCTS (Optional):

WASTE STREAM AFFECTED:
(Circle One)

PLATING SOLVENT POLYMER MISCELLANEOUS

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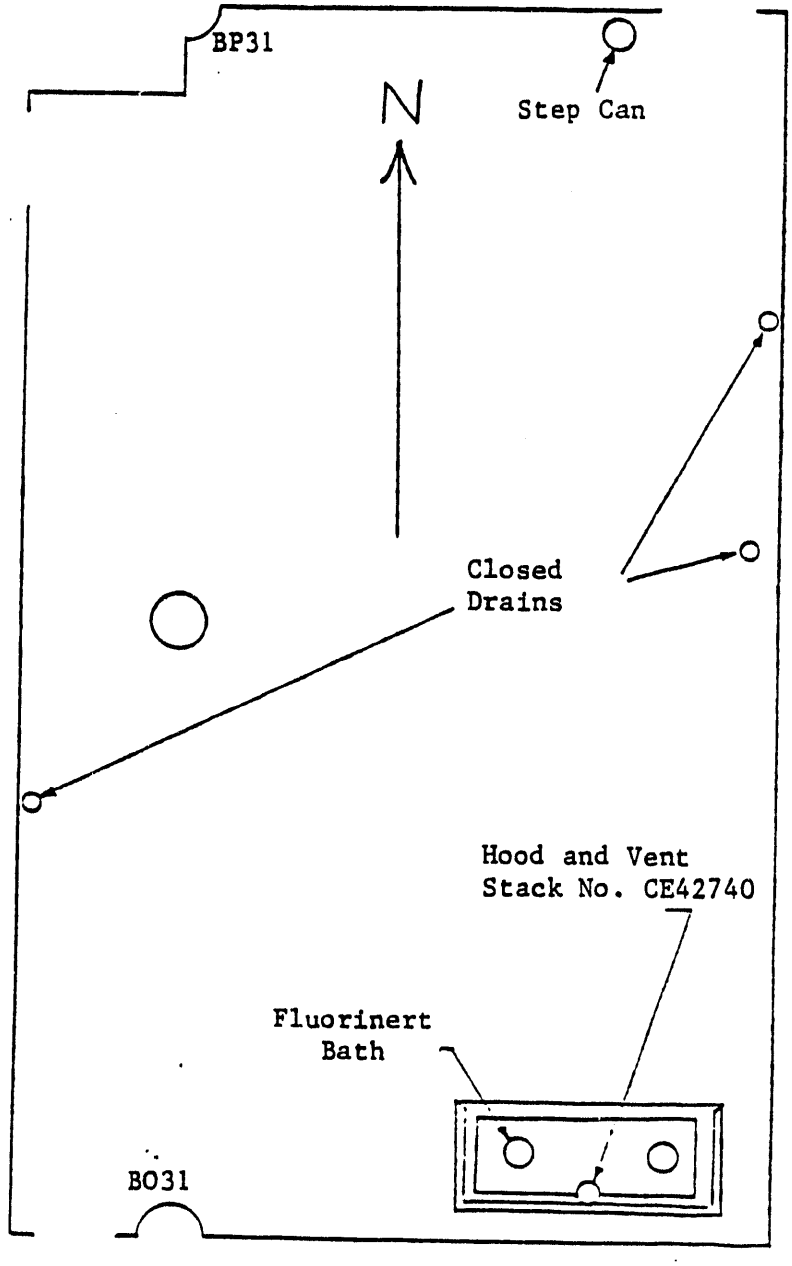
WORKSHEET 3
ISSUE DATE 2-26-92
REVISED____

PROCESS WASTE ASSESSMENT

PROCESS LAYOUT
(OPTIONAL)

