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RESOURCE CONSERVATION AND RECOVERY ACT PART B PERMIT APPLICATION

UNITED TECHNOLOGIES CORPORATION
PRATT & WHITNEY
400 MAIN STREET
EAST HARTFORD, CT 06108

EPA ID NO: CTD 990672081

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VOLUME III

PREPARED BY

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COMM. NO. 971-25

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RESOURCE CONSERVATION AND RECOVERY ACT
PART B PERMIT APPLICATION
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SECTION H - CLOSURE PLAN AND FINANCIAL REQUIREMENTS

A. INTRODUCTION

The present Closure Plan is provided in accordance with the RCRA regulations for the Centralized Waste Storage and Transfer Facility (CWS&TF).

The CWS&TF is presently being constructed to replace the existing container and tank storage areas at the Concentrated Waste Treatment Plant.

The units that P&W is in the process of replacing include four container storage areas (CWTP-1, CWTP-2, CWTP-4, and CWTP-6) and two tank storage areas (CWTP-2, CWTP-3) and are scheduled to be closed once the CWS&TF has been constructed and is fully operational (estimate is 1993). Storage Building CWTP-5 has never been used for storage of hazardous waste and therefore would not undergo closure. After closure has been completed, some of these areas may be used for storage of hazardous waste generated on-site for less than 90 days.

Two other areas that are in the process of being closed include the Burn-Zol hazardous waste incinerator and the wax/solvent storage tank. P&W has an approved partial Closure Plan for the Burn-Zol hazardous waste incinerator, and is presently in the process of implementing closure of this area. Furthermore, on December 11, 1990 P&W submitted a notification of partial closure to EPA, Region I and to the CTDEP, to implement closure of the wax/solvent storage tank located in the same building as the former incinerator, in the CWTP area.

The approved partial closure plan for the Burn-Zol hazardous waste incinerator is included in Appendix H-1, and the interim report on closure of this area is included in Appendix H-2. The partial closure plan for the wax/solvent storage tank is provided in Appendix H-3 while the closure plan

for the remaining four container storage areas and two tank storage areas is given in Appendix H-4.

Closure will be performed in a manner that:

1. Minimizes the need for further maintenance, and;
2. Controls, minimizes or eliminates to the extent necessary, post closure release of hazardous wastes to groundwater, surface water or the atmosphere.

A copy of the closure plan will be maintained on-site at the East Hartford facility until the certification of final closure has been submitted to and accepted by the U.S. Environmental Protection Agency (EPA) Region I and the Connecticut Department of Environmental Protection (CTDEP). P&W will notify the EPA Regional Administrator and CTDEP Commissioner at least 45 days prior to the date of final closure is expected to begin. Upon completion of closure, P&W will submit a certification by both P&W and an independent registered professional engineer to the Regional Administrator and the CTDEP Commissioner that the facility has been closed in accordance with the specifications in the approved closure plan. This site-closure certification will include Appendix IX test results, all other pertinent analytical data plus the final confirmation sampling results. Included also will be:

- Photographic records of the closure documenting each construction step of the closure process
- Contractors daily log
- A list of any departure from the approved plan with rationales in accordance with 40 CFR 264.112(c).

B. CLOSURE REQUIREMENTS

a. General

This section provides a description of general methods to be applied and precautions to be taken in closing the container and tank storage areas at the Centralized Waste Storage and Transfer Facility. Table H-1 lists the process codes, maximum waste inventory, and a schedule for ultimate closure of the container and tank storage areas at the CWS&TF.

In order to determine the effectiveness of the closure activities, surface samples will be analyzed both before and after decontamination. A list of hazardous constituent parameters to be used in establishing the closure performance standards will be developed for each storage area. These clean standard parameter (CSP) lists will consist of all the 40 CFR 264, Appendix IX parameters (Appendix IX) detected during pre-decontamination sampling, and possibly certain 40 CFR 261 Appendix VIII parameters (Appendix VIII) which are not included in Appendix IX. The Appendix VIII parameters will be selected based on the potential for their presence in any given storage area. The inclusion of specific Appendix VIII parameters will be based on a review of all available information including:

- Storage Records
- Waste Product Records
- Material Safety Data Sheets
- Process Information
- Waste Characterization Information
- Monitoring Parameters from NPDES-permitted Discharge

Prior to decontaminating storage area surfaces, the surfaces will be sampled and analyzed for all Appendix IX constituents. After decontamination, samples of each storage area surface will be analyzed for

TABLE H-1

CLOSURE PLAN SUMMARY
CWTP
EAST HARTFORD, CONNECTICUT

Unit	Areas	Process Code	Maximum Inventory	Closure Options Partial/Ultimate #	Schedule For Ultimate Closure Start*/Complete	Year
Centralized Waste Storage and Transfer Facility	Container Storage Areas	S01	59,400 gals.	x	April, September	2041
	Tank Storage Areas	S02	96,000 gals.	x	April, September	2041

* - Assumed start date. Completion date based on estimated time of performance of closure.

- Although partial closure of the CWS&TF is not forseeable at the moment, due to the size of the facility it is possible that certain areas may undergo partial closure.

each of the parameters on the CSP list in order to demonstrate that the cleanup criteria have been met. A clean standard for each identified parameter on the CSP list will be developed for all exposure pathways. The pathways to be addressed are:

- Direct Ingestion
- Dermal Contact

In addition, the inhalation pathway will be considered during closure activities and appropriate personal protective equipment will be used.

Health/risk based target standards will be established for each parameter identified and each of the above exposure pathways. The clean standards to be used, as specified in the Interim Final RCRA Facility Investigation (RFI) Guidance, EPA 530/SW-89-031, May 1989 are:

- Maximum contaminant levels (MCLs)
- Risk-specific doses (RSD)
- Reference doses (RfD)
- State of Connecticut Action Levels (CTAL).

Later versions of this document may be used if available at the time of closure. The only exceptions to this hierarchy will be if a waste constituent has an RfD lower than its RSD, or if a CTAL is lower than the EPA values. In this case the more stringent values will be used.

In order to establish the clean-up criteria for soil and air, the following performance standards will be used.

If EPA or State of Connecticut recommended exposure limits do not exist for a constituent at the time of closure, the standard will be background levels. If background values are used, they will be statistically verified. Any background values that are shown to be in excess of the health/risk based standards will not be used unless it is demonstrated that the residual

constituents are truly indicative of background concentrations and not the result of waste contamination.

Concrete and floor coating samples will be collected and analyzed from the Centralized Waste Storage and Transfer Facility during the construction process. This data is being collected to establish base line containment levels in these materials prior to any use of the building. Alternatively, background concrete samples may be collected from areas unaffected by waste storage or handling operations at the time of closure.

Once the CSP list is developed, specific sample handling and analytical methods will conform to those specified in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA Publication SW-846.

b. General Closure Requirements

1. Health and Safety - A Health and Safety (H&S) Plan will be prepared in conformance with the requirements found in 29 CFR parts 1910 and 1926, the NIOSH/OSHA/USCG/EPA Guidance Manual for Hazardous Waste Site Activities (NIOSH No. 85-115), and US EPA "Standard Operating Safety Guides".

The Health and Safety Plan will address all hazardous waste activities associated with closure of the CWS&TF. More specifically, the plan will:

- provide a description of the site,
- identify key personnel,
- assign responsibilities to H&S personnel,
- provide an analysis and evaluation of the hazards associated with each activity,
- specify initial levels of protection required and action levels for additional protection,
- establish training requirements for participating personnel,
- include provisions for medical surveillance,

- describe air monitoring procedures and requirements,
- outline work zones (exclusion, contamination reduction and decontamination zone), and
- describe decontamination procedures for personnel, small equipment and heavy equipment and machinery.

The three work zones are described in more detail below:

(i) Exclusion Zone:

The Exclusion Zone will isolate the area of contaminant generation and restrict (to the extent possible) the spread of contamination from active areas of the site to support areas and off-site locations. This area will encompass all intrusive work and it will be demarcated by the Hot Line (i.e., a tape, rope line or physical barrier).

(ii) Contamination Reduction Zone:

The Contamination Reduction Zone (CRZ) will start at the Hot Line and extend to the Contamination Control Line. When contaminated personnel, equipment, or materials cross the Hot Line, they are assumed to be contaminated from site operations. Being subjected to the decontamination process, they become less contaminated; when they reach the Contamination Control Line, they are considered clean and can exit this zone without spreading contamination.

Within the Contamination Reduction Zone is the Contamination Reduction Corridor (CRC), where materials necessary for personnel and equipment decontamination are kept. A separate area shall be established for heavy equipment decontamination. In addition,

certain safety equipment (e.g., emergency eye wash, fire extinguisher, and first aid kit) are staged in this zone.

(iii) Support Zone:

The Support Zone is the outermost zone of the site, separated from the Contamination Reduction Zone by the Contamination Control Line; it is considered a clean area.

The Support Zone contains the necessary storage of equipment, stockpiling of material, and support facilities (including personal hygiene facilities) for site operations.

The decontamination crew will consist of a minimum of two individuals who will be adequately clothed, including self-contained breathing apparatus, if required, and coveralls. Supervision of the decontamination process will include an individual(s) responsible for operation of the Treatment, Storage, Disposal Facility (TSDF).

The primary basis for the level of personal protection selected is determined by:

- The type, toxicity, measured concentration, and permissible exposure limits of the chemical substances.
- The potential or measured exposure to substances in the air, splashes of liquids, or other direct contact with materials due to the work being performed.

The personal protective equipment used to protect the body against chemical hazards is divided into four categories according to the degree of protection:

- Level A - Will be worn when the highest level of respiratory, skin, and eye protection is needed.
- Level B - Will be worn when the highest level of respiratory protection is needed, but a lesser level of skin protection is needed.

- Level C - Will be worn when the types of airborne substances are known, the concentrations have been measured, and the criteria for using air-purifying respirators are met.

- Level D - This level is used where no respiratory or skin hazards are present. Level D protection is primarily a work uniform providing minimal protection.

It is not anticipated that personnel will need to use Levels A or B although this determination will be made after the complete CSP list is developed and specific hazardous constituents are known.

2. Sudden or Non-Sudden Release, or Fire Hazard - The decontamination process will be considered as an activity presenting a high risk potential for release of hazardous waste or fire/explosion hazard. As such, the appropriate mechanisms of the Contingency Plan will be ready for activation.

3. Scheduling

Completion of closure of each area will be within 180 days of agency approval of the closure plan or from the last receipt of hazardous wastes; whichever occurs later. The schedule for closure including milestone dates follows:

DAY	ACTIVITY
-45	Written notification of anticipated closure.
0	EPA and CTDEP approved closure plan or last receipt of hazardous wastes (if that is later).
90	All hazardous wastes disposed of off-site at permitted facilities.
100	Inspection for residual wastes complete and all damaged areas identified. Samples collected from damaged areas and analyzed appropriately.
120	Floors cleaned and rinsed. Confirmatory chip samples taken of the concrete containments and soils.
150	Floor repaired as necessary for further use.
180	Completion of closure and certification submittal to the EPA Regional Administrator and CTDEP Commissioner.

All final closure activities will be supervised and certified by an independent registered professional engineer, in addition to P&W personnel.

P&W may require an extension of closure time depending on the season that closure begins.

4. Partial Closure - Partial closure potential for the hazardous waste storage areas has been noted on Table H-1. The potential for partial or ultimate closure exists for the CWS&TF due to the size of the facility. The procedures described for ultimate closure would be followed for partial closure. The schedule for ultimate closure is provided in Table H-1.

5. Certification - The following certification should be submitted to the EPA Region I Administrator and the Commissioner of CTDEP upon completion of closure:

"I, _____ (Name), for Pratt & Whitney, United Technologies Corporation, owner and operator of _____ (Site), a hazardous waste storage area and I, _____ (Name), P.E., employed by _____ (Firm), certify by means of our signatures, that the facility named above has been closed in accordance with the method specified by the Closure Plan, and attached hereto. Closure was completed on _____ (Date), after receiving the final volume of material on _____ (Date)".

c. Amending the Closure Plan

P&W will amend the closure plan whenever changes in operating plans or facility design affect the closure plan, or whenever there is a change in

the expected year of closure. If a request for permit modification is made to authorize a change in operating procedures or facility design, P&W will also request a modification to the Closure Plan at the same time. If a permit modification is made requiring a change in operating procedures or facility design, P&W will make a request for modification of the Closure Plan within 60 days after the change in plans or design occurs.

d. Closure of Container Storage Areas

This closure plan describes the procedures to be followed during closure of the container storage areas at the Centralized Waste Storage and Transfer Facility (CWS&TF).

For these areas it is anticipated that the inventory of hazardous wastes remaining at closure at the CWS&TF will not exceed the maximum inventory values listed in Table H-1 or the quantities listed in the Part A Permit Application.

The procedures for closure of the container storage areas are as follows:

1. Collect two composite concrete chip samples from the containment base of each container storage area. Each composite will be made up of several discrete samples collected from discolored, soft or otherwise damaged areas to represent worst case conditions. Each composite sample will then be analyzed for Appendix IX constituents. Analysis for the organic constituents of Appendix IX will be performed on a grab sample, which will be selected from the discrete samples based on field screening with a

portable volatile organic compound analyzer.

2. Dispose of all remaining hazardous wastes off-site via licensed vendors for disposal at permitted TSDF's.

3. Evaluate the results of Appendix IX analyses and various site-specific records, (as identified above under Section B.a), to establish the clean standard parameter (CSP) list and identify corresponding health/risk based target standards.

4. If health/risk based standards do not exist for a specific parameter at the time of closure, a minimum of four background concrete chip samples will be collected and analyzed for the CSP list. This data will be used for comparison in the absence of health/risk based standards.

5. A Health and Safety Plan, specific to the site being closed and the CSP list, will be prepared to cover the closure activities to be performed. Details on the Health and Safety Plan were provided earlier.

6. The containment areas will then be scrubbed with the appropriate decontamination solution depending on the type(s) of hazardous waste stored in the area, and thoroughly rinsed with water. The plant tap water will also be analyzed for the CSP list parameters. A summary of recommended decontamination solutions for various types of hazardous wastes along with the formulations of the decontamination solutions is provided in Table H-2.

TABLE H-2
CLEANER SOLUTION FORMULATIONS

DECON SOLUTION A - A solution containing 5 percent sodium carbonate (Na_2CO_3 and 5 percent trisodium phosphate (Na_3PO_4).

To 10 gallons of water, add 4 pounds of sodium carbonate (soda ash) and 4 pounds of trisodium phosphate. Stir until evenly mixed.

DECON SOLUTION B - A solution containing 10 percent calcium hypochlorite ($Ca(ClO)_2$).

To 10 gallons of water, add 8 pounds of calcium hypochlorite. Stir with a wooden or plastic stirrer until evenly mixed.

DECON SOLUTION C - A solution containing 5 percent trisodium phosphate. This solution can also be used as a general purpose rinse.

To 10 gallons of water, add 4 pounds of trisodium phosphate. Stir until evenly mixed.

DECON SOLUTION D - A dilute solution of hydrochloric acid (HCl)

To 10 gallons of water, add 1 pint of concentrated hydrochloric acid. Stir with a wooden or plastic stirrer.

TYPE OF HAZARDOUS WASTE	PREFERRED DECONTAMINATION SOLUTION
Inorganic acids, metal processing wastes	A
Heavy metals, i.e., mercury, lead, cadmium	A
Pesticides, fungicides, chlorinated phenols, dioxins	B
Cyanides, ammonia, and other non-acidic inorganic wastes	B
Solvents and organic compounds, such as trichloroethylene, chloroform, and toluene	C, A
PBBs and PCBs	C, A
Oily, greasy, unspecified wastes	C
Inorganic bases, alkali, and caustic waste	D

As an example, a bay used in the past for storage of various types of solvents and other organic compounds in containers, and at times used for storage of alkalies, will have to be decontaminated sequentially with a combination of solutions listed in Table H-2. First, the containment area will be scrubbed with a solution containing 5 percent sodium carbonate and 5 percent trisodium phosphate and then it will be triple rinsed with water. After this procedure has been completed, the container storage area will be scrubbed with a dilute solution of hydrochloric acid (1 pint concentrated hydrochloric acid to 10 gallons water) and again triple rinsed with water.

Spent decontamination solutions and rinsewaters will be collected in existing floor sumps or will be contained through the use of dikes to prevent wash water from migrating into clean areas. This rinsate will be collected using a wet/dry vacuum then collected and disposed of as hazardous waste via licensed transporters to permitted disposal facilities. Similarly, all sweepings, residues or other debris will be disposed of as hazardous waste.

7. All equipment used in closure activities will either be decontaminated or collected and disposed of as hazardous waste. An equipment decontamination zone will be located within the Contamination Reduction Zone (refer to the Health & Safety Plan) and it will include a high pressure wash area for equipment and

vehicles. Respirators, if used, will be decontaminated daily by setting the cartridges aside, disassembling the masks, placing all parts in a cleansing solution and rinsing them with tap water. Old cartridges will be collected for disposal off-site as hazardous waste. Small manual tools and equipment used during decontamination, such as brushes, gloves, disposable suits, etc., will be collected in a 55-gallon drum and disposed of as hazardous waste using licensed transporters and permitted disposal facilities. Portions of larger tools (i.e. lifts, hoists) which have come in contact with the waste will be decontaminated by steam cleaning. Particular attention will be paid to tires, under surfaces, points of contact with the ground and horizontal surfaces where dusts or aerosols may have settled. All rinsate generated during decontamination activities will be collected and disposed of as hazardous waste via permitted TSDFs, unless verified to be non-hazardous via analytical testing. Additional details on the decontamination procedures will be provided in the Health and Safety Plan.

8. Once decontamination has been completed as described above, the container storage area will be inspected for cracks or other visible signs of deterioration. If cracks or deteriorated areas are observed during the integrity assessment of the container

storage areas then the sampling plan discussed below will be modified to include a representative portion of these areas. If sampling of cracks, gaps or damaged and deteriorated areas in the concrete indicate that hazardous constituents may have migrated below the concrete slab, then additional decontamination and/or partial removal of the contaminated surface will be performed. Additional confirmatory sampling will be performed in these areas. In the unlikely situation that the subgrade underneath the slab is found to be contaminated, then the Closure Plan would be modified to include specific clean-up measures for these areas, and will be submitted to the CTDEP and EPA for approval. For container storage areas that include sumps, one of the samples will be collected from the bottom of the sump.

9. If no cracks, or visible signs of deterioration are found, then non-statistical "judgment sampling" of potentially contaminated areas, based on visual observations, is not possible. Instead, verification sampling will be performed according to the following procedure.

Each of the areas, after decontamination, will be gridded and sampled at locations corresponding to randomly selected grid nodes. The size of the grid interval is determined by this generally accepted mathematical formula:

$GI = (A/3.14)^{0.5}/2$, where:

GI = grid interval, ft

A = area to be gridded, sq. ft.

The calculated value for the grid interval is then rounded off to the nearest integer and the container storage area is gridded.

The number of samples (n) to be obtained from each slab is determined by the square root of the number of grid nodes. A random number table or generator is typically used to determine which grid nodes or grid areas will be sampled.

Table H-3 outlines the calculations of the number of verification samples required to be collected from each of the container storage areas to generate statistically viable data according to the procedure outlined above. The number of grid samples is the number of samples statistically required. A random number table procedure was used to calculate the exact location of these samples, which are shown in Figure H-1 for the container storage areas at the Centralized Waste Storage and Transfer Facility. In addition to these samples, each containment sump will be sampled, raising the number of samples to be collected to the value shown in the last column of Table H-3. The locations of the containment sumps are also shown in Figure H-1.