PWA TITLE or PWA ID CODE(S) Z951-421-1

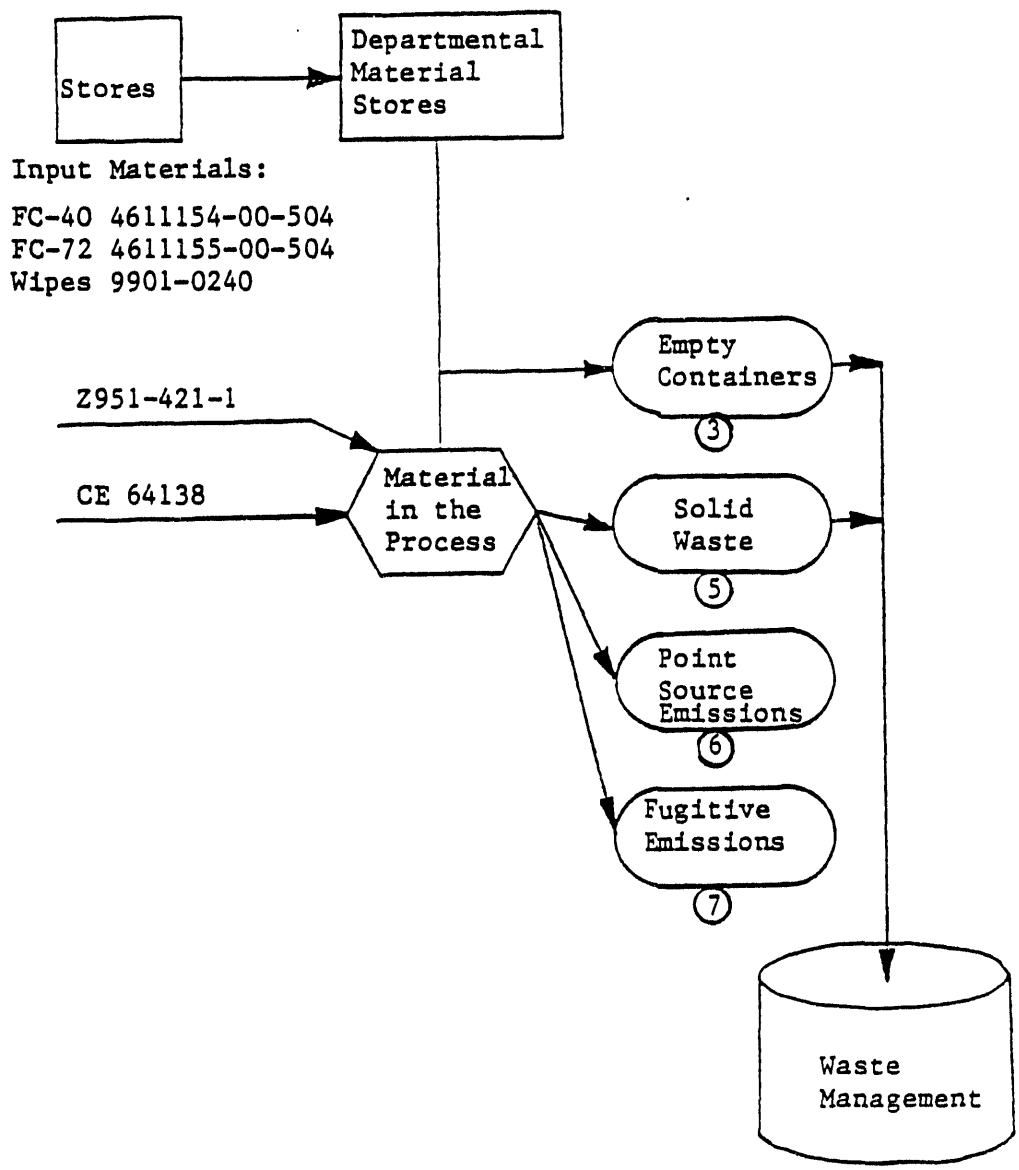


PROCESS WASTE ASSESSMENT

PROCESS FLOW DIAGRAM

PWA TITLE or PWA ID CODE(S) Z951-421-1

(INDICATE THE PWA ID(S) ASSOCIATED WITH THE PROCESS ON THE DIAGRAM.)



Allied Signal

WORKSHEET 5
ISSUE DATE 2-26-92
REVISED_____

PROCESS WASTE ASSESSMENT
MASS BALANCE

PWA TITLE or PWA ID CODE: Temperature Calibration Z951-421-1

			OUTPUT (LBS)								
MATERIAL STANDARD # / SUPPORT STORES #	MATL./COMP. REACTION/PROD (If comp., % of total Mat.) List CAS #	INPUT QTY (LBS) From 12-90 To 12-91	WASTE MGMT. LIQUID *4	WASTE MGMT. SOLID *5	POINT SOURCE AIR *6	FUGITIVE AIR *7	WATER (SANIT.) *8	WATER (INDUST.) *9	INPUT TO ANOTHER PROCESS (Proc. ID) *10	PRODUCT (Retained on) *11	OTHER _____ *12
4611154-00-504	FC-40 Fluorinert	18.4 lb									
	% 100										
	Perfluoro Compound 86508-42-1	18.4 lb		.2 lb	16.4 lb	1.8 lb					
	% 100			1.1%	89.1%	9.8%					
4611155-00-504	FC-72 Fluorinert	58.8 lb									
	% 100										
	Perfluoro Compounds 86508-42-1	58.8 lb		.5 lb	52.5 lb	5.8 lb					
	% 100			.8%	89.3%	9.9%					
99010240	KayDrys	2 lb		2 lb							
	%100			100							

* These are the process releases as coded in the directions for Worksheet 4.

WORKSHEET 5
ISSUE DATE 2-26-92
REVISED _____
PAGE 2 OF 2

PROCESS WASTE ASSESSMENT
MASS BALANCE

PWA TITLE or PWA ID CODE(S): Temperature Calibration Z951-421-1

From: _____
To: _____

MATERIAL STANDARD # / SUPPORT STORES # / NAME	INPUT QTY (LBS) (Component Name and %)	TOTAL OUTPUT Matl./ Comp. / Reaction Prod.	OUTPUT (LBS) WASTE MGMT. EMPTY CONT. *3	WASTE MGMT. LIQUID *4	WASTE MGMT. SOLID *5	POINT SOURCE AIR *6	FUGITIVE AIR *7	WATER (SANIT.) *8	WATER (INDUST.) *9	INPUT TO ANOTHER PROCESS (Proc. ID) *10	PRODUCT (Retained on) *11	OTHER ____ *12
	Empty Containers	10.8 lb.	10.8 lb									
%	100		100									
%												
%												
%												
TOTAL												

* These are the process releases as coded in the directions for Worksheet 4.

Allied Signal

WORKSHEET 6
ISSUE DATE 2-26-92
REVISED____

PROCESS WASTE ASSESSMENT

WASTE STREAM SUMMARY

PWA TITLE or PWA ID CODE(S) Z951-421-1

ATTRIBUTE	Process Release Code 3	Process Release Code 5	Process Release Code 6	Process Release Code 7	Process Release Code ____	Process Release Code ____
WASTE STREAM NAME	Empty Containers	Step Can Waste	(Air) Point Source	(Air) Fugitive		
ANNUAL GENERATION RATE (lbs) From 1- -91 **To** 1- -92						
Overall:						
Components of Concern:						
Empty Containers	10.8 lb					
Wipes		2 lb				
Perfluoro Compounds		.7 lb	68.9 lb	7.6 lb		
DEPT. FINAL DISPOSITION	Waste Management	Waste Management	Air (Stack)	Air (Fugitive		

Allied Signal

WORKSHEET 7
ISSUE DATE 2-26-92
REVISED____

PROCESS WASTE ASSESSMENT

MATERIAL COST SHEET

PWA TITLE or PWA ID CODE(S) Z951-421-1

COST OF INPUT MATERIALS :

MATERIAL(S)	MS/SS NUMBER	COST PER UNIT lb	ANNUAL COST
Fluorinert 40	4611154-00-504	$30.90	$494.40
Fluorinert 72	4611155-00-504	$25.00	$1470.00
Wipes	99010240	$ .77/box	$ .77

OTHER INFORMATION:

COST OF DISPOSAL OF OUTPUT MATERIAL(S):

MATERIAL(S) / WASTE STREAMS	MS/SS NUMBER (If applicable)	COST PER UNIT lb	ANNUAL COST
Wipes	99010240	$2.71	$5.42
Fluorinert FC-40	4611154-00-504	$2.71	$ .54
Fluorinert FC-72	4611155-00-504	$2.71	$1.36
Empty Containers	None	-$ .036	-$ .39

OTHER INFORMATION: Wipes contaminated with Fluorinert are disposed of in step can waste.