All samples will consist of concrete chip samples collected with a chisel or concrete hammer drill. The portion of the tool in direct contact with the concrete will be cleaned between samples using an industrial non-phosphate detergent wash and a tap water rinse.

US EPA New England
RCRA Document Management System
Image Target Sheet

RDMS Document ID # 2418

Facility Name: PRATT & WHITNEY - MAIN STREET

Facility ID#: CTD990672081

Phase Classification: R-1B

Purpose of Target Sheet:

[X] Oversized (in Site File) [ ] Oversized (in Map Drawer)

[ ] Page(s) Missing (Please Specify Below)

[ ] Privileged [ ] Other (Provide Purpose Below)

Description of Oversized Material, if applicable:

FIGURE H-1: SAMPLING LOCATIONS

[X] Map [ ] Photograph [ ] Other (Specify Below)

* Please Contact the EPA New England RCRA Records Center to View This Document *

TABLE H-3
CONTAINER STORAGE AREAS
VERIFICATION SAMPLING

Item	Process	Area (Sq. Ft.)	Grid Interval (Ft)	No. of Grid Nodes	No. of Grid Samples	No. of Sump Samples	Total No. of Samples
Centralized Waste Storage and Transfer Facility:							
a)	Truck Pad (Typ. of 4)	1,814	12	24	5	1	6
b)	Fork Lift Ramp	853	8	33	6	2	8
c)	Transporter Unloading Station (Typ. of 4)	71	2	28	6	1	7
d)	Container/Transporter Storage Area (Type A, Typ. of 5)	190	4	28	6	1	7
e)	Container/Transporter Storage Area (Type B, Typ. of 5)	153	3	24	5	1	6
f)	Container/Transporter Storage Area (Type C, Typ. of 6)	264	5	20	5	1	6
g)	Container/Transporter Storage Area (Type D)	225	4	21	5	1	6
h)	Container/Transporter Storage Area (Type E, Typ. of 3)	388	5	24	5	1	6
i)	Staging Area (Type A)	4,960	20	20	5	4	9

TABLE H-3 (Cont'd)
CONTAINER STORAGE AREAS
VERIFICATION SAMPLING

Item	Process	Area (Sq. Ft.)	Grid Interval(Ft)	No. of Grid Nodes	No. of Grid Samples	No. of Sump Samples	Total No. of Samples
j)	Staging Area (Type B)	6,880	23	24	5	8	13
k)	Acid Scrubber	120	3	20	5	1	6
l)	General Container	285	5	20	5	1	6

NOTE: The sump samples (judgement sampling) will be collected in addition to the statistically required grid samples. Other judgemental samples will be collected based on an integrity assessment of each of the areas being closed.

The resulting concrete chips will be transferred directly into laboratory supplied glassware. The field QA/QC program for concrete chip samples will include one duplicate for every 10 samples and one trip blank to accompany the samples to the laboratory. Immediately following sample collection, each sample will be labeled and placed in an iced cooler. The samples will be transported under full chain-of-custody to a State of Connecticut approved laboratory.

The analytical testing and determination procedures are presented in Section C of this Closure Plan.

10. If based on an evaluation of the analytical data (comparison to available health/risk based levels or background) the decontamination efforts are deemed incomplete, the decontamination will be repeated until follow-up sampling demonstrates that parameters are at, or below, health/risk standards or are consistent with background levels. Any concrete chip sampling areas which exhibit levels consistent with background and either above or below health/risk levels will be considered representative of ambient background levels. Decontamination efforts will therefore be deemed complete, unless it is determined that background samples have been contaminated with the waste.

On the other hand, if repetitive decontamination efforts and subsequent sampling procedures fail to provide satisfactory data, then concrete coring will be performed to determine whether

hazardous constituents have reached the subgrade, underneath the concrete slab. If this is the case, P&W will submit a modified Closure Plan to the CTDEP and EPA outlining additional specific procedures to be followed for closure of these areas.

11. Complete the certification of closure as presented in Section B(b)(5) of this Closure Plan. Within 60 days of completion of all closure activities, the Certification of Closure will be sent by registered mail to the EPA Regional Administrator and the Commissioner of the Connecticut Department of Environmental Protection.

e. Closure of Tank Storage Areas

This section describes the procedures to be followed for closure of the tank storage areas in the Centralized Waste Storage and Transfer Facility. The facility will contain 16 aboveground tanks with secondary containment and several additional secondary containment areas for ancillary equipment and loading/unloading stations. The inventory of hazardous wastes remaining at closure in the tank area of the Centralized Waste Storage and Transfer Facility will not exceed the maximum inventory value listed in Table H-1. This value is lower than the value listed in the Part A Permit Application for storage in tanks.

The procedures for closure of the tank storage area are as follows:

1. Collect two composite concrete chip samples from the containment base of each tank and ancillary equipment containment structure. Each composite will be made up of several discrete samples collected from discolored, soft or otherwise damaged areas to represent worst case

conditions. Each composite sample will then be analyzed for Appendix IX constituents.

2. Dispose of all remaining hazardous wastes off-site via licensed vendors for disposal at permitted TSDF's. Any waste residues remaining in the tanks will be pumped out from the bottom of the tank. Residues remaining in pipings will be flushed out into the tank and also pumped out. A pressure washer will be used as needed to remove additional residues from the tank wall, bottom and associated piping and controls. Caution will be used in entering a confined space, if an entry is required. Rinse solutions and personal protective gear will be compatible with the waste's compatibility grouping. (Additional details will be provided in the Health and Safety Plan). Sludges accumulated at the bottom and/or walls of the tank will be scraped, and the scrapings and other residues will be collected and disposed of as hazardous waste via licensed vendors.

3. Evaluate the results of Appendix IX analyses and various site-specific records (as identified earlier under Section B.a), to establish the clean standard parameter (CSP) list and identify corresponding health/risk based target standards.

4. If health/risk based standards do not exist for a specific parameter at the time of closure, a minimum of four background concrete chip samples will be collected and analyzed for the CSP list.

5. A Health and Safety Plan, specific to the site being closed, and the CSP List, will be prepared to cover the closure activities to be performed. Details on the Health & Safety Plan were provided earlier.

6. All aboveground piping will be removed and disposed of as hazardous waste. The tank itself and any tank components which have not been decontaminated will either be decontaminated, dismantled and disposed of as non-hazardous waste as described above, or dismantled and disposed of as a hazardous waste without prior decontamination. The adequacy of the decontamination procedures used will be assessed by collecting wipe test samples. One wipe sample will be collected from each 100 sf area within the tank. (A minimum of three wipe test samples will be collected from each tank). Each wipe sample will cover an area of approximately 3 sf for steel tanks or 6 sf per sample for non-metal tanks. If the results of the wipe testing indicate that the decontamination efforts were insufficient, then P&W may elect to dispose of these tanks as hazardous waste, or proceed to further decontamination and wipe testing. The cost estimate, presented in Section D of this Closure Plan is based on the assumption that the tank components will be removed and disposed of off-site as hazardous waste. This conservative assumption is intended to maximize the closure cost estimate.

   Disassembly will be performed by manual dismantling and/or by the use of powered equipment. The option is available to use both hot or cold cutting techniques. The size of stockpiled components will be directly influenced by the disposal facility's requirements for landfilling. It is anticipated that all piping will be cut into four foot sections and that larger components will not exceed 10 feet in any dimension.

7. After removal of the tank components, as described above, the floor of

the concrete containment area will then be scrubbed with the appropriate decontamination solution depending on the type(s) of hazardous waste stored in the area, and then thoroughly rinsed with water. A summary of recommended decontamination solutions for various types of hazardous wastes along with the formulations of the decontamination solutions has been provided in Table H-2. The plant tap water will also be analyzed for the CSP list parameters.

Spent decontamination solutions or rinsewaters will be collected in existing floor sumps or will be contained through the use of dikes to prevent washwater migrating into clean areas. This rinsate will be collected using a wet/dry vacuum then disposed of as hazardous waste via permitted TSDFs.

8. All equipment used in closure activities will either be decontaminated or collected and disposed of as hazardous waste. An equipment decontamination zone will be located within the Contamination Reduction Zone (as outlined by the Health & Safety Plan) and will include a high pressure wash area for equipment and vehicles, as needed. Respirators, if used, will be decontaminated daily by setting the cartridges aside, disassembling the masks, placing all parts in a cleaning solution and rinsing them with tap water. Old cartridges, as well as discarded personal protective gear from the decontamination of the tank storage areas will be collected and disposed of off-site as hazardous waste. Small manual tools and equipment used during

decontamination such as brushes, gloves, disposable suits, etc., will be collected in a 55-gallon drum and disposed of as hazardous waste using licensed transporters and permitted disposal facilities. Portions of larger tools (i.e. lifts, hoists) which have contacted the waste will be decontaminated by steam cleaning. All rinsate generated during decontamination activities will be collected and disposed of as hazardous waste.

9. Once determination has been completed as described above, the tank storage area containments will be inspected for cracks or other visible signs of deterioration. If during the integrity assessment of each tank storage area cracks or deteriorated areas are observed, then the sampling plan presented below will be modified to include a representative portion of these areas. If sampling of cracks, gaps, or damaged and deteriorated areas in the concrete indicate that hazardous constituents may have migrated below the concrete slab, then additional decontamination and/or partial removal of the contamination surface will be performed. Additional confirmatory sampling will be performed in these areas. In the unlikely situation that the subgrade underneath the slab is found to be contaminated then the Closure Plan would be modified to include specific clean-up measures for these areas. Containment sumps will be sampled in addition to the samples discussed above.

   If no cracks or other visible signs of deterioration are found, then non-statistical "judgment sampling" of potentially contaminated areas,

based on visual observations, is not possible. Instead, verification sampling will be performed using a statistical procedure:

Each of the areas, after decontamination, will be gridded and sampled at locations corresponding to randomly selected grid nodes. The size of the grid interval is determined by this generally accepted mathematical formula:

$$GI = (A/3.14)^{0.5}/2, \text{ where:}$$

GI = grid interval, ft

A = area to be gridded, sq. ft.

The calculated value for the grid interval is then rounded off to the nearest interger and the tank containments are gridded. The number of samples to be obtained from each slab is determined by the square root of the number of grid nodes. A random number table or generator is typically used to determine which grid nodes or grid areas will be sampled.

Each of the 16 tank storage areas at the Centralized Waste Storage and Transfer Facility will be gridded separately to ensure that statistically significant data will be obtained from each area. The exact locations of these samples are shown in Figure H-3 for one of the areas only, typical of how each of the areas will be sampled.

Table H-4 outlines the calculation of the number of verification samples required to be collected from the tank storage areas in the Centralized Waste Storage and Transfer Facility. The number of grid samples is the number of samples statistically required based on the

TABLE H-4
TANK STORAGE AREAS
VERIFICATION SAMPLING

Item	Process	Area (Sq. Ft.)	Grid Interval(Ft)	No. of Grid Nodes	No. of Grid Samples	No. of Sump Samples	Total No. of Samples
Centralized Waste Storage and Transfer Facility:							
	Tank Storage Area (Typical of 16)	321	5	19	5	1	6

NOTE: The sump samples (judgement sampling) will be collected in addition to the statistically required grid samples. Other judgemental samples will be collected based on an integrity assessment of each of the areas being closed.

random number procedure outlined above. In addition to these samples, the containment sumps will be sampled, raising the number of samples to be collected to the value shown in the last column of Table H-4. The locations of the containment sumps are also shown in Figure H-1. All samples will consist of concrete chip samples collected with a chisel or concrete hammer drill. The portion of the tool in direct contact with the concrete will be cleaned between samples using an industrial non-phosphate detergent wash and a potable water rinse. The resulting concrete chips will be transferred directly into laboratory supplied glassware. The field QA/QC program for concrete chip samples will consist of one field duplicate for every 10 samples and one trip blank to accompany the samples to the laboratory. Immediately following sample collection, each sample will be labeled and placed in an iced cooler. The samples will be transported under full chain-of-custody to a State of Connecticut certified laboratory. The analytical testing and determination procedures are presented in Section C of the Closure Plan.

10. If based on an evaluation of the analytical data (comparison to available health/risk based levels and background), the decontamination process is deemed incomplete, the decontamination will be repeated until follow-up sampling demonstrates that parameters are at or below health/risk standards or are consistent with background levels. Any concrete chip sampling areas which exhibit levels consistent with background and either above or below health/risk

levels will be considered representative of ambient background levels. Decontamination will then be deemed complete unless background samples are deemed to be contaminated by the waste.

On the other hand, if repetitive decontamination efforts and subsequent sampling procedures fail to provide satisfactory data, then concrete coring will be performed to determine whether hazardous constituents have reached the subgrade, underneath the concrete slab. If this is the case, P&W will submit a modified Closure Plan to the CT DEP and EPA outlining additional specific procedures to be followed for closure of these areas.

11. Complete the certification of closure as presented in Section C(b) (5) of this Closure Plan. Within 60 days of completion of all closure activities, the Certification of Closure will be sent by registered mail to the EPA Regional Administrator and the Commissioner of the Connecticut Department of Environmental Protection.

C. LABORATORY ANALYSIS AND DATA EVALUATION

The analytical methods that will be used for analysis of concrete samples will be those described in the latest edition of EPA Publication SW-846 - Test Methods for Evaluating Solid Waste. The designated laboratory will follow all applicable internal QA/QC procedures outlined in SW-846.

Upon receipt of the analytical data, an initial evaluation of the results will be performed through data validation. Data validation includes a review of field QA/QC procedures (i.e. trip blanks, field duplicates) and laboratory QA/QC procedures (i.e. holding times, blind duplicate analysis, surrogate recoveries). Data points that are not adequately supported by the QA/QC procedures will be referred to the sampling team and/or the laboratory for appropriate corrective actions.

Upon completion of data validation, the results will be compared to background data points and the relevant and appropriate regulatory standards and criteria. An explanation of how this will be performed is presented below.

Data Evaluation

As previously stated, decontamination of the storage areas will be demonstrated complete by concrete chip sampling and comparison to regulatory and background levels.

Test results will be compared to the Health/Risk based target standards specified in the interim final RCRA Facility Guidance (EPA-530/SW-89-031). If any parameter exceeds the applicable target standard, then decontamination will be deemed incomplete in the area of

that sample. Decontamination efforts will continue until follow-up sample data achieves the applicable target standard.

For constituents for which a health/risk based standard is not available, comparison will be made to background data. The analytical results of these samples will be statistically analyzed using Cochran's approximation to the Behrens-Fisher Students' t-Test (40 CFR Part 264, Appendix IV). If the reported concentration of a specific constituent is the method detection limit, the numerical value of the method detection limit will be used in the calculations. The mean and variance of the background samples will be used to determine if clean standard verification samples contain significant constituent concentrations at a 95 percent confidence level. If any parameter exceeds the corresponding background level, decontamination will be considered incomplete in the area of that sample. Decontamination efforts will continue until follow-up sample data achieves the corresponding background level.

D. MAXIMUM CLOSURE COST ESTIMATE

The estimated closure cost for the Centralized Waste Storage and Transfer Facility is $1,528,400 dollars. A breakdown of the closure cost for the CWS&TF is provided in Table H-5. All costs assume performance of closure activities by a qualified third-party contractor. The estimates assume that the maximum waste inventory will be present at closure.

The closure cost estimate will be revised whenever a change in the closure plan affects the cost of closure. The closure cost will be adjusted annually as described in 40 CFR 264.14(b).

All costs provided in Table H-5 include overhead for conventional type of work (construction, sampling, decontamination, etc.). The additional insurance costs (estimated approximately at 7%) account for the incremental overhead required for work involving hazardous waste. All costs are in 1991 dollars.

TABLE H-5
MAXIMUM CLOSURE COST ESTIMATE
CENTRALIZED WASTE STORAGE AND TRANSFER FACILITY

ACTIVITY DESCRIPTION	COST
Initial Sampling (Appendix IX)	
9 areas x 2 samples x $4,500/ea:	$ 81,000.00
9 areas x 16 mh x $60/hr:	$ 8,640.00
Removal & Disposal of Waste Inventory (1)	
59,400 gal x $8/gal (non-bulk):	$ 475,200.00
96,000 gal x $2/gal (bulk):	$ 192,000.00
Background Sampling & Analysis	
2 samples x $1,200/ea:	$ 2,400.00
16 mh x $60/hr:	$ 960.00
Concrete Coring Equip. Rental:	$ 500.00
Development of CSP list	
60 mh x $60/hr:	$ 3,600.00
Development of Health & Safety Plan:	$ 3,000.00
Dismantle and Disposal of Aboveground Tanks and Ancillary Equipment	
400 mh x $40/hr:	$ 16,000.00
Disposal:	$ 44,000.00
Decontamination of Concrete Containments	
1,200 mh x $40/hr:	$ 48,000.00
Equipment Rental:	$ 3,000.00
Collection & Analysis of Confirmational Samples	
315 samples x $1,200/ea:	$ 378,000.00
300 mh x $60/hr:	$ 18,000.00
Removal and Disposal of Contaminated Concrete	
Allowance (40 tons):	$ 20,000.00
Data Evaluation & Closure Certification	
200 mh x $60/hr:	$ 12,000.00
Subtotal:	$1,306,300.00
Insurance (7%):	$ 91,500.00
Contingency (10%):	$ 130,600.00
Total: (Centralized Waste Storage and Transfer Facility)	$1,528,400.00

mh: manhours
(1): Assumes maximum inventory present at closure.

E. FINANCIAL ASSURANCE

The required financial assurances for closure and pollution liability coverage are presented in Exhibit H-1 in the following order:

- A letter from UTC's Executive Vice President and Chief Financial Officer, John A. Rolls, transmitting financial documentation to the DEP, dated March 27, 1991 including Exhibit A.
- A special report by Price Waterhouse, independent Certified Public Accountants, dated March 27, 1991.
- Letter from UTC's Executive Vice President and Chief Financial Officer, John A. Rolls to the CTDEP dated, March 27, 1991.
- Cover letter from Felicia DeDominicis of United Technologies to the CTDEP, copied to the EPA and dated March 27, 1991.
- UTC Annual Report 1990.

EXHIBIT H-1
FINANCIAL ASSURANCE DOCUMENTATION

UNITED TECHNOLOGIES

United Technologies Building
Hartford, Connecticut 06101
203/728-7000

Office of the General Counsel

R. H. HENSON

JUL 25 1991

July 23, 1991

Ronald H. Henson
Pratt & Whitney Aircraft
400 Main Street
East Hartford, CT 06108

Re: Financial Assurance Documents for TSD Facilities

Dear :

Enclosed please find a complete package of financial assurance documents filed with the State of Connecticut regarding the Pratt & Whitney TSD facilities at the following locations:

1. 400 Main Street, East Hartford, CT 06108
2. Aircraft Road, Middletown, CT 06457
3. 415 Washington Avenue, North Haven, CT 06473
4. Aircraft Road, Southington, CT 06489
5. Belamose Avenue, Rocky Hill, CT 06067
6. Newell Street, Southington, CT 06489
7. Pine Street, Manchester, CT 06040
8. Pent Road, East Hartford, CT 06108
9. Colt Street, East Hartford, CT 06108

This documentation of financial assurance should be kept at each TSDF. Extra copies of the annual report are enclosed if you wish to prepare a complete duplicate package for your files.