PROCESS WASTE ASSESSMENT

OPTION GENERATION

PWA TITLE or PWA ID CODE(S) Z951-421-1

SUGGESTED OPTIONS	CONSIDER *Y/N	DESCRIPTION/COMMENTS
Smaller bath	N	Waste amount not significant
Reuse wipes	N	Waste amount not significant
Use alcohol vs. FC-72	N	Fire hazard unacceptable
Interval evaluation	N	Waste amount not significant

* IF 'Y', FILL OUT WORKSHEET 9.

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WORKSHEET 12
ISSUE DATE 2-26-92
REVISED_____

PROCESS WASTE ASSESSMENT

REGULATORY REPORTING REQUIREMENTS

PWA TITLE or PWA ID CODE(S) Z951-421-1

MATERIAL NAME	Fluorinert FC-40 and FC-72
MS/SS #	4611154-00-504 4611155-00-504
CAS #	85508-42-1
STORAGE LOC (MFL)	D/421 BN30
PHYSICAL STATE	Liquid Pure
STORAGE CODES	D14
ANNUAL USE CY 90	77.2 lbs.
MAX STORED	215 lbs.
PROCESS USE	Amounts are from inventory records

	COMPONENT _	COMPONENT _	COMPONENT _	COMPONENT _	COMPONENT _
COMPONENT	Perfluoro Compounds				
COMPONENT %	100%				
CAS #	86508-42-1				
PHYSICAL STATE	Liquid				
ANNUAL USAGE	77.2 lbs.				
MAX STORED	215 lbs.				
FUGITIVE EM	7.6 lbs.				
POINT SOURCE EM	68.9 lbs.				
STACK NO.	CE 42740				
DEPT. TREATMENT QTY(RECYCLING)	0				
DEPT. TREATMENT EFFICIENCIES	0				
WASTE MGMT. DISPOSAL QTY CY	.7 lbs.				
OFFSITE RELEASES: AIR LAND WATER (IF KNOWN)	76.5 lbs. 0 0				

KANSAS CITY DIVISION
KCD-2745L (11/91)

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WORKSHEET 13
ISSUE DATE 2-26-92
REVISED_____

PROCESS WASTE ASSESSMENT

REGULATORY REPORTING REQUIREMENTS
(COMPLETE APPLICABLE INFORMATION)

PWA TITLE or PWA ID CODE(S) Temperature Calibration
Z951-421-1

SURFACE FINISHING OPERATION

MATERIAL NAME	N/A				
MS/SS #					
	COMPONENT	COMPONENT	COMPONENT	COMPONENT	COMPONENT
COMPONENT					
SUBSTRATE					
APPLICATION METHOD					
COATING TYPE					
COATING USE/RATE					
SOLV. /% OF COATING					
THINNER AND % OF COATING AND THINNER MIXTURE					
STRIPPER AND %					

EMISSION CONTROL EQUIPMENT

TYPE	N/A
CE#	
PROCESS CONTROLLED	
EFFICIENCY	

DEGREASER/SPRAY EQUIPMENT

CE#	N/A
SOLVENT(S)	
CAPACITY	
DEPT./POST LOC.	

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WORKSHEET 14
ISSUE DATE 2-26-92
REVISED_____

PROCESS WASTE ASSESSMENT

WASTE MANAGEMENT
REGULATORY REPORTING REQUIREMENTS

PWA TITLE AND PWA ID CODE(S) Temperature Calibration
Z951-421-1

Description of Waste Generation

(Optional: Attach Process Description, Process Flow Diagram and Mass Balance.)

Fluorinert is used as a temperature medium during calibrations. During use, part of the liquid is evaporated, which accounts for the point source and fugitive emissions. When some parts are removed from the bath, a wipe is used to remove excess Fluorinert. This accounts for the solid waste put in the step cans.

Is recycling performed within the department? Yes_____ No X

Method of Recycling:

Is the reclaimed material returned to the department?
Used by others_____ Yes_____ No X

If used by others, in what way?

Is the waste mixed with other wastes before it is sent to Waste Management?

Process Release Code	Waste Stream Name	Ind./EPA Haz. Waste No.	Yes/No	Materials Mixed or Comments
3	Empty Containers	None	Yes	Other empty containers
5	Solid Waste	None	Yes	Fluorinert and Wipes

KANSAS CITY DIVISION
KCD-2745N (11 91)

WORKSHEET 15
ISSUE DATE 2-26-92
REVISED

PROCESS WASTE ASSESSMENT
EMPLOYEE EXPOSURE ASSESSMENT INFORMATION
(FOR ALL MATERIALS)

PWA TITLE Fluorinert Bath Temperature Calibration

PWA ID CODE(S) Z951-421-1

1. **Number of personnel that work directly with this process.** 2

2. **Are there any KCD known or suspected carcinogens used or produced in this process?** Yes ____ No X

3. **How could employees be exposed during performance of the process? (Mark more than one if needed.)**

   4 Inhalation of airborne contaminant
   3 Eye/skin absorption by direct contact with substance
   2 Ingestion of substance
   1 Injection or entry through cuts, scrapes, burns, or other open wounds
   0 No exposure, not possible

4. **Does the process release airborne contaminants (e.g. dusts, mists, fumes) into the work area?**

   4 Airborne or high potential to become airborne
   3 Airborne or moderate potential to become airborne
   2 Airborne or low potential to become airborne
   1 Not airborne but may be released by an incident
   0 Not airborne, not possible

5. **Can employees recognize if they are exposed to the substance in the work area?**

   3 Not perceptible, no warning properties (e.g., no odor)
   2 Barely perceptible, poor warning properties
   1 Perceptible, good warning properties
   0 Highly perceptible, warning properties at very low levels

6. **What types of air contaminants could be released into the work area? (Mark more than one if needed.)**

7 Gas (e.g., compressed nitrogen gas)
6 Vapor (e.g., evaporation of solvent)
5 Dust (e.g., mechanical grinding or solid)
4 Aerosol (e.g., by-product of combustion)
3 Fume (e.g., welding of metal)
2 Mist (e.g., spray painting)
1 Fiber (e.g., refractory ceramic fibers)
0 Unknown type of contaminant

7. **What type of administrative or process controls are used in the work area during the process? (Mark more than one if needed.)**

4 Carcinogen Control Program
3 Mandatory employee rotation or time limit
2 Written safe work practices or supervision
1 Employee information and training
0 No administrative controls, not required

8. **How many employees are exposed in the work area while working on the process?**

4 More than 50 employees
3 11 to 50 employees
2 3 to 10 employees
1 1 to 3 employees
0 No employees exposed

9. **How long are employees exposed to the substance in the work area during the process? (Mark all that apply and indicate number of employees.)**

6 Full-shift exposure, more than 5 hours
5 Partial shift exposure, 3 to 5 hours
4 Partial shift exposure, 1 to 3 hours 2 employees
3 Partial shift exposure, less than 1 hour
2 Short-term exposure, less than 15 minutes
1 Incidental, caused by incident or non-routine
0 No exposure, not possible

10. **How long are employees exposed during the process on a typical monthly basis? (Choose maximum for any employee.)**

3 High (40 hours/month or greater)
2 Medium (4-39 hours/month)
1 Low (less than 4 hours/month)
0 Process not currently in use

11. Is respiratory protective equipment (RPE) worn by employees in the work area during the process?

4 Mandatory use of RPE, major hazard
3 Mandatory use of RPE, minor hazard
2 Optional use of RPE, minor hazard
1 Optional use, prevent incidental exposure
0 No RPE used, not required

12. What type of engineering controls are used during the process?

4 Dilution ventilation (e.g., general room HVAC)
3 Local exhaust on the process
2 Containment or enclosure w/o exhaust
1 Containment or enclosure w/exhaust
0 No engineering controls

13. What are the primary types of controls used during the process? (Mark more than one if needed.)

5 Personal protective equipment (PPE)
4 Respiratory protective equipment (RPE)
3 Administrative controls (e.g., employee job rotation)
2 Engineering controls (e.g., local exhaust)
1 Process control (e.g., work instructions)
0 Elimination of substance (e.g., substitution of less hazardous material)

14. Are there any additional special concerns for employee exposure in the work place during the process?

3 Many special concerns
2 Some special concerns
1 Few special concerns
0 No special concerns

COMMENTS

Hit CTRL U, then <RET> to Continue.