Very truly yours,

Kevin M. Doyle

/cag

cc: Mike Brown

UNITED TECHNOLOGIES

United Technologies Building
Hartford, Connecticut
203/728-7000

March 27, 1991

Mr. George Dews
Connecticut Department of Environmental Protection
Hazardous Waste Management Section
165 Capitol Avenue
Hartford, CT 06106

Dear Mr. Dews:

For your records, I have provided evidence of financial responsibility for the following facilities:

Facility	EPA ID Number
Pratt & Whitney Aircraft - Colt Street	CTD000844399
Pratt & Whitney Aircraft - 400 Main Street	CTD990672081
Pratt & Whitney Aircraft - Pent Road	CTD000845131
Pratt & Whitney Aircraft - Pine Street	CTD000844324
Pratt & Whitney Aircraft - Aircraft Road	CTD003935905
Pratt & Whitney Aircraft - 415 Washington Avenue	CTD001449511
Pratt & Whitney Aircraft - Belamose Avenue	CTD000844407
Pratt & Whitney Aircraft - Aircraft Road	CTD001149277
Pratt & Whitney Aircraft - Newell Street	CTD000844332
International Fuel Cell	CTD010166791
Hamilton Standard Complex B-1, 2 and 3	CTD001145341
Norden Systems	CTD089623318
Sikorsky Aircraft Bridgeport Plant	CTD001449735
Sikorsky Aircraft	CTD001449784
United Technologies Research Center	CTD095532131

This evidence includes:

- A March 27, 1991 letter from UTC's chief financial officer J. A. Rolls.
- Exhibit A: UTC Hazardous Waste Management and UIC Facility Closure and Post-closure Costs by State dated March 25, 1991.
- UTC Annual Report 1990, including our independent certified public accountant's report on examination.
- A corporate guarantee of closure for the facility owned by Norden Systems, Inc.
- A corporate guarantee of closure for the facility owned by International Fuel Cells, Inc.
- A corporate guarantee for pollution liability coverage for the facility owned by Norden Systems, Inc.

- A corporate guarantee for pollution liability coverage for the facility owned by International Fuel Cells, Inc.

- A special report by Price Waterhouse, independent certified public accountant.

Please call me at (203) 728-7829 if additional information is needed to evidence UTC's compliance with your financial requirements.

Respectfully submitted,

F. DeDominicis

Felicia DeDominicis

Enclosure

CERTIFIED MAIL

cc: Regional Administrator
U.S. EPA Region I
JFK Federal Building
Boston, MA 02203

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UNITED TECHNOLOGIES

March 27, 1991

Mr. George Dews
Connecticut Department of Environmental Protection
Hazardous Waste Management Section
165 Capitol Avenue
Hartford, CT 06106

Dear Mr. Dews:

I am the chief financial officer of United Technologies Corporation, United Technologies Building, Hartford, CT 06101. This letter is in support of the use of the financial test to demonstrate financial responsibility for liability coverage and closure and/or postclosure care as specified in Subpart H of 40 CFR Parts 264 and 265.

The firm identified above is the owner or operator of the following facilities which are located in the State of Connecticut for which liability coverage for both sudden and nonsudden accidental occurrences is being demonstrated through the financial test specified in Subpart H of 40 CFR Parts 264 and 265: **See Exhibit A attached hereto. Facilities of the Corporation are designated "division".**

The firm identified above guarantees, through the guarantee specified in Subpart H of 40 CFR Parts 264 and 265, liability coverage for both sudden and nonsudden accidental occurrences at the following facilities owned or operated by the following: Norden Systems, Inc. of Norden Place, Norwalk, Connecticut - CTD089623318 and International Fuel Cells Corporation of South Windsor, Connecticut - CTD010166791. The firm identified above is the direct or higher-tier parent corporation of the owners or operators.

1. The firm identified above owns or operates the following facilities which are located in the State of Connecticut for which financial assurance for closure or post-closure care or liability coverage is demonstrated through the financial test specified in Subpart H of 40 CFR Parts 264 and 265. The current closure and/or post-closure cost estimates covered by the test are shown for each facility: **See Exhibit A attached hereto. Facilities of the Corporation are designated "division".**

2. The firm identified above guarantees, through the guarantee specified in Subpart H of 40 CFR Parts 264 and 265, the closure and post-closure care of the following facilities owned or operated by the guaranteed party. The current cost estimates for the closure or post-closure care so guaranteed are shown for each facility: **See Exhibit A attached hereto. Facilities of subsidiaries are designated "subsidiary".**

3. In States where EPA is not administering the financial requirements of Subpart H of 40 CFR Parts 264 or 265, this firm is demonstrating financial assurance for the closure or postclosure care of the following facilities through the use of a test equivalent or substantially equivalent to the financial test specified in Subpart H of 40 CFR Parts 264 and 265. The current closure or post-closure cost estimates covered by such a test are shown for each facility. For the following authorized states, see Exhibit A for a list of facilities in: **California, Colorado, Connecticut, Florida, Kentucky, Maine, Michigan, Mississippi, New York, Ohio.**

4. The firm identified above owns or operates the following hazardous waste management facilities for which financial assurance for closure or, if a disposal facility, post-closure care, is not demonstrated either to EPA or a State through the financial test or any other financial assurance mechanisms specified in Subpart H of 40 CFR Parts 264 and 265 or equivalent or substantially equivalent State mechanisms. The current closure and/or post-closure cost estimates not covered by such financial assurance are shown for each facility: **None.**

5. This firm is the owner or operator of the following UIC facilities for which financial assurance for plugging and abandonment is required under Part 144. The current closure cost estimates as required by 40 CFR 144.62 are shown for each facility: **See Exhibit A attached hereto.**

This firm is required to file a Form 10K with the Securities and Exchange Commission (SEC) for the latest fiscal year.

The fiscal year of this firm ends on December 31. The figures for the following items marked with an asterisk are derived from this firm's independently audited, year-end financial statements for the latest completed fiscal year, ended December 31, 1990.

Part B. CLOSURE OR POST-CLOSURE CARE AND LIABILITY COVERAGE

Alternative II

1.	Sum of current closure and post-closure cost estimates	$ 21,191,051
2.	Amount of annual aggregate liability coverage to be demonstrated	$ 36,000,000
3.	Sum of lines 1 and 2	$ 57,191,051
4.	Current bond rating of most recent issuance and name of rating service	Standard & Poor's AA- Moody's Aa3
5.	Date of issuance of bond	March 4, 1991
6.	Date of maturity of bond	March 1, 2021
*7.	Tangible net worth	$3,927,600,000
*8.	Total assets in the U.S.	$9,597,800,000
9.	Is line 7 at least $10 million?	Yes
10.	Is line 7 at least 6 times line 3?	Yes

*11.	Are at least 90% of the firm's assets located in the U.S.?	No
12.	Is line 8 at least 6 times line 3?	Yes

I hereby certify that the wording of this letter is identical to the wording specified in 40 CFR 264.151(g).

John A. Rolls
Executive Vice President and Chief Financial Officer
UNITED TECHNOLOGIES CORPORATION
Date: March 27, 1991

Enclosures

CERTIFIED MAIL

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Corporate Guarantee for Closure

Guarantee made this 27th day of March, 1991, by United Technologies Corporation, a business corporation organized under the laws of the State of Delaware, herein referred to as guarantor, to the Connecticut Department of Environmental Protection, obligee, on behalf of our subsidiary Norden Systems, Inc., of Norden Place, Norwalk, CT 06856.

Recitals

1. Guarantor meets or exceeds the financial test criteria and agrees to comply with the reporting requirements for guarantors as specified in 40 CFR 264.143(f), 264.145(f), 265.143(e), 265.145(e).

2. Norden Systems, Inc. owns or operates the following hazardous waste management facility covered by this guarantee:

   CTD089623318 - Closure
   Norden Systems, Inc.
   Norden Place
   Norwalk, Connecticut 06856

3. "Closure plans" and "post-closure plans" as used below refer to the plans maintained as required by Subpart G of 40 CFR Parts 264 and 265 for the closure of the facilities identified above.

4. For value received from Norden Systems, Inc., guarantor guarantees to the Connecticut Department of Environmental Protection that in the event that Norden Systems, Inc. fails to perform closure of the above facility in accordance with the closure plans and other permit or interim status requirements whenever required to do so, the guarantor shall do so or establish a trust fund as specified in Subpart H of 40 CFR Part 264 or 265, as applicable, in the name of Norden Systems, Inc. in the amount of the current closure cost estimates as specified in Subpart H of 40 CFR Parts 264 and 265.

5. Guarantor agrees that if, at the end of any fiscal year before termination of this guarantee, the guarantor fails to meet the financial test criteria, guarantor shall send within 90 days, by certified mail, notice to the Commissioner of the Connecticut Department of Environmental Protection and to Norden Systems, Inc. that it intends to provide alternate financial assurance as specified in Subpart H of 40 CFR Part 264 or 265, as applicable, in the name of Norden Systems, Inc. Within 120 days after the end of such fiscal year, the guarantor shall establish such financial assurance unless Norden Systems, Inc. has done so.

6. The guarantor agrees to notify the Commissioner of the Connecticut Department of Environmental Protection by certified mail, of a voluntary or involuntary proceeding under Title 11 (Bankruptcy) U.S. Code, naming guarantor as debtor, within 10 days after commencement of the proceeding.

7. Guarantor agrees that within 30 days after being notified by the Commissioner of the Connecticut Department of Environmental Protection of a determination that guarantor no longer meets the financial test criteria or that it is disallowed from continuing as a guarantor of closure or post-closure care, it shall establish alternate financial assurance as specified in Subpart H of 40 CFR Part 264 or 265, as applicable, in the name of Norden Systems, Inc. unless Norden Systems, Inc. has done so.

8. Guarantor agrees to remain bound under this guarantee notwithstanding any or all of the following: amendment or modification of the closure or post-closure plan, amendment or modification of the permit, the extension or reduction of the time of performance of closure

or post-closure, or any other modification or alteration of an obligation of the owner or operator pursuant to 40 CFR Part 264 or 265.

9. Guarantor agrees to remain bound under this guarantee for so long as Norden Systems, Inc. must comply with the applicable financial assurance requirements of Subpart H of 40 CFR Parts 264 and 265 for the above listed facility, except that guarantor may cancel this guarantee by sending notice by certified mail to the Commissioner of the Connecticut Department of Environmental Protection and to Norden Systems, Inc. such cancellation to become effective no earlier than 120 days after receipt of such notice by both the Connecticut Department of Environmental Protection and Norden Systems, Inc. as evidenced by the return receipts.

10. Guarantor agrees that if Norden Systems, Inc. fails to provide alternate financial assurance as specified in Subpart H of 40 CFR Part 264 or 265, as applicable, and obtain written approval of such assurance from the Commissioner of the Connecticut Department of Environmental Protection within 90 days after a notice of cancellation by the guarantor is received by the Commissioner of the Connecticut Department of Environmental Protection from guarantor, guarantor shall provide such alternate financial assurance in the name of Norden Systems, Inc.

11. Guarantor expressly waives notice of acceptance of this guarantee by the Connecticut Department of Environmental Protection or by Norden Systems, Inc. Guarantor also expressly waives notice of amendments or modifications of the closure and/or post-closure plan and of amendments or modifications of the facility permit.

I hereby certify that the wording of this guarantee is identical to the wording specified in 40 CFR 264.151(h) as such regulations were constituted on the date first above written.

Effective Date: January 1, 1991
UNITED TECHNOLOGIES CORPORATION

John A. Rolls
Executive Vice President and Chief Financial Officer

Subscribed and sworn to this 27th day of March, 1991

Patricia J. Nelson
Notary

(SEAL)

My Commission Expires: 3-31-94

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Corporate Guarantee for Closure

Guarantee made this 27th day of March, 1991, by United Technologies Corporation, a business corporation organized under the laws of the State of Delaware, herein referred to as guarantor, to the Connecticut Department of Environmental Protection, obligee, on behalf of our subsidiary, International Fuel Cells Corporation of South Windsor, Connecticut 06070.

Recitals

1. Guarantor meets or exceeds the financial test criteria and agrees to comply with the reporting requirements for guarantors as specified in 40 CFR 264.143(f), 264.145(f), 265.143(e), 265.145(e).

2. International Fuel Cells Corporation owns or operates the following hazardous waste management facility covered by this guarantee:

   CTD010166791 - Closure
   International Fuel Cells Corporation
   P.O. Box 739
   South Windsor, Connecticut 06070

3. "Closure plans" and "post-closure plans" as used below refer to the plans maintained as required by Subpart G of 40 CFR Parts 264 and 265 for the closure and post-closure care of facilities as identified above.

4. For value received from International Fuel Cells Corporation, guarantor guarantees to the Connecticut Department of Environmental Protection that in the event International Fuel Cells Corporation fails to perform closure of the above facility in accordance with the closure plans and other permit or interim status requirements whenever required to do so, the guarantor shall do so or establish a trust fund as specified in Subpart H of 40 CFR Part 264 or 265 as applicable, in the name of International Fuel Cells Corporation in the amount of the current closure cost estimates as specified in Subpart H of 40 CFR Parts 264 and 265.

5. Guarantor agrees that if, at the end of any fiscal year before termination of this guarantee, the guarantor fails to meet the financial test criteria, guarantor shall send within 90 days, by certified mail, notice to the Commissioner of the Connecticut Department of Environmental Protection and to International Fuel Cells Corporation that it intends to provide alternate financial assurance as specified in Subpart H of 40 CFR Parts 264 and 265, as applicable, in the name of International Fuel Cells Corporation. Within 120 days after the end of such fiscal year, the guarantor shall establish such financial assurance unless International Fuel Cells Corporation has done so.

6. The guarantor agrees to notify the Commissioner of the Connecticut Department of Environmental Protection by certified mail, of a voluntary or involuntary proceeding under Title 11 (Bankruptcy), U.S. Code, naming guarantor as debtor, within 10 days after commencement of the proceeding.

7. Guarantor agrees that within 30 days after being notified by the Commissioner of the Connecticut Department of Environmental Protection of a determination that guarantor no longer meets the financial test criteria or that it is disallowed from continuing as a guarantor of closure, it shall establish alternate financial assurance as specified in Subpart H of 40 CFR Parts 264 or 265 as applicable, in the name of International Fuel Cells Corporation unless International Fuel Cells Corporation has done so.

8. Guarantor agrees to remain bound under this guarantee notwithstanding any or all of the following: amendment or modification of the closure plan, amendment or modification of the permit, the extension or reduction of the time of performance of closure, or any other modification or alteration of an obligation of the owner or operator pursuant to 40 CFR Parts 264 and 265.

9. Guarantor agrees to remain bound under this guarantee for so long as International Fuel Cells Corporation must comply with the applicable financial assurance requirements of Subpart H of 40 CFR Parts 264 and 265 for the above listed facility, except that guarantor may cancel this guarantee by sending notice by certified mail to the Commissioner of the Connecticut Department of Environmental Protection and to International Fuel Cells Corporation, such cancellation to become effective no earlier than 120 days after receipt of such notice by both the Connecticut Department of Environmental Protection and International Fuel Cells Corporation, as evidenced by the return receipts.

10. Guarantor agrees that if International Fuel Cells Corporation fails to provide alternate financial assurance as specified in Subpart H of 40 CFR Part 264 or 265, as applicable, and obtain written approval of such assurance from the Commissioner of the Connecticut Department of Environmental Protection within 90 days after a notice of cancellation by the guarantor is received by the Connecticut Department of Environmental Protection from guarantor, guarantor shall provide such alternate financial assurance in the name of International Fuel Cells Corporation.

11. Guarantor expressly waives notice of acceptance of this guarantee by the Connecticut Department of Environmental Protection or by International Fuel Cells Corporation. Guarantor also expressly waives notice of amendment or modifications of the closure plan and of amendments or modifications of the facility permit.

I hereby certify that the wording of this guarantee is identical to the wording specified in 40 CFR 264.151(h) as such regulations were constituted on the date first above written.

Effective Date: January 1, 1991
UNITED TECHNOLOGIES CORPORATION

John A. Rolls
Executive Vice President and Chief Financial Officer

Subscribed and sworn to this 27th day of March, 1991.

Patricia A. Nolan
Notary

(SEAL)

My Commission Expires: 3-31-94

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March 27, 1991

Guarantee for Liability Coverage

Guarantee made this 27th day of March, 1991 by United Technologies Corporation, a business corporation organized under the laws of the State of Delaware, herein referred to as guarantor. This guarantee is made on behalf of our subsidiary Norden Systems, Inc. of Norden Place, Norwalk, Connecticut, to any and all third parties who have sustained or may sustain bodily injury or property damage caused by sudden accidental occurrences arising from operation of the facilities covered by this guarantee.

Recitals

1. Guarantor meets or exceeds the financial test criteria and agrees to comply with the reporting requirements for guarantors as specified in 40 CFR 264.147(g) and 265.147(g).

2. Norden Systems, Inc. owns and operates the following hazardous waste management facilities covered by this guarantee: EPA Identification Number CTD089623318, Norden Systems, Inc., Norden Place, Norwalk, Connecticut 06856. This corporate guarantee satisfies RCRA third-party liability requirements for sudden accidental occurrences in above named owner or operator facilities for coverage in the amount of $1,000,000 for each occurrence and $2,000,000 annual aggregate.

3. For value received from Norden Systems, Inc., guarantor guarantees to any and all third parties who have sustained or may sustain bodily injury or property damage caused by sudden accidental occurrences arising from operations of the facility covered by this guarantee that in the event that Norden Systems, Inc. fails to satisfy a judgment or award based on a determination of liability for bodily injury or property damage to third parties caused by sudden accidental occurrences, arising from the operation of the above-named facility, or fails to pay an amount agreed to in settlement of a claim arising from or alleged to arise from such injury or damage, the guarantor will satisfy such judgment(s), award(s) or settlement agreement(s) up to the limits of coverage identified above.

4. Such obligation does not apply to any of the following:

   (a) Bodily injury or property damage for which Norden Systems, Inc. is obligated to pay damages by reason of the assumption of liability in a contract or agreement. This exclusion does not apply to liability for damages that Norden Systems, Inc. would be obligated to pay in the absence of the contract or agreement.

   (b) Any obligation of Norden Systems, Inc. under workers' compensation, disability benefits, or unemployment compensation law or any similar law.

   (c) Bodily injury to:

      (1) An employee of Norden Systems, Inc. arising from, and in the course of, employment by Norden Systems, Inc.; or
      (2) The spouse, child, parent, brother or sister of the employee as a consequence of, or arising from, and in the course of employment by Norden Systems, Inc.

This exclusion applies:

A. Whether Norden Systems, Inc. may be liable as an employer or in any other capacity; and

B. To any obligation to share damages with or repay another person who must pay damages because of the injury to persons identifed in paragraphs (1) and (2).

(d) Bodily injury or property damage arising out of the ownership, maintenance, use, or entrustment to others of any aircraft, motor vehicle or watercraft.

(e) Property damage to:

(1) Any property owned, rented, or occupied by Norden Systems, Inc.;
(2) Premises that are sold, given away or abandoned by Norden Systems, Inc. if the property damage arises out of any part of those premises;
(3) Property loaned to Norden Systems, Inc.;
(4) Personal property in the care, custody or control of Norden Systems, Inc.;
(5) That particular part of real property on which Norden Systems, Inc. or any contractors or subcontractors working directly or indirectly on behalf of Norden Systems, Inc. are performing operations, if the property damage arises out of these operations.