3M General Offices
3M Center
St. Paul, MN 55144-1000
(612) 733-1110
Duns No.: 00-617-3082

MATERIAL SAFETY DATA SHEET

FACSIMILE COPY

DIVISION: INDUSTRIAL CHEMICAL PRODUCTS DIVISION
TRADE NAME: FC-40 FLUORINERT Brand Electronic Liquid
3M I.D. NUMBER: 98-0204-0901-1 98-0204-0903-7 98-0204-0904-5
98-0211-3507-8 98-0211-3972-4 98-0211-3973-2 98-0211-5502-7
ISSUED: October 10, 1990
SUPERSEDES: August 13, 1990
DOCUMENT: 10-3783-7

1. INGREDIENTS	CAS NO.	PERCENT	EXPOSURE LIMITS VALUE	UNIT	TYPE	AUTH
Perfluoro compounds, C5-18	86508-42-1	100.0	NONE	NONE	NONE	NONE

SOURCE OF EXPOSURE LIMIT DATA:
- NONE: None Established

2. PHYSICAL DATA

BOILING POINT:.....155.00 C
(Typical)
VAPOR PRESSURE:..... ca. 3.000 mmHg
Calc. @ R.T.
VAPOR DENSITY:..... ca. 22.50 Air = 1
Calc. @ R.T.
EVAPORATION RATE:..... < 1.00 Butyl Acetate = 1
SOLUBILITY IN WATER:..... nil
SPECIFIC GRAVITY:..... ca. 1.900 Water = 1
PERCENT VOLATILE:.....100.00 %
VOLATILE ORGANICS:..... N/D
pH:..... N/A
VISCOSITY:.....2.2 centistoke
@ R.T.
APPEARANCE AND ODOR: Colorless, odorless, liquid.

3. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT:..... None (Setaflash CC)
FLAMMABILITY LIMIT - LEL:..... N/A
FLAMMABILITY LIMIT - UEL:..... N/A
AUTOIGNITION TEMPERATURE:..... N/D
EXTINGUISHING MEDIA:
Not Flammable
SPECIAL FIRE FIGHTING PROCEDURES:
Self-contained breathing apparatus and full encapsulated suit impervious to HF.
UNUSUAL FIRE AND EXPLOSION HAZARDS:

Abbreviations: N/D - Not Determined N/A - Not Applicable

3. FIRE AND EXPLOSION HAZARD DATA (continued)

Toxic by-products may form upon decomposition (See Section 4).
NFPA HAZARD CODES: HEALTH: 4 FIRE: 0 REACTIVITY: 0

4. REACTIVITY DATA

STABILITY: Stable
INCOMPATABILITY - MATERIALS TO AVOID:
Finely divided active metals, alkali and alkaline earth metals.
HAZARDOUS POLYMERIZATION: Will Not Occur
HAZARDOUS DECOMPOSITION PRODUCTS:
Thermal decomposition may produce trace amounts of HF and in some cases PFIB. Trace decomposition may occur at the b.p.; increased decomposition at increased surface temperatures.

5. ENVIRONMENTAL INFORMATION

SPILL RESPONSE:
Observe precautions from other sections. Cover with inorganic absorbent material. Collect spilled material. Place in a closed container.
RECOMMENDED DISPOSAL:
Evaporate small quantities, <1 gal., in a hood. To reclaim or return, contact your 3M sales representative. U.S. EPA Hazardous Waste No.: None (Not U.S. EPA Hazardous)
ENVIRONMENTAL DATA:
COD = Nil; BOD20 = Nil; 96-Hr. LC50, Fathead Minnow(Pimephales promelas)= >1000 mg/l (immiscible mixture); U.S. Clean Water Act, Section 307, Toxic Pollutants = None.
SARA HAZARD CLASS:
FIRE HAZARD: No PRESSURE: No REACTIVITY: No ACUTE: Yes CHRONIC: No

6. SUGGESTED FIRST AID

EYE CONTACT:
Flush with plenty of water. Call a physician.
SKIN CONTACT:
Wash affected area with soap and water.
INHALATION:
If exposed to decomposition products, remove person to fresh air. Call a physician.
INGESTION:
Call a physician or Poison Control Center with detailed description. Include possible material that contaminated liquid during use.
OTHER FIRST AID:
NONE

7. PRECAUTIONARY INFORMATION

FC-40 is not expected to present a hazard when used with good

Abbreviations: N/D - Not Determined N/A - Not Applicable

7. PRECAUTIONARY INFORMATION (continued)

industrial hygiene practices under the following conditions. Use only in areas with sufficient local exhaust ventilation to maintain airborne concentrations at recognized health and safety levels. Avoid prolonged breathing of vapors. Do not breathe thermal decomposition products. Avoid eye contact; wear safety glasses. Do not smoke when using the product. Local exhaust ventilation with a minimum capture velocity of 50 linear feet per minute should be provided for applications at or above the boiling point. If interfering air currents are present, minimum capture velocity should be at least 100 linear feet per minute.

SPECIAL PROTECTION:

EYE PROTECTION: Safety Glasses

SKIN PROTECTION: None required at room temperature.

VENTILATION: Local exhaust recommended for temperatures. > or at boiling point. See Section 8.

RESPIRATORY PROTECTION: If decomposition occurs, in the absence of adequate ventilation, an air supplied respirator should be worn.

8. HEALTH HAZARD DATA

EYE CONTACT: FC-40 is not expected to produce significant irritation of the eyes on contact. After FC-40 has been in use, contaminants may be introduced that may cause irritation of the eyes.

SKIN CONTACT: FC-40 is not expected to cause irritation of the skin after limited, direct contact. After FC-40 has been in use, contaminants may be introduced that may cause irritation to the skin.

INHALATION: The hazards associated with vapors of FC-40 are expected to be low. Above the boiling point, small amounts of toxic decomposition products which may include hydrogen fluoride (HF) and perfluoroisobutylene (PFIB) may occur. Hydrogen fluoride (HF) has an ACGIH threshold limit value of 3 parts per million of fluoride as a ceiling limit and an OSHA PEL of 3 parts per million of fluoride as an 8 hour time-weighted average and 6 parts per million of fluoride as a Short Term Exposure Limit. Perfluoroisobutylene (PFIB) has a 3M recommended exposure guideline of 0.01 parts per million of air as a ceiling value.

INGESTION: FC-40 is expected to be practically non-toxic by ingestion. After FC-40 has been in use, contaminants may be introduced that are toxic by ingestion.

Abbreviations: N/D - Not Determined N/A - Not Applicable

The information on this Data Sheet represents our current data and best opinion as to the proper use and handling of this material under normal conditions. Any use of the material which is not in conformance with this Data Sheet or which involves using the material in combination with any other material or any other process is the responsibility of the user.

Hit CTRL U, then <RET> to Continue.

3M General Offices
3M Center
St. Paul, MN 55144-1000
(612) 733-1110
Duns No.: 00-617-3082

MATERIAL SAFETY DATA SHEET

FACSIMILE COPY

DIVISION: INDUSTRIAL CHEMICAL PRODUCTS DIVISION
TRADE NAME: FC-72 FLUORINERT Brand Electronic Liquid
3M I.D. NUMBER: 98-0211-0216-9 98-0211-0217-7 98-0211-0267-2
98-0211-1795-1 98-0211-4860-0 98-0211-5506-8 98-0211-5533-2
98-0211-5592-8 98-0211-5660-3 98-0211-6414-4
ISSUED: November 27, 1991
SUPERSEDES: August 13, 1990
DOCUMENT: 10-3789-4

1. INGREDIENTS	CAS NO.	PERCENT	EXPOSURE LIMITS VALUE	UNIT	TYPE	AUTH
Perfluoro compounds, C5-18	86508-42-1	100.0	NONE	NONE	NONE	NONE