5. Guarantor agrees that if, at the end of any fiscal year before termination of this guarantee, the guarantor fails to meet the financial test criteria, guarantor shall send within 90 days, by certified mail, notice to the Commissioner of the Connecticut Department of Environmental Protection and to Norden Systems, Inc. that it intends to provide alternate liability coverage as specified in 40 CFR 264.147 and 265.147, as applicable, in the name of Norden Systems, Inc. Within 120 days after the end of such fiscal year, the guarantor shall establish such liability coverage unless Norden Systems, Inc. has done so.

6. The guarantor agrees to notify the Commissioner of the Connecticut Department of Environmental Protection by certified mail of a voluntary or involuntary proceeding under Title 11 (Bankruptcy), U.S. Code, naming guarantor as debtor, within 10 days after commencement of the proceeding.

7. Guarantor agrees that within 30 days after being notified by the Commissioner of the Connecticut Department of Environmental Protection of a determination that guarantor no longer meets the financial test criteria or that it is disallowed from continuing as a guarantor, it shall establish alternate liability coverage as specified in 40 CFR 264.147 or 265.147 in the name of Norden Systems, Inc. unless Norden Systems, Inc. has done so.

8. Guarantor reserves the right to modify this agreement to take into account amendment or modification of the liability requirements set by 40 CFR 264.147 and 265.147, provided that such modification shall become effective only if the Commissioner of the Department of Environmental Protection does not disapprove the modification within 30 days of receipt of notification of the modification.

9. Guarantor agrees to remain bound under this guarantee for so long as Norden Systems, Inc. must comply with the applicable requirements of 40 CFR 264.147 and 265.147 for the above- listed facility, except as provided in paragraph 9 of this agreement.

10. Guarantor may terminate this guarantee by sending notice by certified mail to the Commissioner of the Connecticut Department of Environmental Protection and to Norden Systems, Inc. provided that this guarantee may not be terminated unless and until Norden Systems, Inc. obtains, and the Commissioner of the Connecticut Department of

Environmental Protection approves, alternate liability coverage complying with 40 CFR 264.147 and/or 265.147.

11. Guarantor hereby expressly waives notice of acceptance of this guarantee by any party.

12. Guarantor agrees that this guarantee is in addition to and does not affect any other responsibility or liability of the guarantor with respect to the covered facilities.

13. The guarantor shall satisfy a third-party liability claim only on receipt of one of the following documents:

    (a) Certification from the Principal and the third-party claimant(s) that the liability claim should be paid. The certificiation must be worded as follows, except that instructions in brackets are to be replaced with the relevant information and the brackets deleted:

Certification of Valid Claim

The undersigned, as parties [insert Principal] and [insert name and address of third-party claimant(s)], hereby certify that the claim of bodily injury and/or property damage caused by a sudden accidental occurrence arising from operating [Principal's] hazardous waste treatment, storage, or disposal facility should be paid in the amount of $[ ].

[Signatures]
Principal _____

(Notary) _____ **Date** _____

[Signatures]

Claimant(s) _____

_____

(Notary) _____ **Date** _____

    (b) A valid final court order establishing a judgment against the Principal for bodily injury or property damage caused by sudden or non-sudden accidental occurrences arising from the operation of the Principal's facility or group of facilities.

14. In the event of combination of this guarantee with another mechanism to meet liability requirements, this guarantee will be considered excess coverage.

I hereby certify that the wording of the guarantee is identical to the wording specified in 40 CFR 264.151(h) (2) as such regulations were constituted on the date shown immediately below.

Effective date: January 1, 1991
UNITED TECHNOLOGIES CORPORATION

John A. Rolls
Executive Vice President and Chief Financial Officer

Patricia J. Nolan
Notary

My Commission Expires: 3-31-94

(SEAL)

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March 27, 1991

Guarantee for Liability Coverage

Guarantee made this 27th day of March, 1991 by United Technologies Corporation, a business corporation organized under the laws of the State of Delaware, and herein referred to as guarantor. This guarantee is made on behalf of our subsidiary International Fuel Cells Corporation of South Windsor, Connecticut, to any and all third parties who have sustained or may sustain bodily injury or property damage caused by sudden accidental occurrences arising from operation of the facilities covered by this guarantee.

Recitals

1. Guarantor meets or exceeds the financial test criteria and agrees to comply with the reporting requirements for guarantors as specified in 40 CFR 264.147(g) and 265.147(g).

2. International Fuel Cells Corporation owns and operates the following hazardous waste management facilities covered by this guarantee: EPA Identification Number CTD089623318, International Fuel Cells Corporation, South Windsor, Connecticut 06856. This corporate guarantee satisfies RCRA third-party liability requirements for sudden accidental occurrences in above named owner or operator facilities for coverage in the amount of $1,000,000 for each occurrence and $2,000,000 annual aggregate.

3. For value received from International Fuel Cells Corporation, guarantor guarantees to any and all third parties who have sustained or may sustain bodily injury or property damage caused by sudden accidental occurrences arising from operations of the facility covered by this guarantee that in the event that International Fuel Cells Corporation fails to satisfy a judgment or award based on a determination of liability for bodily injury or property damage to third parties caused by sudden accidental occurrences, arising from the operation of the above-named facility, or fails to pay an amount agreed to in settlement of a claim arising from or alleged to arise from such injury or damage, the guarantor will satisfy such judgment(s), award(s) or settlement agreement(s) up to the limits of coverage identified above.

4. Such obligation does not apply to any of the following:

   (a) Bodily injury or property damage for which International Fuel Cells Corporation is obligated to pay damages by reason of the assumption of liability in a contract or agreement. This exclusion does not apply to liability for damages that International Fuel Cells Corporation would be obligated to pay in the absence of the contract or agreement.

   (b) Any obligation of International Fuel Cells Corporation under workers' compensation, disability benefits, or unemployment compensation law or any similar law.

   (c) Bodily injury to:

      (1) An employee of International Fuel Cells Corporation arising from, and in the course of, employment by International Fuel Cells Corporation; or

      (2) The spouse, child, parent, brother or sister of the employee as a consequence of, or arising from, and in the course of employment by International Fuel Cells Corporation.

This exclusion applies:

A. Whether International Fuel Cells Corporation may be liable as an employer or in any other capacity; and

B. To any obligation to share damages with or repay another person who must pay damages because of the injury to persons identifed in paragraphs (1) and (2).

(d) Bodily injury or property damage arising out of the ownership, maintenance, use, or entrustment to others of any aircraft, motor vehicle or watercraft.

(e) Property damage to:

(1) Any property owned, rented, or occupied by International Fuel Cells Corporation;

(2) Premises that are sold, given away or abandoned by International Fuel Cells Corporation if the property damage arises out of any part of those premises;

(3) Property loaned to International Fuel Cells Corporation;

(4) Personal property in the care, custody or control of International Fuel Cells Corporation;

(5) That particular part of real property on which International Fuel Cells Corporation or any contractors or subcontractors working directly or indirectly on behalf of International Fuel Cells Corporation are performing operations, if the property damage arises out of these operations.

5. Guarantor agrees that if, at the end of any fiscal year before termination of this guarantee, the guarantor fails to meet the financial test criteria, guarantor shall send within 90 days, by certified mail, notice to the Commissioner of the Connecticut Department of Environmental Protection and to International Fuel Cells Corporation that it intends to provide alternate liability coverage as specified in 40 CFR 264.147 and 265.147, as applicable, in the name of International Fuel Cells Corporation Within 120 days after the end of such fiscal year, the guarantor shall establish such liability coverage unless International Fuel Cells Corporation has done so.

6. The guarantor agrees to notify the Commissioner of the Connecticut Environmental Protection by certified mail of a voluntary or involuntary proceeding under Title 11 (Bankruptcy), U.S. Code, naming guarantor as debtor, within 10 days after commencement of the proceeding.

7. Guarantor agrees that within 30 days after being notified by the Commissioner of the Connecticut Department of Environmental Protection of a determination that guarantor no longer meets the financial test criteria or that it is disallowed from continuing as a guarantor, it shall establish alternate liability coverage as specified in 40 CFR 264.147 or 265.147 in the name of International Fuel Cells Corporation unless International Fuel Cells Corporation has done so.

8. Guarantor reserves the right to modify this agreement to take into account amendment or modification of the liability requirements set by 40 CFR 264.147 and 265.147, provided that such modification shall become effective only if the Commissioner of the Department of Environmental Protection does not disapprove the modification within 30 days of receipt of notification of the modification.

9. Guarantor agrees to remain bound under this guarantee for so long as International Fuel Cells Corporation must comply with the applicable requirements of 40 CFR 264.147 and 265.147 for the above- listed facility, except as provided in paragraph 10 of this agreement.

10. Guarantor may terminate this guarantee by sending notice by certified mail to the Commissioner of the Connecticut Department of Environmental Protection and to International Fuel Cells Corporation provided that this guarantee may not be terminated unless and until International Fuel Cells Corporation obtains, and the Commissioner of the Connecticut Department of Environmental Protection approves, alternate liability coverage complying with 40 CFR 264.147 and/or 265.147.

11. Guarantor hereby expressly waives notice of acceptance of this guarantee by any party.

12. Guarantor agrees that this guarantee is in addition to and does not affect any other responsibility or liability of the guarantor with respect to the covered facilities.

13. The guarantor shall satisfy a third-party liability claim only on receipt of one of the following documents:

    (a) Certification from the Principal and the third-party claimant(s) that the liability claim should be paid. The certificiation must be worded as follows, except that instructions in brackets are to be replaced with the relevant information and the brackets deleted:

Certification of Valid Claim

The undersigned, as parties [insert Principal] and [insert name and address of third-party claimant(s)], hereby certify that the claim of bodily injury and/or property damage caused by a sudden accidental occurrence arising from operating [Principal's] hazardous waste treatment, storage, or disposal facility should be paid in the amount of $[ ].

[Signatures]
Principal_____

(Notary)_____ Date_____

[Signatures]

Claimant(s)_____

_____

(Notary)_____ Date _____

    (b) A valid final court order establishing a judgment against the Principal for bodily injury or property damage caused by sudden accidental occurrences arising from the operation of the Principal's facility or group of facilities.

14. In the event of combination of this guarantee with another mechanism to meet liability requirements, this guarantee will be considered excess coverage.

I hereby certify that the wording of the guarantee is identical to the wording specified in 40 CFR 264.151(h) (2) as such regulations were constituted on the date shown immediately below.

Effective date: January 1, 1991
UNITED TECHNOLOGIES CORPORATION

(SEAL)

John A. Rolls
Executive Vice President and Chief Financial Officer

Patricia J. Nolan
Notary

My Commission Expires: 3-31-94

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Price Waterhouse

March 27, 1991

To the Board of Directors of
United Technologies Corporation

We have audited the consolidated financial statements of United Technologies Corporation and subsidiaries (the "Corporation") as of December 31, 1990 and for the year then ended and have issued our report thereon dated January 18, 1991. We have not audited any financial statements of the Corporation as of any date or for any period subsequent to December 31, 1990.

Reference is made to the letter dated March 27, 1991 to the Connecticut Department of Environmental Protection from Mr. John A. Rolls, Executive Vice President and Chief Financial Officer of United Technologies Corporation (the "Letter"). We have compared the amounts listed below and included in the Letter to the corresponding amounts included in the aforementioned consolidated financial statements, rounded to the nearest one hundred thousand, and found such amounts to be in agreement.

Description	Amount (000's)	
Tangible net worth at December 31, 1990	$ 3,927,600	(1)
Total assets in U.S. at December 31, 1990	$ 9,597,800	(2)

(1) Shareowners' Equity, $5,343,100; less Deferred Charges, $1,415,500.

(2) United States operations, $9,597,800 only; excludes General corporate assets and other, $1,941,100.

Because the foregoing procedure does not constitute an audit made in accordance with generally accepted auditing standards, we do not express an opinion on the amounts listed above. In connection with this procedure, no matters came to our attention that caused us to believe that the amounts should be adjusted.

We performed no audit or other procedures with respect to the amounts shown on lines 1 and 2 in Part B of the Letter. Accordingly, we do not express an opinion or any other form of assurance on such amounts.

It is understood that this report is solely for your information and assistance in complying with the requirements of the Environmental Protection Agency-Subpart H of 40 CFR, Parts 264 and 265 and the regulations of authorized states, and should not be used for any other purpose.

Yours very truly,

Price Waterhouse

United Technologies Corporation
Hazardous Waste Management and UIC Facility Closure and Post-Closure
Care Costs and Applicable Cost Revisions by State
Inflated for Year 1990
(RCRA Parts 264 and 265 Subpart H)
EXHIBIT A

*** State: California ******

Facility Name : Chemical Systems Division (Division)
Address : 600 Metcalf Road
San Jose, CA 95138
EPA Identification Number : CAD001705235
Closure Facility Type : Storage & Treatment (Surface Impoundments)
Post-Closure Facility Type: Treatment (Includes Surface Impoundments)

Year	Inflation Factor	Closure Cost		Post-Closure Cost	
1981	1.000	$ 165,000		$ 0	
1982	1.090	$ 360,000	Revision	$ 0	
1983	1.060	$ 360,000		$ 0	
1984	1.040	$ 374,400		$ 0	
1985	1.040	$ 592,000	Revision	$ 0	
1986	1.030	$ 609,760		$ 0	
1987	1.030	$ 309,000	Revision	$ 372,000	Revision
1988	1.033	$ 634,360	Revision	$ 510,000	Revision
1989	1.041	$ 1,102,460	Revision	$ 1,120,299	Revision
1990	1.041	$ 1,147,661		$ 1,166,231	

Facility Name : Hamilton Standard Overhaul & Repair (Division)
Address : 4401 Donald Douglas Drive
Long Beach, CA 90801
EPA Identification Number : CAD044433613
Closure Facility Type : Storage & Treatment
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost		Post-Closure Cost
1981	1.000	$ 4,000		$ 0
1982	1.090	$ 4,360		$ 0
1983	1.060	$ 4,622		$ 0
1984	1.040	$ 4,807		$ 0
1985	1.040	$ 35,000	Revision	$ 0
1986	1.030	$ 36,050		$ 0
1987	1.030	$ 37,132		$ 0
1988	1.033	$ 38,357		$ 0
1989	1.041	$ 39,930		$ 0
1990	1.041	$ 41,567		$ 0

California Total Cost for 1990: Closure $ 1,189,228 Post-Closure $ 1,166,231

**** State: Colorado ******

Facility Name : United Technologies Microelectronics Center, Inc. (Subsidiary)
Address : 1575 Garden of the Gods Road
Colorado Springs, CO 80907
EPA Identification Number : COD000716597
Closure Facility Type : Storage
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost		Post-Closure Cost
1981	1.000	$ 14,360		$ 0
1982	1.090	$ 19,632	Revision	$ 0
1983	1.060	$ 38,000	Revision	$ 0
1984	1.040	$ 39,520		$ 0
1985	1.040	$ 41,101		$ 0
1986	1.030	$ 42,334		$ 0
1987	1.030	$ 43,604		$ 0
1988	1.033	$ 45,043		$ 0
1989	1.041	$ 46,890		$ 0
1990	1.041	$ 48,812		$ 0

Colorado Total Cost for 1990: Closure $ 48,812 Post-Closure $ 0

United Technologies Corporation
Hazardous Waste Management and UIC Facility Closure and Post-Closure
Care Costs and Applicable Cost Revisions by State
Inflated for Year 1990
(RCRA Parts 264 and 265 Subpart H)
EXHIBIT A

*** State: Connecticut ******

Facility Name : Hamilton Standard (Division)
Address : Hamilton Road
Windsor Locks, CT 06096
EPA Identification Number : CTD001145341
Closure Facility Type : Storage & Treatment (Surface Impoundments)
Post-Closure Facility Type: Treatment (Includes Surface Impoundments)

Year	Inflation Factor	Closure Cost		Post-Closure Cost	
1981	1.000	$ 580,000		$ 0	
1982	1.090	$ 632,200		$ 0	
1983	1.060	$ 670,132		$ 0	
1984	1.040	$ 696,937		$ 0	
1985	1.040	$ 686,073	Revision	$ 567,000	Revision
1986	1.030	$ 707,335	Revision	$ 584,010	
1987	1.030	$ 728,555		$ 601,530	
1988	1.033	$ 546,676	Revision	$ 562,309	Revision
1989	1.041	$ 569,090		$ 3,534,118	Revision
1990	1.041	$ 799,572	Revision	$ 7,980,000	Revision

Facility Name : International Fuel Cells Corporation (Subsidiary)
Address : P.O. Box 739
South Windsor, CT 06070
EPA Identification Number : CTD010166791
Closure Facility Type : Storage
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost		Post-Closure Cost
1981	1.000	$ 6,450		$ 0
1982	1.090	$ 7,031		$ 0
1983	1.060	$ 7,453		$ 0
1984	1.040	$ 7,751		$ 0
1985	1.040	$ 8,061		$ 0
1986	1.030	$ 8,303		$ 0
1987	1.030	$ 8,552		$ 0
1988	1.033	$ 209,585	Revision	$ 0
1989	1.041	$ 218,178		$ 0
1990	1.041	$ 227,123		$ 0

Facility Name : Norden Systems, Inc. (Subsidiary)
Address : 100 Norden Place
Norwalk, CT 06856
EPA Identification Number : CTD089623318
Closure Facility Type : Storage & Treatment
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost	Post-Closure Cost
1981	1.000	$ 12,250	$ 0
1982	1.090	$ 13,353	$ 0
1983	1.060	$ 14,154	$ 0
1984	1.040	$ 14,720	$ 0
1985	1.040	$ 15,309	$ 0
1986	1.030	$ 15,768	$ 0
1987	1.030	$ 16,241	$ 0
1988	1.033	$ 16,777	$ 0
1989	1.041	$ 17,465	$ 0
1990	1.041	$ 18,181	$ 0

United Technologies Corporation
Hazardous Waste Management and UIC Facility Closure and Post-Closure
Care Costs and Applicable Cost Revisions by State
Inflated for Year 1990
(RCRA Parts 264 and 265 Subpart H)
EXHIBIT A

Facility Name : Pratt & Whitney Aircraft (Division)
Address : 400 Main Street
East Hartford, CT 06108
EPA Identification Number : CTD990672081
Closure Facility Type : Storage & Treatment
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost		Post-Closure Cost
1981	1.000	$ 290,000	Revision	$ 0
1982	1.090	$ 316,100	Revision	$ 0
1983	1.060	$ 335,066	Revision	$ 0
1984	1.040	$ 348,469	Revision	$ 0
1985	1.040	$ 362,408		$ 0
1986	1.030	$ 373,280		$ 0
1987	1.030	$ 384,478		$ 0
1988	1.033	$ 397,166		$ 0
1989	1.041	$ 413,450		$ 0
1990	1.041	$ 1,920,712	Revision	$ 0

Facility Name : Pratt & Whitney Aircraft (Division)
Address : Aircraft Road
Middletown, CT 06457
EPA Identification Number : CTD003935905
Closure Facility Type : Storage & Disposal (Surface Impoundments)
Post-Closure Facility Type: Treatment/Disposal (Surface Impoundments/Landfill)

Year	Inflation Factor	Closure Cost		Post-Closure Cost	
1981	1.000	$ 280,000		$ 860,400	Revision
1982	1.090	$ 305,200		$ 973,836	
1983	1.060	$ 323,512		$ 994,106	
1984	1.040	$ 977,080	Revision	$ 1,033,870	
1985	1.040	$ 1,688,004	Revision	$ 1,075,225	
1986	1.030	$ 2,978,000	Revision	$ 1,107,482	
1987	1.030	$ 835,000	Revision	$ 1,140,706	
1988	1.033	$ 862,555		$ 1,178,349	
1989	1.041	$ 897,920		$ 1,226,661	
1990	1.041	$ 934,735		$ 1,276,954	

Facility Name : Pratt & Whitney Aircraft (Division)
Address : 415 Washington Avenue
North Haven, 06473
EPA Identification Number : CTD001449511
Closure Facility Type : Storage (Surface Impoundments)
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost		Post-Closure Cost	
1981	1.000	$ 480,000		$ 0	
1982	1.090	$ 523,200		$ 0	
1983	1.060	$ 554,592		$ 0	
1984	1.040	$ 584,982	Revision	$ 0	
1985	1.040	$ 608,381		$ 0	
1986	1.030	$ 626,632		$ 0	
1987	1.030	$ 645,431		$ 0	
1988	1.033	$ 186,060	Revision	$ 0	
1989	1.041	$ 193,688		$ 0	
1990	1.041	$ 881,629	Revision	$ 150,000	Revision

United Technologies Corporation
Hazardous Waste Management and UIC Facility Closure and Post-Closure
Care Costs and Applicable Cost Revisions by State
Inflated for Year 1990
(RCRA Parts 264 and 265 Subpart H)
EXHIBIT A

Facility Name : Pratt & Whitney Aircraft (Division)
Address : Aircraft Road (Mfg)
Southington, CT 06489
EPA Identification Number : CTD001149277
Closure Facility Type : Storage (Surface Impoundments)
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost		Post-Closure Cost	
1981	1.000	$ 60,000		$ 0	
1982	1.090	$ 65,400		$ 0	
1983	1.060	$ 69,324		$ 0	
1984	1.040	$ 72,097		$ 0	
1985	1.040	$ 74,981		$ 0	
1986	1.030	$ 77,230		$ 0	
1987	1.030	$ 79,547		$ 0	
1988	1.033	$ 259,000	Revision	$ 0	
1989	1.041	$ 269,619		$ 0	
1990	1.041	$ 280,673		$ 150,000	Revision

Facility Name : Pratt & Whitney Aircraft (Division)
Address : Belamose Avenue
Rocky Hill, CT 06067
EPA Identification Number : CTD000844407
Closure Facility Type : Storage
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost		Post-Closure Cost
1981	1.000	$ 1,000		$ 0
1982	1.090	$ 1,090		$ 0
1983	1.060	$ 1,155		$ 0
1984	1.040	$ 11,400	Revision	$ 0
1985	1.040	$ 11,856		$ 0
1986	1.030	$ 12,212		$ 0
1987	1.030	$ 12,578		$ 0
1988	1.033	$ 128,790	Revision	$ 0
1989	1.041	$ 134,070		$ 0
1990	1.041	$ 139,567		$ 0

Facility Name : Pratt & Whitney Aircraft (Division)
Address : Newell Street (O&R)
Southington, CT 06489
EPA Identification Number : CTD000844332
Closure Facility Type : Storage & Treatment (Surface Impoundments)
Post-Closure Facility Type: Treatment (Surface Impoundments/Landfill)

Year	Inflation Factor	Closure Cost		Post-Closure Cost
1981	1.000	$ 115,000		$ 0
1982	1.090	$ 125,350		$ 0
1983	1.060	$ 132,871		$ 0
1984	1.040	$ 138,186		$ 0
1985	1.040	$ 143,713		$ 0
1986	1.030	$ 226,405	Revision	$ 0
1987	1.030	$ 213,945	Revision	$ 0
1988	1.033	$ 221,005		$ 0
1989	1.041	$ 230,066		$ 0
1990	1.041	$ 239,499		$ 0

United Technologies Corporation
Hazardous Waste Management and UIC Facility Closure and Post-Closure
Care Costs and Applicable Cost Revisions by State
Inflated for Year 1990
(RCRA Parts 264 and 265 Subpart H)
EXHIBIT A

Facility Name : Pratt & Whitney Aircraft (Division)
Address : Pine Street
Manchester, CT 06040
EPA Identification Number : CTD000844324
Closure Facility Type : Storage
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost		Post-Closure Cost	
1981	1.000	$ 4,500		$ 0	
1982	1.090	$ 4,905		$ 0	
1983	1.060	$ 5,199		$ 0	
1984	1.040	$ 5,407		$ 0	
1985	1.040	$ 5,623		$ 0	
1986	1.030	$ 5,792		$ 0	
1987	1.030	$ 5,966		$ 0	
1988	1.033	$ 87,400	Revision	$ 0	
1989	1.041	$ 22,308	Revision	$ 0	
1990	1.041	$ 23,223		$ 0	

Facility Name : Pratt & Whitney Aircraft (Division)
Address : Pent Road (Willgoos)
East Hartford, CT 06108
EPA Identification Number : CTD000845131
Closure Facility Type : Storage
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost		Post-Closure Cost	
1981	1.000	$ 3,000		$ 0	
1982	1.090	$ 3,270		$ 0	
1983	1.060	$ 3,466		$ 0	
1984	1.040	$ 3,605		$ 0	
1985	1.040	$ 3,749		$ 0	
1986	1.030	$ 3,861		$ 0	
1987	1.030	$ 3,977		$ 0	
1988	1.033	$ 21,600	Revision	$ 0	
1989	1.041	$ 22,486		$ 0	
1990	1.041	$ 23,408		$ 0	

Facility Name : Pratt & Whitney Aircraft (Division)
Address : Colt Street
East Hartford, CT 06108
EPA Identification Number : CTD000844399
Closure Facility Type : Storage & Treatment (Surface Impoundments)
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost		Post-Closure Cost	
1981	1.000	$ 100,000		$ 0	
1982	1.090	$ 109,000		$ 0	
1983	1.060	$ 115,540		$ 0	
1984	1.000	$ 120,162		$ 115,540	Revision
1985	1.040	$ 124,968		$ 120,162	
1986	1.030	$ 128,717		$ 123,767	
1987	1.030	$ 132,579		$ 127,480	
1988	1.033	$ 136,954		$ 131,687	
1989	1.041	$ 142,569		$ 137,086	
1990	1.041	$ 148,614		$ 142,707	

United Technologies Corporation
Hazardous Waste Management and UIC Facility Closure and Post-Closure
Care Costs and Applicable Cost Revisions by State
Inflated for Year 1990
(RCRA Parts 264 and 265 Subpart H)
EXHIBIT A

Facility Name : Sikorsky Aircraft (Division)
Address : 6900 Main Street
Stratford, CT 06601-1381
EPA Identification Number : CTD001449784
Closure Facility Type : Storage & Treatment (Surface Impoundments)
Post-Closure Facility Type: Treatment (Includes Surface Impoundments)

Year	Inflation Factor	Closure Cost		Post-Closure Cost	
1981	1.000	$ 145,000		$ 0	
1982	1.090	$ 158,050		$ 0	
1983	1.060	$ 167,533		$ 0	
1984	1.040	$ 174,234		$ 0	
1985	1.040	$ 181,203		$ 70,000	Revision
1986	1.030	$ 186,639		$ 72,100	
1987	1.030	$ 451,000	Revision	$ 285,000	Revision
1988	1.033	$ 465,883		$ 294,405	
1989	1.041	$ 50,000	Revision	$ 306,476	
1990	1.041	$ 80,000	Revision	$ 319,042	

Facility Name : Sikorsky Aircraft (Division)
Address : South Avenue
Bridgeport, CT 06604
EPA Identification Number : CTD001449735
Closure Facility Type : Storage
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost		Post-Closure Cost
1981	1.000	$ 17,000		$ 0
1982	1.090	$ 18,530		$ 0
1983	1.060	$ 19,642		$ 0
1984	1.040	$ 20,428		$ 0
1985	1.040	$ 21,245		$ 0
1986	1.030	$ 21,882		$ 0
1987	1.030	$ 22,538		$ 0
1988	1.033	$ 23,282		$ 0
1989	1.041	$ 66,000	Revision	$ 0
1990	1.041	$ 68,706		$ 0

Facility Name : United Technologies Research Center (Division)
Address : Silver lane
East Hartford, CT 06108
EPA Identification Number : CTD095532131
Closure Facility Type : Storage
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost		Post-Closure Cost
1981	1.000	$ 10,000		$ 0
1982	1.090	$ 10,900		$ 0
1983	1.060	$ 11,554		$ 0
1984	1.040	$ 12,016		$ 0
1985	1.040	$ 12,497		$ 0
1986	1.030	$ 12,872		$ 0
1987	1.030	$ 13,258		$ 0
1988	1.033	$ 13,696		$ 0
1989	1.041	$ 14,258		$ 0
1990	1.041	$ 40,000	Revision	$ 0

United Technologies Corporation
Hazardous Waste Management and UIC Facility Closure and Post-Closure
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Inflated for Year 1990
(RCRA Parts 264 and 265 Subpart H)
EXHIBIT A

*** State: Florida ******

Facility Name : Pratt & Whitney Aircraft (Division)
Address : P.O. Box 2691
West Palm Beach, FL 33402
EPA Identification Number : FLD001447952
Closure Facility Type : Storage & Treatment
Post-Closure Facility Type: Treatment (Treatment Tanks Without Containment)

Year	Inflation Factor	Closure Cost		Post-Closure Cost	
1981	1.000	$ 533,000	Revision	$ 0	
1982	1.090	$ 580,970	Revision	$ 0	
1983	1.060	$ 615,828	Revision	$ 0	
1984	1.040	$ 596,437	Revision	$ 0	
1985	1.040	$ 634,126	Revision	$ 0	
1986	1.030	$ 1,333,057	Revision	$ 604,500	Revision
1987	1.030	$ 1,373,049		$ 622,635	
1988	1.033	$ 1,418,360		$ 643,182	
1989	1.041	$ 1,476,513		$ 669,552	
1990	1.041	$ 1,532,727	Revision	$ 697,004	

Facility Name : Pratt & Whitney Aircraft (Division)
Address : P.O. Box 2691
West Palm Beach, FL 33402
EPA Identification Number : UD 50-081415
Closure Facility Type : Underground Inj. Control Fac. (FL Non-RCRA Reqmt.)
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost	Post-Closure Cost
1981	1.000	$ 0	$ 0
1982	1.090	$ 0	$ 0
1983	1.060	$ 0	$ 0
1984	1.040	$ 0	$ 0
1985	1.040	$ 100,000	$ 0
1986	1.030	$ 103,000	$ 0
1987	1.030	$ 106,090	$ 0
1988	1.033	$ 109,591	$ 0
1989	1.041	$ 114,084	$ 0
1990	1.041	$ 118,761	$ 0

orida Total Cost for 1990: Closure $ 1,651,488 Post-Closure $ 697,004

*** State: Iowa ******

Facility Name : Sheller-Globe Corporation (Subsidiary)
Address : 3200 Main Street
Keokuk, IA 52240
EPA Identification Number : IAD005136023
Closure Facility Type : Storage
Post-Closure Facility Type: None

Facility Name (Continued): Sheller-Globe Corporation

Year	Inflation Factor	Closure Cost		Post-Closure Cost
1989	1.000	$ 85,000	Revision	$ 0
1990	1.041	$ 88,485		$ 0

owa Total Cost for 1990: Closure $ 88,485 Post-Closure $ 0

***** State: Kentucky ******

Facility Name : Sheller-Globe Corporation (Subsidiary)
Address : P.O. Box 436 Highway 60 West
Morganfield, KY 42437
EPA Identification Number : KYD096551346
Closure Facility Type : Storage
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost		Post-Closure Cost
1990	1.041	$ 42,000	Revision	$ 0

entucky Total Cost for 1990: Closure $ 42,000 Post-Closure $ 0

**** State: Maine ******

Facility Name : Pratt & Whitney Aircraft (Division)
Address : P.O. Box 455
North Berwick, ME 03906
EPA Identification Number : MED000791681
Closure Facility Type : Storage
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost		Post-Closure Cost
1981	1.000	$ 60,000		$ 0
1982	1.090	$ 40,000	Revision	$ 0
1983	1.060	$ 42,400		$ 0
1984	1.040	$ 112,000	Revision	$ 0
1985	1.040	$ 116,480		$ 0
1986	1.030	$ 119,975		$ 0
1987	1.030	$ 123,574		$ 0
1988	1.033	$ 127,652		$ 0
1989	1.041	$ 132,886		$ 0
1990	1.041	$ 138,334		$ 0

ine Total Cost for 1990: Closure $ 138,334 Post-Closure $ 0

**** State: Michigan ******

Facility Name : Sheller-Globe Corporation (Subsidiary)
Address : 1501 South Third Street
Niles, MI 49120
EPA Identification Number : MID082859315
Closure Facility Type : Storage
Post-Closure Facility Type: None

Facility Name (Continued): Sheller-Globe Corporation

Year	Inflation Factor	Closure Cost		Post-Closure Cost
1989	1.000	$ 90,000	Revision	$ 0
1990	1.041	$ 93,690		$ 0

ichigan Total Cost for 1990: Closure $ 93,690 Post-Closure $ 0

***** State: Mississippi ******

Facility Name : United Technologies Motor Systems, Inc (Subsidiary)
Address : P.O. Box 2228
Columbus, MS 39701
EPA Identification Number : MSD004010724
Closure Facility Type : Storage
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost		Post-Closure Cost
1981	1.000	$ 20,000	Revision	$ 0
1982	1.090	$ 21,800		$ 0
1983	1.060	$ 23,108		$ 0
1984	1.040	$ 24,032		$ 0
1985	1.040	$ 26,993	Revision	$ 0
1986	1.030	$ 27,803		$ 0
1987	1.030	$ 28,637		$ 0
1988	1.033	$ 53,000	Revision	$ 0
1989	1.041	$ 55,173		$ 0
1990	1.041	$ 57,435		$ 0

ss i Total Cost for 1990: Closure $ 57,435 Post-Closure $ 0

***** State: New York ******

Facility Name : Carrier Corporation (Subsidiary)
Address : Carrier Parkway
Syracuse, NY 13221
EPA Identification Number : NYD001317072
Closure Facility Type : Storage
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost		Post-Closure Cost
1981	1.000	$ 0		$ 0
1982	1.090	$ 0		$ 0
1983	1.060	$ 0		$ 0
1984	1.040	$ 0		$ 0
1985	1.040	$ 45,000		$ 0
1986	1.030	$ 46,350		$ 0
1987	1.030	$ 47,740	Revision	$ 0
1988	1.033	$ 49,315		$ 0
1989	1.041	$ 51,337		$ 0
1990	1.041	$ 53,442		$ 0

w York Total Cost for 1990: Closure $ 53,442 Post-Closure $ 0

United Technologies Corporation
Hazardous Waste Management and UIC Facility Closure and Post-Closure
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(RCRA Parts 264 and 265 Subpart H)
EXHIBIT A

State: Ohio

Facility Name : Sheller-Globe Corporation (Subsidiary)
Address : Linfoot and Bayes Streets
Wauseon, OH 43567
EPA Identification Number : OHD018421453
Closure Facility Type : Storage
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost		Post-Closure Cost
1989	1.000	$ 16,500	Revision	$ 0
1990	1.041	$ 17,177		$ 0

Facility Name : Sheller-Globe Corporation (Subsidiary)
Address : 55 N. Garfield Street
Norwalk, OH 44857
EPA Identification Number : OHD039999164
Closure Facility Type : Storage
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost		Post-Closure Cost
1989	1.000	$ 45,500	Revision	$ 0
1990	1.041	$ 47,366		$ 0

Facility Name : Sheller-Globe Corporation (Subsidiary)
Address : 4444 North Detroit Avenue
Toledo, OH 43612
EPA Identification Number : OHD063717565
Closure Facility Type : Storage
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost		Post-Closure Cost
1989	1.000	$ 46,000	Revision	$ 0
1990	1.041	$ 47,886		$ 0

Facility Name : Sheller-Globe Corporation (Subsidiary)
Address : Lint and Dura Avenues
Toledo, OH 43612
EPA Identification Number : OHD18354894
Closure Facility Type : Storage
Post-Closure Facility Type: None

Year	Inflation Factor	Closure Cost		Post-Closure Cost
1989	1.000	$ 8,000	Revision	$ 0
1990	1.041	$ 8,328		$ 0

Ohio Total Cost for 1990: Closure $ 120,757 Post-Closure $ 0

UTC Total Costs for 1990: Closure $ 9,309,113 Post-Closure $ 11,881,938 Grand Total $ 21,191,051

UNITED TECHNOLOGIES

1990 Annual Report

GLOBAL

"Many companies today are trying to tap the growth potential of the international marketplace. UTC already has a strong global presence. In fact, our international business has grown 85 percent over the last five years and now accounts for more than half of our total revenues. . . .

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"UTC will continue to grow, because our core businesses are market leaders, and we are

GROWTH

constantly exploring new business opportunities worldwide. We also remain committed to maintaining consistent performance improvement. Clearly, we will benefit from the unfolding global economy, because we are strategically positioned to provide our customers with the best products and services to meet their needs."

Robert F. Daniell
Chairman and Chief Executive Officer

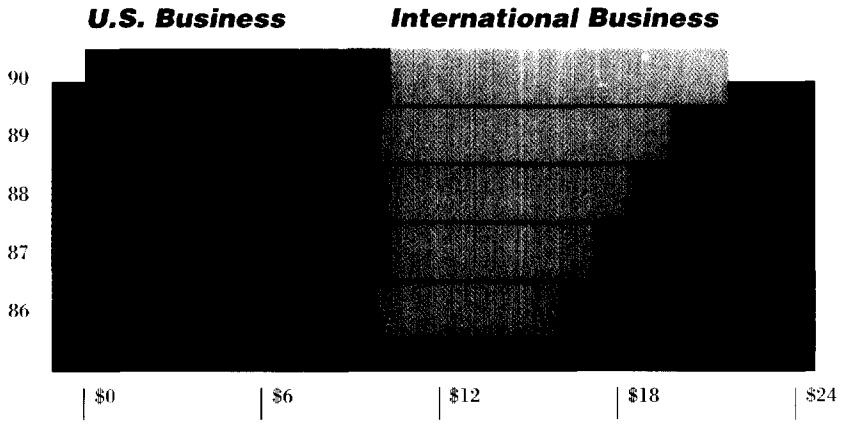
Financial Summary

Millions of Dollars (except per share amounts)	1990	1989
UTC's Performance in Brief		
Sales	**$21,442.0**	$19,532.1
Net Income	**$ 750.6**	$ 702.1
Earnings per share:		
Primary	**$ 5.91**	$ 5.34
Fully diluted	**$ 5.53**	$ 5.20
Dividends per common share	**$ 1.80**	$ 1.60
Yearend business backlog	**$20,875.0**	$20,125.0
Research and development	**$ 1,021.4**	$ 956.6
Capital expenditures	**$ 1,200.4**	$ 1,023.3

	December 31,	
	1990	1989
Other Financial Information		
Assets		
Current assets	**$ 9,012.2**	$ 8,506.8
Fixed assets—net	**$ 4,396.2**	$ 3,951.9
Other	**$ 2,509.9**	$ 2,139.5
Liabilities		
Current liabilities, excluding debt	**$ 5,291.3**	$ 4,796.5
Total debt	**$ 3,561.8**	$ 3,592.8
Other	**$ 1,722.1**	$ 1,468.6
Shareowners' equity	**$ 5,343.1**	$ 4,740.3

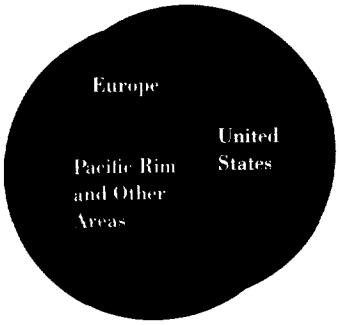
Global Growth

Revenues in $ Billions



Global Markets

Share of Total Revenues



Original includes color coding.