SOURCE OF EXPOSURE LIMIT DATA:
- NONE: None Established

2. PHYSICAL DATA

BOILING POINT:.....56.00 C
(Typical)
VAPOR PRESSURE:..... ca. 232.000 mmHg
Calc. @ R.T.
VAPOR DENSITY:..... ca. 11.70 Air = 1
Calc. @ R.T.
EVAPORATION RATE:..... > 1.00 Butyl Acetate = 1
SOLUBILITY IN WATER:..... nil
SPECIFIC GRAVITY:..... ca. 1.700 Water = 1
PERCENT VOLATILE:..... ca. 100.00 %
VOLATILE ORGANICS:..... N/D
pH:..... N/A
VISCOSITY:.....00.4 centistoke
@ R.T.
APPEARANCE AND ODOR: Colorless, clear, odorless liquid.

3. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT:..... None (Setaflash CC)
FLAMMABILITY LIMIT - LEL:..... N/A
FLAMMABILITY LIMIT - UEL:..... N/A
AUTOIGNITION TEMPERATURE:..... N/D
EXTINGUISHING MEDIA:
Not Flammable
SPECIAL FIRE FIGHTING PROCEDURES:
Self-contained breathing apparatus and full encapsulated suit impervious to HF.

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3. FIRE AND EXPLOSION HAZARD DATA (continued)

UNUSUAL FIRE AND EXPLOSION HAZARDS:
Toxic by-products may form upon decomposition (See Section 4).
NFPA HAZARD CODES: HEALTH: 4 FIRE: 0 REACTIVITY: 0

4. REACTIVITY DATA

STABILITY: Stable
INCOMPATABILITY - MATERIALS TO AVOID:
Finely divided active metals, alkali and alkaline earth metals.
HAZARDOUS POLYMERIZATION: Will Not Occur
HAZARDOUS DECOMPOSITION PRODUCTS:
Thermal decomposition may produce trace amounts of HF and in some cases PFIB. Trace decomposition at 200 C and increased decomposition with increased surface temperatures.

5. ENVIRONMENTAL INFORMATION

SPILL RESPONSE:
Observe precautions from other sections. Cover with inorganic absorbent material. Collect spilled material. Place in a closed container.
RECOMMENDED DISPOSAL:
To reclaim or return, contact your 3M sales representative. U.S. EPA Hazardous Waste No.: None (Not U.S. EPA Hazardous)
ENVIRONMENTAL DATA:
COD= Nil; BOD20= Nil; 96-Hr. LC50, Fathead Minnow(Pimephales promelas)= >1000 mg/l (of immiscible mixture); U.S. Clean Water Act, Section 307, Toxic Pollutants = None.
SARA HAZARD CLASS:
FIRE HAZARD: No PRESSURE: No REACTIVITY: No ACUTE: Yes CHRONIC: No

6. SUGGESTED FIRST AID

EYE CONTACT:
Immediately flush with plenty of water. Continue for 15 minutes. Call a physician.
SKIN CONTACT:
Wash affected area with soap and water.
INHALATION:
If exposed to decomposition products, remove person to fresh air. Call a physician.
INGESTION:
Call a physician or Poison Control Center with detailed description. Include possible material that contaminated liquid during use.
OTHER FIRST AID:
NONE

7. PRECAUTIONARY INFORMATION

Not expected to present a hazard when used with good industrial

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7. PRECAUTIONARY INFORMATION (continued)

hygiene practices under the following conditions. Use only in areas with sufficient local exhaust ventilation to maintain airborne concentrations at recognized health and safety levels. Avoid prolonged breathing of vapors. Do not breathe thermal decomposition products. Avoid eye contact; wear safety glasses. Do not smoke when using the product. Local exhaust ventilation with a minimum capture velocity of 50 linear feet per minute should be provided for applications at or above the boiling point. If interfering air currents are present, minimum capture velocity should be at least 100 linear feet per minute.

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INGESTION: Expected to be practically non-toxic by ingestion. After product has been in use, contaminants may be introduced that are toxic by ingestion.

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DATE FILMED

12 / 13 / 93

END