Dear Shareowner

I am pleased to report that United Technologies achieved record earnings in 1990 for the third consecutive year.

Revenues increased 10 percent, net income rose seven percent and earnings per share were up six percent. Strong performances at Pratt & Whitney, Otis and Sikorsky were mainly responsible for these results.

United Technologies Posts Record Yearend Backlog

Our yearend backlog, the best indicator of future revenue growth, was a record $20.9 billion, due in large part to another successful year at Pratt & Whitney's Commercial Engine Business. In 1990, Pratt & Whitney received a $4 billion order—its largest ever—from United Airlines. United selected the PW4000 engine to power as many as 128 wide-body 777 and 747-400 aircraft, if all options are exercised. This win is especially important to us, because the PW4000 growth engine, a derivative of our advanced-technology PW4000 family, was chosen as the launch engine on Boeing's new 777 twin-jet aircraft.

We did have some disappointments in 1990. Norden continued to experience substantial losses on its two major fixed-price development contracts. One of these, the Joint STARS radar system, essentially has been completed. Development of the other advanced radar system continues, and delivery of the first production unit is scheduled for 1992.

Carrier continued to show poor operating results, but we made considerable progress during the year developing new technologies to achieve the product differentiation Carrier needs to improve its competitiveness and profitability. Products incorporating these technologies will be introduced to the marketplace over the next three years.

Of course, UTC's commitment to technology is a key to the future success of all our business units. Carrier's new scroll compressor, Otis' innovative linear induction motor elevator, and Pratt & Whitney's F119 engine for the Advanced Tactical Fighter are just a few recent examples of technology advances that should give us competitive advantage in the world markets we serve.

In 1990, we reaffirmed our commitment to protecting the environment. To raise awareness of this commitment throughout the corporation and to improve UTC's environmental performance, we added the new corporate post of senior vice president-environmental and business practices, and appointed environmental officers at each of our business units.

We are introducing products that will have a positive impact on the environment. Carrier, for example, is a leader in introducing technologies that employ alternate air-conditioning refrigerants much less harmful to the ozone layer than those now in use. Carrier also is at the forefront in developing refrigerant recovery systems that will help control ozone-depleting CFC emissions. Pratt & Whitney and its partners have developed and are installing hush kits on older aircraft that will enable them to comply with new airport noise regulations.

As we enter 1991, United Technologies faces a difficult economic environment, especially in the United States. We have been implementing cost-reduction programs and instituting performance improvement initiatives throughout the corporation. We also will continue to strengthen UTC by investing prudently in research and development and capital assets.

Majority of Revenues from International Business

Going forward, we see numerous growth opportunities in international markets. Many companies today are trying to tap the growth potential of the international marketplace. UTC already has a strong global presence. In fact, our international business has grown 85 percent over the last five years and now accounts for more than half our revenues.

Otis, which derives more than three-fourths of its revenues from outside the United States, is strategically positioned to capitalize on the array of opportunities emerging in Europe and the Pacific Rim. Carrier stands to benefit from increased demand for its products in rapidly growing warm-climate countries, and UT Automotive is expanding its presence in Europe, the world's

Dividends Declared

UTC's board of directors, on January 28, 1991, declared a regular quarterly dividend of 45 cents per common share, payable March 10, 1991 to shareowners of record at the close of business on February 25. In addition, the directors declared a regular quarterly dividend of $1.20 per share on the convertible preferred stock held by the corporation's Employee Stock Ownership Plan, payable March 10, 1991 to shareowners of record at the start of business that day.

largest automotive market and the one with the greatest growth potential.

The globalization of the aerospace industry offers tremendous opportunities for Pratt & Whitney, as well as for Hamilton Standard and Sikorsky. Our business alliance with the MTU aerospace unit of Daimler-Benz will enhance our commercial aerospace prospects internationally, especially in Europe. Sikorsky sees substantial opportunities for its helicopter business in such overseas markets as Korea, Turkey, Japan and Saudi Arabia.

Successful international companies will no longer simply be exporters. They will operate as local companies in many markets around the world. International partnerships and business alliances are critical to gaining entry to these markets. They are also essential in today's world for gaining market knowledge and sharing resources. Our annual report for 1990 offers you a look at UTC's plans to sustain global growth, while improving long-term profitability. In the following pages, we will discuss the strategic direction we are taking throughout the corporation to build for the future.

UTC will continue to grow, because our core businesses are market leaders and because we are well-positioned in international markets. We remain committed to maintaining consistent performance improvement, while we explore additional business opportunities worldwide. Clearly, we will benefit from the unfolding global economy, because we are strategically positioned to provide our customers with the best products and services to meet their needs.

Sincerely,

Robert F. Daniell

Robert F. Daniell
Chairman and Chief Executive Officer
February 1, 1991

Tokyo, Japan

"The Pacific Rim is booming. A united Germany beckons. And EC92 is on its way. The Soviet Union and the nations of Eastern Europe, meanwhile, are opening their doors to some promising new business ventures. United Technologies is well-established in these and other growing areas of the world, such as Japan, one of our largest international markets. Now, we're stepping up our pursuit of growth opportunities through an array of cross-border partnerships and licensing and co-production agreements. All on a global basis."

Global Growth

Otis, the international leader in the manufacture and service of elevators and escalators, is UTC's most global company, offering products for sale in almost every country of the world. The company's dollar share of the global new-equipment market at yearend was 23 percent, nearly twice that of its nearest competitor. And Otis is the only elevator manufacturer with double-digit market shares in virtually every market around the world. More than 75 percent of its revenues for 1990 were generated outside the United States.

During the year, Otis enhanced its leadership position in the world's elevator industry by forging a number of new business alliances in emerging markets, such as Central and Eastern Europe. The company established a joint-venture partnership with GFV, a Hungarian elevator manufacturer, and acquired a 60 percent share of eastern Germany's largest elevator company, Berliner Aufzugs- und Fahrtreppenbau.

Otis also signed two joint-venture agreements in the Soviet Union, which has the potential of becoming a very large market for new elevator equipment. Soviet demand, driven by the need to upgrade the country's elevatored housing infrastructure, is estimated to be 50,000 units in the year 2000, or three times greater than the current North American market. One of the new partnerships, Shcherbinka Otis Lift, is the first of several prospective ventures with Liftmash, the Soviet national elevator authority, which now accounts for more than half of the country's total production. Located outside Moscow, the Shcherbinka Otis plant will manufacture elevator equipment and provide related installation and maintenance services for office buildings, small hotels and apartment complexes. And in Leningrad, another new joint venture—Len Otis Lift—will provide equipment for the regional housing market there.

Strong demand for housing projects in Brazil and continued expansion of that country's business sector should result in significant new-equipment sales for Otis through the decade. In 1990, Otis completed a new 450,000-square-foot manufacturing facility in Sao Bernardo, near Sao Paolo, Brazil, that will enhance the company's leadership position in this growing market. The new plant also will supply elevator components to Otis' worldwide markets.

The Pacific Rim will produce Otis' largest growth over the next 10 years, particularly in rapidly developing countries such as the Republic of Korea and the Southeast Asian nations, and in emerging

Leningrad, USSR

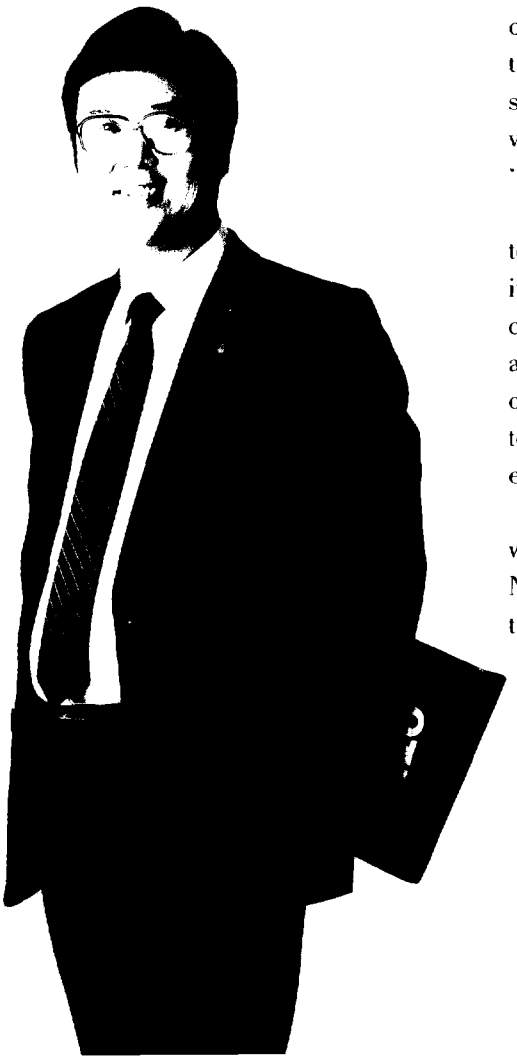
"Otis' success as a global company stems largely from having a local presence in just about every country of the world. Our two new joint ventures in Leningrad and Moscow further expand that infrastructure. We've been selling directly to the Soviet Union, which is potentially one of the world's largest elevator markets, for more than 20 years. The ability to manufacture equipment locally should give us even greater access to this expansive market and help us capitalize on the region's growth opportunities."

Глобальное развитие

全球发展

Tianjin, China

"The new TV Tower rising high above the city of Tianjin is an elevator project of ours that symbolizes the enormous growth potential of China's economy. Otis is building a solid manufacturing and marketing base that will span the country. Our Tianjin Otis joint venture has been operating successfully for more than six years. And Otis is negotiating additional partnerships to enhance its presence in southern China, the fastest-growing area of the country."



markets such as the People's Republic of China. In 1990, Otis increased its participation in the China Tianjin Otis Elevator Company to 44 percent, and Otis is negotiating partnerships to enhance its presence in southern China. The company plans to sign a joint-venture agreement with its long-time sales agent in Indonesia in 1991. Otis also is exploring partnership opportunities in Korea to service that country's fast-growing domestic market. In India, the company has modernized its large, existing factory and has begun construction of a new plant in Mysore, in southern India, to support the introduction of a new product line and continued expansion of the domestic market.

In Japan, where the requirements for advanced technology are the highest in the world, Nippon Otis recently opened its new Technology Institute and is in the process of doubling its R&D capabilities. The company also completed a substantial capacity expansion at its Shibayama manufacturing facility to service the country's continuing strong market conditions. Otis expects its volume of business in this strategically critical market will grow to $500 million in 1991, reflecting a continuation of the marketshare increases in Japan that the company has achieved in recent years.

The industry's most innovative product, the linear induction motor (LIM) elevator system that Otis introduced in 1989, continues to win customer acceptance in Japan. Otis is the only company offering this breakthrough product, and it anticipates sales of more than 500 units in Japan in 1991. The LIM system allows for a space-efficient mid-rise elevator that eliminates the need for a conventional rooftop motor room, removing what architects refer to as "skyline pollution."

Otis has increased its sales force and introduced new products to capitalize on the global growth of the modernization market. One of its new product offerings, the Elevonic® 411M™ system, gives owners of older high-rise buildings the same elevator performance advantages found in the highly advanced Elevonic 411™ systems offered for new construction projects. Both systems use artificial intelligence to monitor a building's traffic patterns and dispatch elevators more efficiently.

Test marketing of a new residential elevator in the United States was successful, and the product was released for sale throughout North America in early 1991. Otis is now marketing similar residential products in Europe and the Pacific Rim, especially in Japan.

Pratt & Whitney Commercial Engine Business

The Commercial Engine Business of Pratt & Whitney (P&W) had one of its strongest years ever in 1990. This performance, following a record year in 1989, reflects P&W's successful efforts to win additional new business from U.S. and overseas customers.

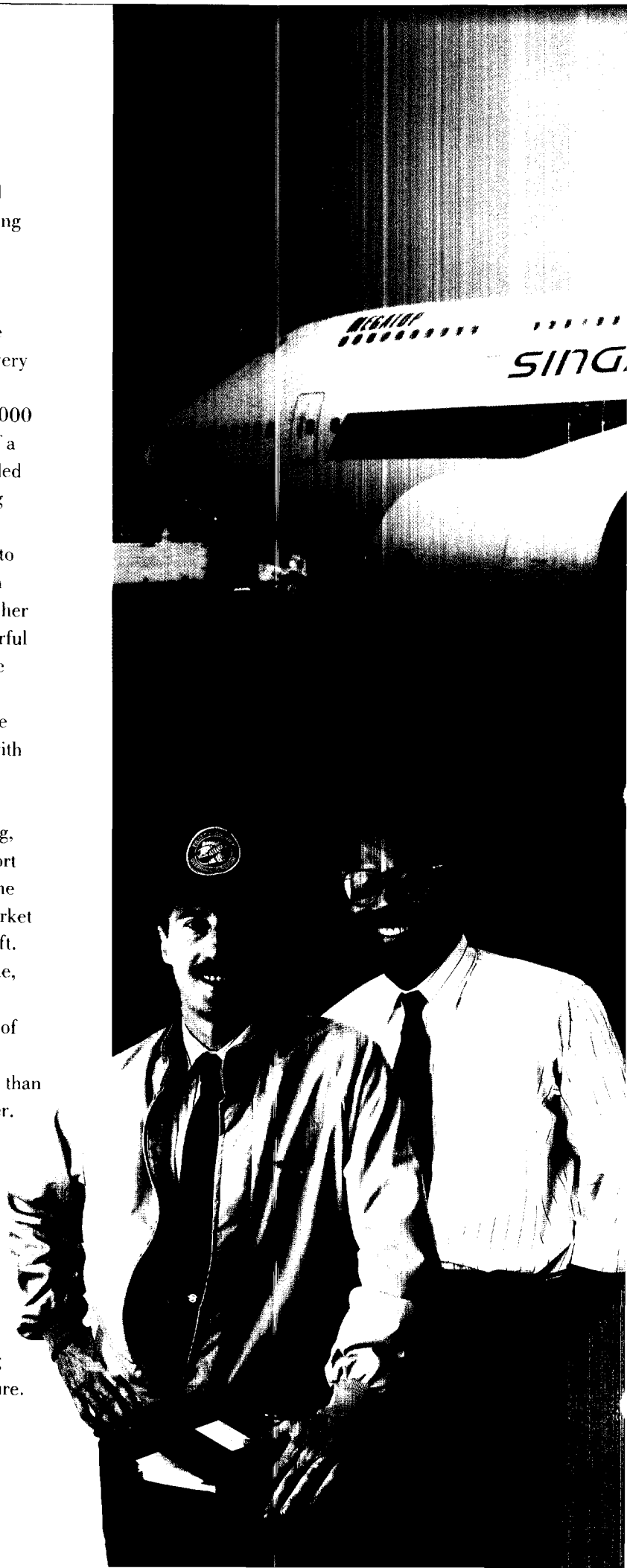
P&W's most powerful commercial engine, the PW4000, accounted for $7.3 billion in 1990 orders, including options. The engine, which now has 50 customers around the world, powers every wide-body aircraft model currently in production and planned for production. United Airlines selected a growth version of the PW4000 as the launch engine on the all-new Boeing 777 twin-jet as part of a $4 billion engine order. Other major PW4000 orders were awarded by Singapore Airlines, Air China and Japan Air System, reflecting strong traffic growth by Pacific Rim airlines.

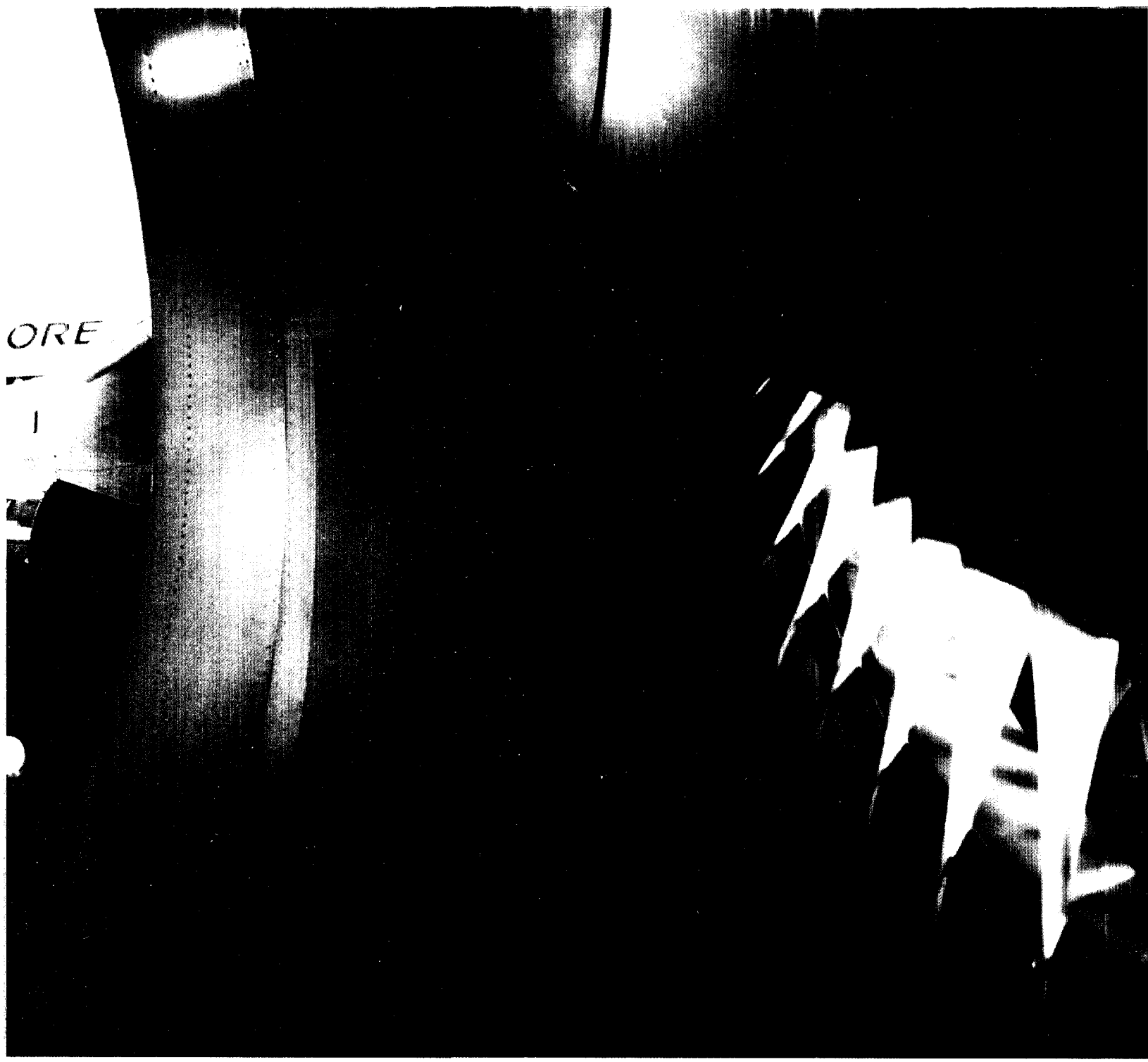
In Europe, the agreement between UTC and Daimler-Benz to form a business alliance will allow P&W and Daimler's propulsion systems unit, Motoren- und Turbinen-Union (MTU), to work together on a number of commercial engine programs, such as more powerful versions of the PW4000 for future aircraft designs and the engine for the next-generation 150-passenger aircraft. As a result of the agreement, MTU will be P&W's principal partner for Europe. The collaboration with MTU is expected to enhance P&W's position with Western European customers and help to open new markets in Eastern Europe and the Soviet Union.

The PW2000 engine, which MTU participated in developing, has been selected by the Soviet Ministry of Aviation to power export versions of the Ilyushin-96 four-engine aircraft and the twin-engine Tupolev Tu-204. Worldwide, the fuel-efficient PW2000 is the market leader in its class, powering the Boeing 757 standard-body aircraft.

Pratt & Whitney has a 30 percent stake in the V2500 engine, which is produced by the five-nation International Aero Engines consortium. The quiet, fuel-efficient V2500 captured 43 percent of the Airbus A320 and A321 business during 1990 and is the sole powerplant on the new McDonnell Douglas MD-90 aircraft. More than 1,300 V2500 engines, worth a potential $6.5 billion, are on order.

Demand for P&W's workhorse engine, the JT8D, also has been strong. During the year, 11 customers ordered 200 JT8D-200s, with a potential value of $560 million. The company is now working on several "hush-kit" programs to bring early-model JT8Ds into compliance with federally legislated airport noise restrictions, enabling carriers to operate these engines for their full economic lives. The 17,500 JT8Ds, JT9Ds and other P&W engines now flying, combined with the growing number of new engines entering service, provide a strong base of spare parts business for Pratt & Whitney well into the future.





全球發展

Singapore

"International air traffic has been growing rapidly. That's why most of Pratt's commercial engine business now comes from outside the United States. But we're not relying on customer demand alone to fuel our growth. Winning orders today means staying out in front of the competition with advanced technology and quality products. It often means multinational partnerships to share in the development costs. And it means working as hard as we can—whatever it takes—to make customer service as dependable as our engines."

Pratt & Whitney Government Engine Business

Global Growth

Long Beach, California

"These days, faced with reduced defense spending, Pratt & Whitney is going after new ways to grow within the government engine business. One way to supplement our fighter-engine sales is to increase our penetration of the transport segment of the market. Our F117 turbofan for the U.S. Air Force's new C-17 cargo plane is an example of how we're putting that strategy to work. The F117 is the military version of Pratt's proven PW2000 commercial engine, and the C-17 is the cornerstone of the nation's airlift plans for the 21st century. We delivered 10 F117s for this new transport in 1990."

The market for large military aircraft engines, despite reduced defense spending, is projected to be more than $50 billion over the next 10 years. The company's ongoing strategy to compete in that sizable market is based on winning a major share of the U.S. Air Force's fighter-engine requirements, increasing participation in the military transport segment of the business, and selling engine upgrade kits.

A military program of major significance for the 1990s and beyond is the Air Force's Advanced Tactical Fighter (ATF). Flight tests of P&W's F119 turbofan for the ATF aircraft in 1990 successfully demonstrated the new engine's capabilities, including its ability to achieve supersonic flight without using afterburners. The Air Force is expected to select its ATF airframe and engine suppliers in mid-1991.

Pratt & Whitney, with its new F100-PW-229 engine, won a 50 percent share in the Air Force's 1990 Improved Performance Engine competition. This 29,000-pound-thrust fighter engine enhances the company's competitive position, especially in international markets, where thrust is a critical issue.

The U.S. Air Force also awarded P&W a sole-source contract to supply 265 F100-PW-220E upgrade kits that will enhance the durability, reliability and maintainability of older F100 engines. More than 3,000 F100s in service around the world are candidates for these kits.

Pratt & Whitney produced 22 RL10 rocket engines in 1990, and has orders for an additional 120 engines to be produced through the end of the decade. P&W is testing an upgraded version of the RL10 that will power the upper stage of the Atlas IIA launch vehicle. P&W also is testing liquid hydrogen and liquid oxygen turbopumps under a NASA contract to increase the reliability and durability of the space shuttle main engine.

Pratt & Whitney is part of the five-member team developing the National Aerospace Plane and its hypersonic propulsion system. The company also is a member of the engine contractor team developing the liquid propulsion system for the Advanced Launch System.

In 1990, Chemical Systems Division solid rockets performed successfully on flights of the Air Force's new Titan IV expendable launch vehicle and the commercial Titan launch vehicle.

USBI's participation in the Cape York International Spaceport in Australia has received U.S. approval, pending certain agreements being reached with the Soviet Union. USBI, a P&W unit, would perform program management, engineering and development work for the proposed project.

Pratt & Whitney Canada

Pratt & Whitney Canada (PWC) is the world's leading producer of gas turbine engines for general aviation, including business and regional commuter aircraft. Nearly 40 percent of PWC's 1990 revenues came from outside the United States and Canada.

The company's engines are flown by some 6,500 operators in approximately 150 countries. With its worldwide customer base, PWC is well-prepared for the increasing globalization of the aviation industry, including Eastern Europe and the Soviet Union.

PWC benefited from a major order awarded in 1990 to Aerospatiale from AMR Eagle, the regional associate of American Airlines, for some 250 PW100 turboprop engines to power ATR 42 and ATR 72 aircraft. The ATRs are produced by a consortium composed of France's Aerospatiale and Aeritalia of Italy. The PW100, the sole-source engine on nine of the world's 11 regional aircraft models, powers the majority of the new-generation regional turboprop transports flying today.

First flight of the British Aerospace BAe 1000 business jet took place in June. The BAe 1000 is powered by PWC's new PW305 turbofan, a 5,000-pound-thrust class engine developed in a cooperative venture with Daimler-Benz's MTU unit. The PW305, which complements PWC's lower-thrust JT15D engine family, also has been selected by Learjet to power its new Model 60 business jet, and by Volpar and Retrofit Partners to re-engine their Falcon 20 aircraft.

Pratt & Whitney Canada increased its presence in the military engine business when the JT15D-powered Beechcraft jet was selected in 1990 by the U.S. Air Force for its Tanker Transport Trainer System, known as TTTS. The Air Force plans to buy 211 of these twin-engine aircraft.

PWC is developing its new-technology PW200 series for new, light single- and twin-engine helicopters, the biggest growth segment of the commercial helicopter market. McDonnell Douglas has ordered 456 PW206 turboshaft engines for its new MDX light helicopter.

PWC also is expanding its participation in the auxiliary power unit (APU) business. Eighteen airlines have taken delivery of the company's PW901A, which provides aircraft with power for main engine start and cabin environment, for their Boeing 747-400s.

Longueuil, Quebec

"Pratt & Whitney Canada's engines are flying on nearly two-thirds of the regional aircraft and over one-third of the corporate jets in the world today. The new PW300 turbofan offers the potential to expand our customer base even further. The PW300 was developed together with Motoren- und Turbinen-Union—MTU—a longtime partner in several Pratt & Whitney engine programs. UTC's new business alliance with Daimler-Benz, MTU's parent company, would greatly enhance Pratt's international marketing efforts in Western Europe and help open new markets in Eastern Europe and the Soviet Union."

세계적 성장

Seoul, Korea

"Carrier is a market leader in the Pacific Rim, where especially strong economic growth is expected to continue. We've expanded our position in the region over the last several years by way of strategic acquisitions and joint ventures. Our partnership with Daewoo, for example, gives us low-cost production capability and an entry into emerging markets in Korea and other Asian countries. Our newest facility manufactures rotary compressors for the room air conditioners we produce here and at the Springer Carrier plant in Brazil."

Carrier

Carrier, the world's leading producer of heating, ventilating and air conditioning (HVAC) equipment, generated half of its revenues in 1990 outside the United States and is the industry's only company with double-digit shares in most major markets worldwide.

Carrier also is the market leader in the world's three fastest-growing geographic market segments: Latin America, Europe and the Asia Pacific area, other than Japan. Japanese competitors are very strong in Japan, the world's single largest air conditioning market, but have yet to establish a substantial presence in HVAC markets outside of Japan and the Far East.

Carrier continued its leadership of the large North American market, estimated at $7.5 billion, in 1990. However, weak North American demand for residential air conditioning equipment, combined with the economic downturn and severe competitive pressures, negatively impacted the company's revenues and profit margins in 1990.

To enhance its future profitability, Carrier has been increasing its investment in research and development to advance its core technologies, including innovations in compression, electronics and controls, refrigerants, air management, heat transfer, and indoor air quality. Its next generation of product lines will continue to emphasize digital and communicating electronic controls, as well as variable-speed equipment driven with solid state power conditioning. Carrier's R&D spending in 1991 will exceed $100 million, which is more than 50 percent higher than the level two years ago.

In 1990, Carrier began selling its new Refrigerant Management System, which safely recycles the refrigerant CFC-11 used in about 80 percent of the world's centrifugal chillers. This product innovation, together with the company's PreVent and PreVac refrigerant recovery systems, greatly reduces chlorofluorocarbon (CFC) emissions. Carrier has committed $70 million over a five-year period to phase out the use of CFC refrigerants, develop environmentally safe alternate refrigerants, and introduce products that prevent harmful emissions.

During the year, Carrier committed more than $160 million in capital expenditures, including a strategic investment in a facility in Arkansas to manufacture advanced-technology scroll compressors for use in its residential and light commercial air conditioners and heat pumps. These scroll compressors are smaller, quieter, less expensive, and more energy-efficient than current designs. The new plant is scheduled to begin large-scale production in 1992.

Some 50 percent of Carrier's manufacturing now takes place outside the United States. This strategic positioning, which utilizes low-cost production opportunities and allows the company to partici-

pate more effectively in local markets around the world, is primarily the result of acquisitions and joint ventures that were completed in the 1980s. Principal among these were the acquisitions of Delchi in Italy, Interclisa in Spain, and Springer in Brazil, and the formation of the Daewoo Carrier venture in South Korea. In total, companies acquired by Carrier in the 1980s added more than $1 billion in sales volume in 1990, and on average, turn in strong profitability.

Carrier is continuing its acquisition program worldwide, especially in Western Europe, in anticipation of the 1992 Economic Community agreement, and in Central and Eastern Europe, in response to the opening of these emerging markets. In 1990, the company broadened its European distribution network by acquiring Frigo Import in the Netherlands and Climatech in Belgium—both air conditioning and refrigeration wholesalers—and Transex in Austria, Carrier's distributor for many years to Central and Eastern European markets.

Pacific Rim nations are especially important for Carrier. More than half of the total world market for HVAC equipment will be in this region by the turn of the century. These markets are growing rapidly, reflecting both the vibrancy of local economies and the fact that their climates are well-suited to air conditioning. Carrier is continuing its acquisition efforts in the region, and is bringing to maturity earlier acquisitions and ventures. Chief among these is Daewoo Carrier in Korea, where volume will exceed $200 million by 1992 and where the company has developed a strong market position. By 1995, Korea is expected to be the world's third largest HVAC market, behind only Japan and the United States. In 1990, Carrier acquired Luke Air Conditioning in Australia, bringing Carrier to market leadership in applied systems, which are sold to large commercial buildings and industrial facilities, in that country.

Carrier also is expanding its presence in Japan and is addressing the challenges of Japanese competition throughout the Asia Pacific region by doubling its engineering capabilities in Japan over the next two years. The company will open an engineering center in Japan's Shizuoka Prefecture in 1991, is expanding the distribution systems of its Toyo Carrier subsidiary, and is making substantial capital commitments to its large manufacturing facility at Tsuyama in central Japan.

Carrier Transicold Division, the world's leading supplier of transportation refrigeration equipment, had another strong year in 1990 and enhanced its already strong global market position. Carrier Transicold signed an agreement with the Soviet Union and an Italian firm, FATA, to participate in manufacturing container refrigeration equipment in the USSR by 1993. The division is exploring similar opportunities in Czechoslovakia and Hungary.

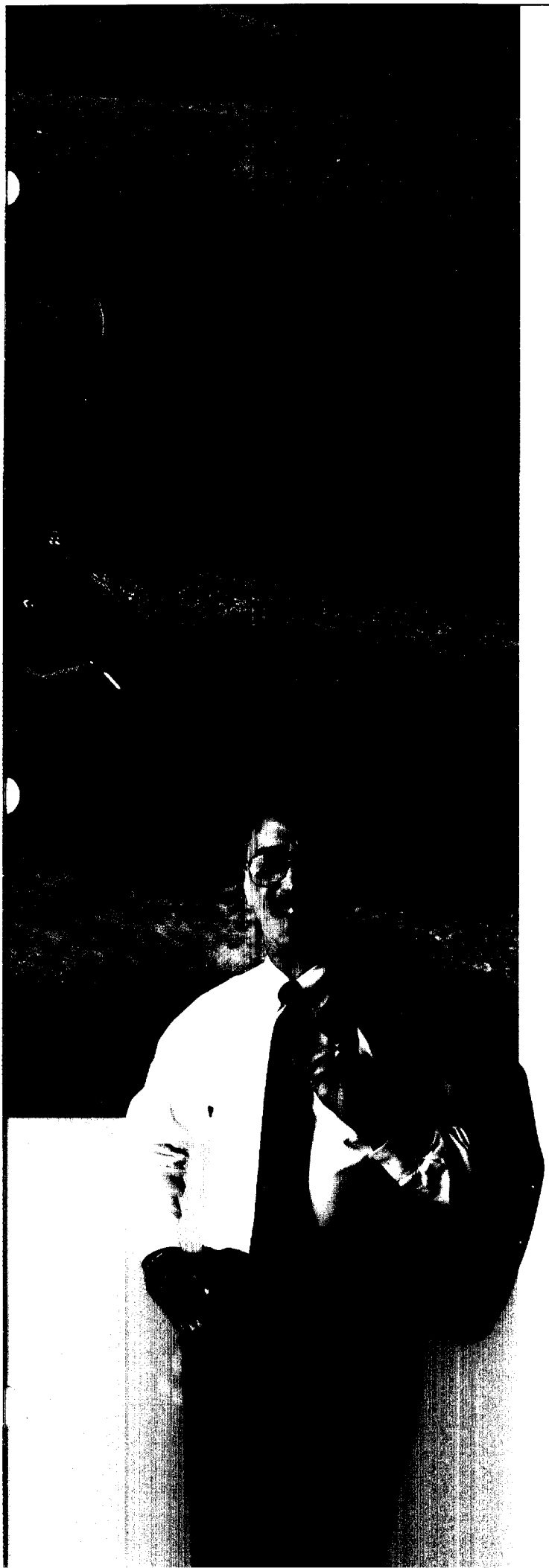
Copenhagen, Denmark

"World trade growth continues to power Carrier Transicold's strong container and truck/trailer refrigeration sales. That's because there is a high demand for perishable foods throughout the world today, and refrigeration equipment is needed to transport those products safely over land and sea. Shipping companies like Maersk, one of our largest customers, especially need precise temperature control to assure their cargo's survival over long distances. Our refrigeration units offer the kind of technology and reliability these customers require."

Global Vækst

Ankara, Turkey

"Much of Sikorsky's future growth will come from helicopter sales to international markets. By 1993, in fact, we expect that international business—both commercial and military—will account for about 30 percent of our sales, up from less than 10 percent only a few years ago. This business requires contributions from a lot of team players. In 1990, we completed a contract with Korean Air to co-produce more than 80 BLACK HAWK helicopters for the Republic of Korea, plus an important second contract in Turkey. We're now competing for a contract to supply as many as 200 BLACK HAWK aircraft to the Turkish government."



Sikorsky

Sikorsky is the world's leading helicopter manufacturer. In recent years, the company has made the globalization of its marketing efforts a top priority, as it continues to address the steady decline in U.S. defense spending. Nearly one-fourth of the company's 1990 revenues came from sales and licensed production contracts to international markets. Shipments of Sikorsky's commercial S-76 aircraft remained strong, with more than 70 percent delivered to overseas markets.

Fourteen international customers are now operating or have contracted for derivatives of Sikorsky's core product line, the UH-60A BLACK HAWK. During 1990, the governments of Turkey, the Republic of Korea, Egypt, Japan, Australia, Bahrain, and Saudi Arabia took delivery of a total of 31 BLACK HAWK derivatives to upgrade their aircraft fleets.

In December, Sikorsky delivered the first BLACK HAWK to Korean Air as part of a $490 million co-production contract from the Republic of Korea for 81 helicopters. The first seven aircraft are being fully assembled by Sikorsky in the United States. The rest will be co-produced under license by Korean Air.

Sikorsky also turned over the first four of six BLACK HAWKs on order to the Turkish National Police, which provides security in Turkey's urban areas. The $69 million contract includes training, support and spare parts. This is the second shipment of Sikorsky BLACK HAWK helicopters to Turkey. In 1988, six aircraft were delivered to the Turkish Jandarma, which patrols rural areas of the country. The Turkish government also plans to modernize its military forces by co-producing as many as 200 general-purpose helicopters over the next 10 years. Sikorsky is competing against several U.S. and overseas manufacturers for the co-production contract.

Current U.S. government requirements continue to drive the bulk of Sikorsky's BLACK HAWK, SEAHAWK and derivative business, such as the HH-60J JAYHAWK medium-range recovery helicopter for the Coast Guard. JAYHAWK deliveries began in 1990, and the Coast Guard has exercised an option to purchase eight additional helicopters, bringing the total number of aircraft on contract to 32. Sikorsky also continues to meet the government's needs for heavy-lift helicopters with its SUPER STALLION and SEA DRAGON product lines. In addition, the Japanese Defense Force has identified a need for 12 of these aircraft, and 10 are now under contract.

Sikorsky and Boeing have been working together closely to compete for production of the LH aircraft, the next generation of U.S. Army light helicopters. Present requirements call for a minimum of 1,292 aircraft. Messerschmitt-Boelkow-Blohm, Germany's largest aerospace company and a unit of Daimler-Benz, joined the Sikorsky/Boeing team in 1990. The winning LH team is expected to be chosen in early 1991.

UT Automotive

As the automotive industry becomes more global, car makers are developing sourcing programs that rely increasingly on suppliers with world-class capabilities. To meet that demand, UT Automotive (UTA) has been expanding its international marketing and manufacturing efforts, especially in Europe, the largest automotive market in the world.

While North America continues to be its largest, most important market, UTA expects its European business, which now accounts for nearly one-fourth of its total sales, to almost double over the next five years. The company supplies parts to all major European car manufacturers, as well as to Japanese manufacturers now producing vehicles in Europe. UTA is expanding the sales and engineering resources of its Tokyo office to meet the growing needs of its Japanese customers worldwide.

The ability to provide automakers with fully integrated interior trim and wiring systems, including increased engineering content, forms the core of UTA's future product plans. These integrated vehicle systems incorporate trim, wiring, switches and electronics for car ceiling units, known as headliners, and for instrument panels and door panels. Such system integration addresses a growing industry trend that favors top-tier vendors like UT Automotive.

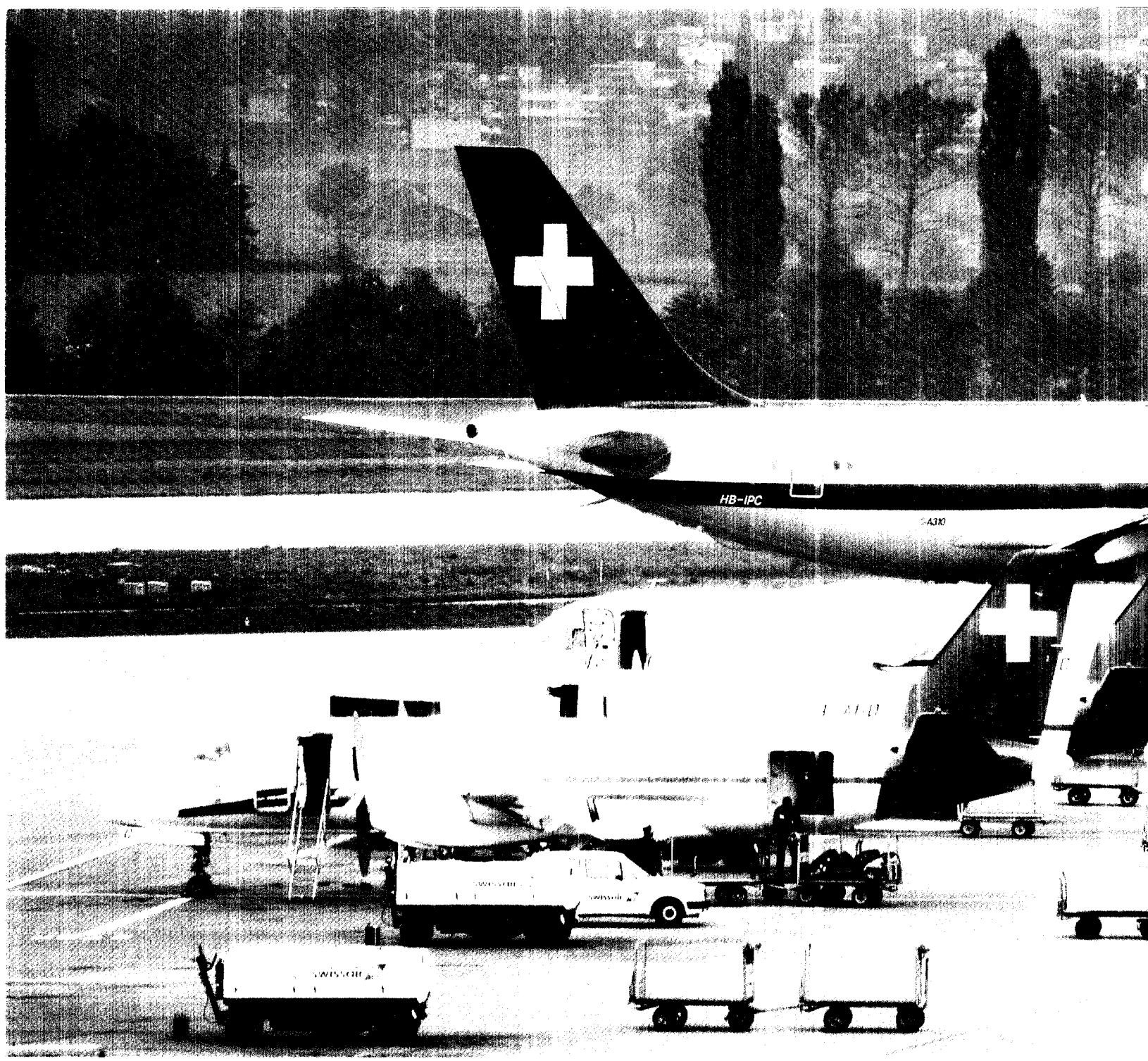
In Western Europe, UTA is a leading independent supplier of vehicle wire harness systems, which form the electrical distribution system in a vehicle. The company also is the leading European supplier of electric-motor driven cooling fan modules and, through its operation in England, is a leading supplier of steering wheels for European car makers. In 1991, UTA will begin supplying European customers with power steering hose assemblies from its U.K. operations.

The company recently enlarged its production facilities in Northern Ireland, Spain and Portugal, and opened a new plant in the Philippines. UTA is establishing engineering centers in the United Kingdom and France, and is strengthening its engineering capabilities in Germany, Spain and Italy, to address the region's growth opportunities in systems integration.

The company also has formed new joint ventures and technical agreements in France, Italy and Korea, to increase its manufacturing and marketing capabilities, and it is exploring partnerships with other suppliers in both Western and Eastern Europe. Car production in Eastern Europe is expected to increase significantly by the mid-1990s, offering additional growth potential for suppliers. UTA is considering establishing plants in Eastern Europe in order to participate in this growing market and as an additional cost-effective source for serving customers across the Continent.

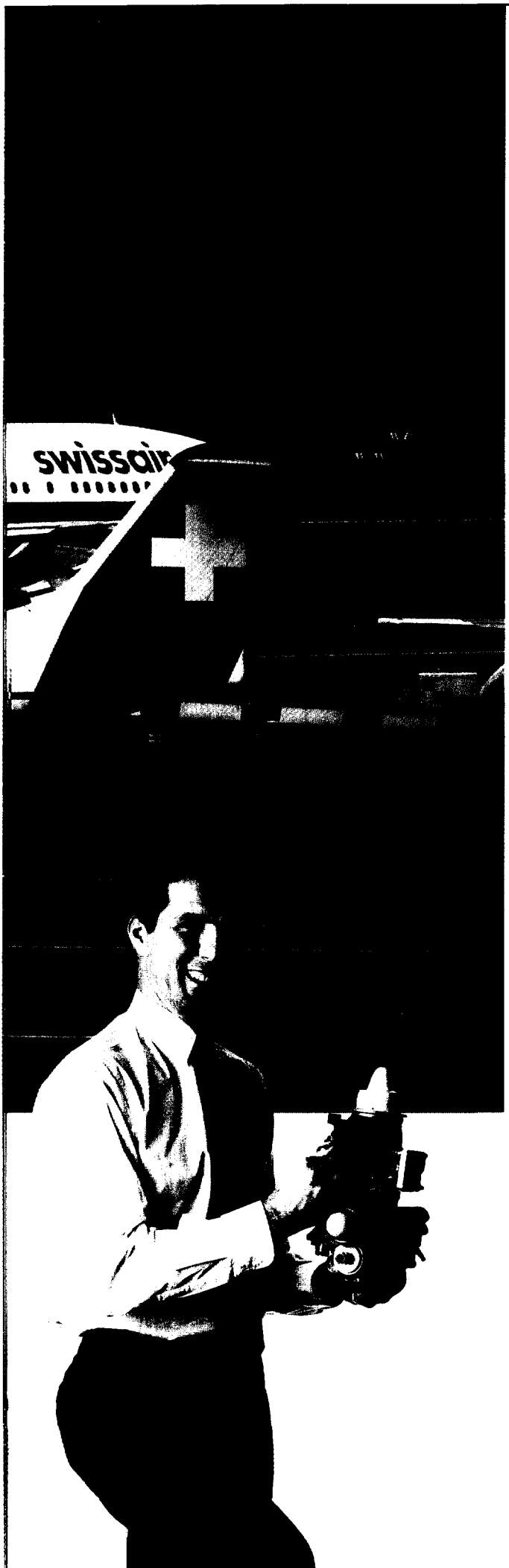
Paris, France

"A major reason for UTA's growing success in Europe is our ability to respond quickly to customers of different nationalities and cultures, with automotive products and services tailored to their unique needs. In the years ahead, we plan to develop an even broader customer and geographic base for our product lines. We see multiple opportunities to provide complete vehicle wiring systems, for example, an area where we are a leader in the market. We are also a leader in engine cooling modules, and we are investing to expand that business significantly."



Frankfurt, Germany

"Hamilton Standard products can be found on four of every five commercial and regional aircraft in the West today—thanks in part to our two successful European business units, Frankfurt-based Nord-Micro and Microtecnica in Italy. A common goal now is to explore the many aerospace opportunities unfolding in Eastern Europe and the Soviet Union. In Czechoslovakia, for example, we will provide the propeller and environmental control systems for a new regional aircraft, and we're working to supply a range of equipment for two Soviet commercial programs."



Hamilton Standard

Hamilton Standard serves many segments of the aerospace market worldwide. International sales increased 13 percent in 1990, compared with the previous year, reflecting the rapid expansion of the global aerospace industry and the company's vigorous efforts to market its products and support services to overseas customers.

With its Italian affiliate, Microtecnica, and its German affiliate, Nord-Micro, Hamilton Standard is focused on expanding its Western European business and on exploring new markets in Eastern Europe. In turn, the company is assisting its two European affiliates in penetrating the U.S. marketplace.

Microtecnica has extensive experience in Europe in collaborative and consortium programs, such as the Tornado aircraft and EH101 helicopter, as well as in Brazil on the AMX aircraft. Microtecnica also is expanding its overhaul and repair business to better support Hamilton Standard products in Europe, the Middle East and North Africa. Nord-Micro's charter is to utilize and extend Hamilton Standard's electronic control system capability and to identify business opportunities throughout Europe for that technology.

In Eastern Europe, Hamilton Standard will provide the propeller and environmental control systems for Czechoslovakia's LET 610 regional aircraft. And the company is working closely with Pratt & Whitney to market its starters, fuel controls and environmental control systems in the Soviet Union for the new Ilyushin-96 and Tupolev Tu-204 commercial aircraft.

Hamilton Standard is teamed with Ratier-Figeac, a French aerospace company with which it has close business ties, to produce and support a family of lightweight, all-composite-blade propeller systems for the regional aircraft market. The new all-composite-blade propeller will be introduced on the next version of the ATR 72 turboprop aircraft, which was selected in 1990 as part of an order from AMR Eagle for up to 100 ATR 72s and ATR 42s. Hamilton Standard also is providing other systems for all the ATRs on order.

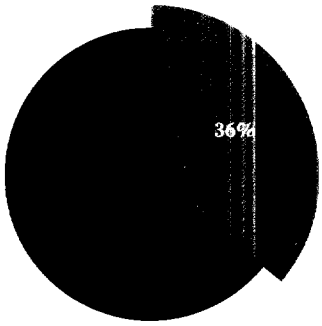
In the commercial aircraft sector, Hamilton Standard received an order to supply an advanced-technology cabin air conditioning and temperature control system, as well as the airfoil and cowl ice protection system, for Boeing's new 777 aircraft. The anti-icing system order marks the company's entry into this market segment. The company also continues to provide a wide range of engine control systems and accessories for Pratt & Whitney's growing PW4000 business.

Hamilton Standard has long supplied environmental control and life support systems for U.S. space programs, and it has been an integral part of the European Space Agency's spacecraft project and the Columbus module for Space Station Freedom. It also is supporting Japan on its module for the proposed space station.

UTC at a Glance

(1990 Revenues)

Aerospace and Defense



Pratt & Whitney Commercial Engine Business
$3.8 billion

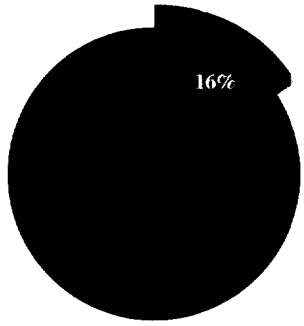
Pratt & Whitney Government Engine Business
$2.0 billion

Space Propulsion and Systems
$839.8 million

Pratt & Whitney Canada
$1.2 billion

Primary Customers
Commercial airlines and aircraft leasing companies; U.S. government, including NASA and the military services; non-U.S. governments; regional and commuter airlines; aircraft manufacturers; private business.

Principal Products and Services
Commercial and military jet engines, spare parts and product support, including engineering and development, specialized engine maintenance, overhaul and repair services; rocket engines and space propulsion systems; space launch systems; processing and refurbishing nonmotor segments of space shuttle boosters; solid rocket motors for strategic and tactical weapons systems; high-technology robotics; small gas turbine engines, spare parts and related services for business and regional/commuter aircraft, and for fixed-wing military aircraft and helicopters.



Sikorsky
$2.0 billion

Hamilton Standard
$1.2 billion

Norden
$252.6 million

Primary Customers
U.S. government, including NASA and the military services; non-U.S. governments; aerospace and defense prime contractors: airframe and jet-engine manufacturers; oil industry and other corporate businesses; hospitals and ambulance services.

Principal Products and Services
Military and commercial helicopters and related maintenance services; jet-engine and flight controls; aircraft propellers; environmental controls for aircraft, spacecraft and submarines; space life-support systems; military radar systems and computers; battlefield command and control systems; air traffic control radar systems; high-technology optical systems.

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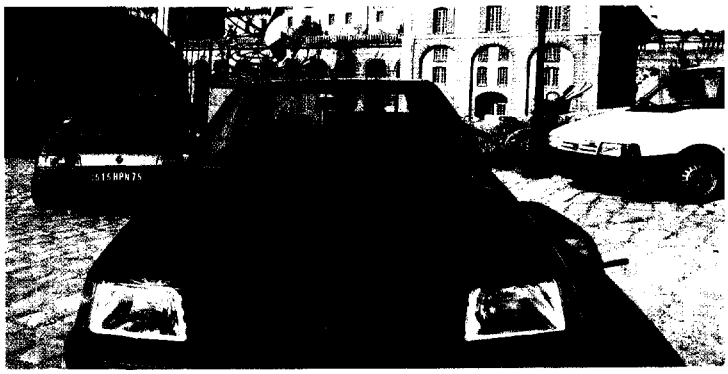
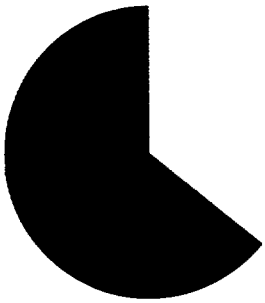
Commercial and Industrial



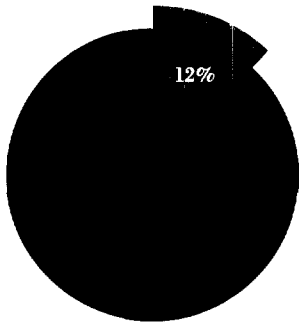


Carrier
$4.0 billion

Otis
$4.0 billion

Primary Customers
Mechanical and building contractors; homeowners, building owners, developers and retailers; architects and consultants; transportation companies and shipping operations.

Principal Products and Services
Heating, ventilating and air conditioning (HVAC) equipment for commercial, industrial and residential buildings; industrial and transportation refrigeration units; HVAC replacement parts and services; building controls; elevators, escalators, moving walks and shuttle systems, and related installation, maintenance and repair services; modernization products and services for elevators and escalators.



UT Automotive
$2.5 billion

Primary Customers
Original equipment manufacturers of automobiles, trucks, and off-road vehicles and equipment; automotive aftermarket suppliers and service centers.

Principal Products and Services
Automotive electrical distribution systems, including wire harnesses, terminals, connectors and junction blocks; DC electric motors and actuators; motor-driven cooling fan modules; electromechanical and electronic switches, modules and components; automotive interior trim systems, including steering wheels, instrument panels, door panels, consoles, and headliners; hydraulic systems and components; insulation and acoustical materials and systems; automotive exterior trim.

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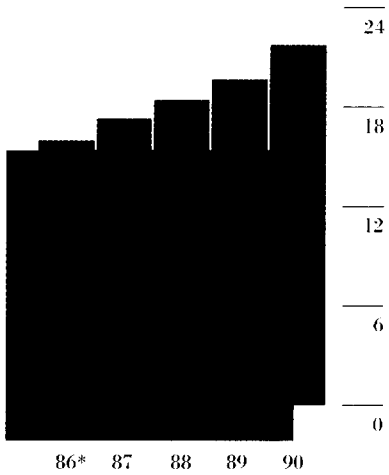
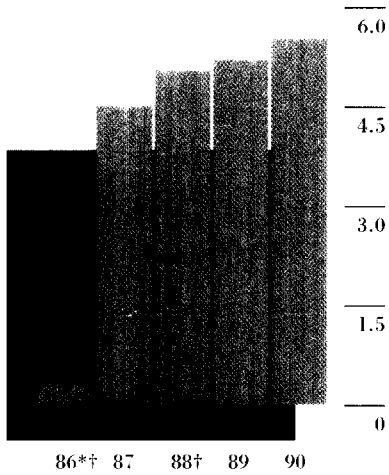
Financials at a Glance

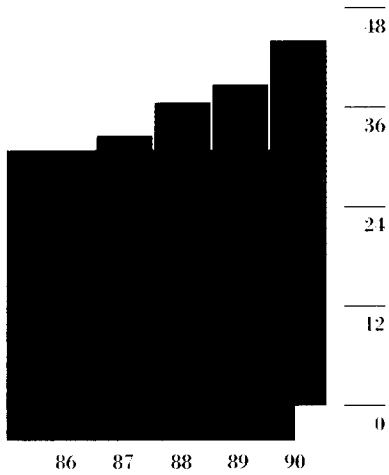
Revenues
$ Billions



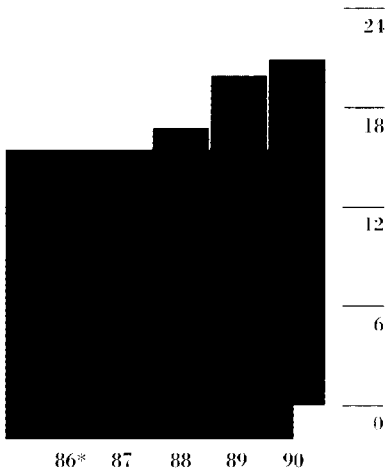
Earnings per Share
$ per Share



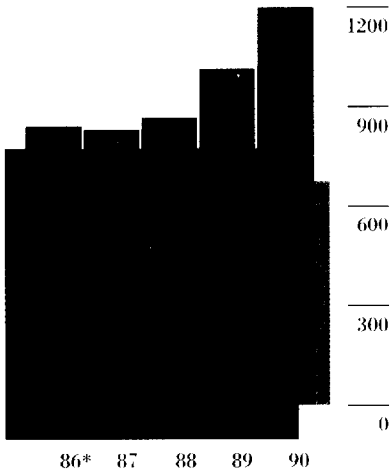
Equity per Common Share
$ per Common Share



Backlog
$ Billions

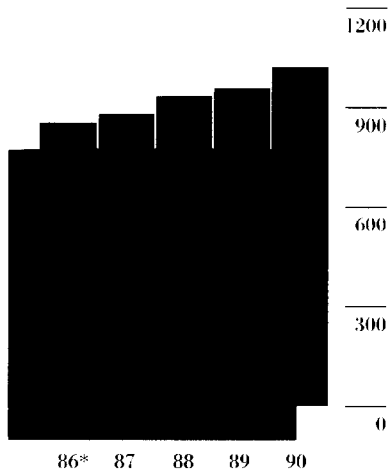


Capital Expenditures and Depreciation
$ Millions



■ Capital Expenditures
■ Depreciation

Research and Development Expenditures
$ Millions



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* Continuing operations
† Includes the restructuring provisions discussed on page 37.

Management's Discussion and Analysis of Results of Operations and Financial Position

The following discussion and analysis sets forth major factors affecting the Corporation's results of operations during the three-year period ended December 31, 1990. It also comments on the Corporation's financial position at that date as presented in the accompanying financial statements. Operating results for the Corporation's business segments are shown in the Consolidated Summary of Business Segment Financial Data on pages 55 through 57 of this Annual Report.

Business Environment

The Corporation's major business units serve government and commercial aerospace, automotive manufacturing, commercial property and residential housing customers. Management believes that during 1990 these units were important suppliers in their markets and in most cases were either number one or two in each of their major lines of business. Like most businesses, these operations are affected by global economic cycles and by various regional economic cycles affecting demand for their products and services.

For example, North American commercial and residential property development has declined significantly in recent years, while similar development in the Pacific Rim has experienced dramatic growth. Further, North American automobile production in 1990 was at its lowest level in several years, while the European automobile market continued to expand. Finally, dramatic increases in jet fuel prices combined with price-sensitive passenger demand have severely impacted the U.S. airline industry, while business growth in the Pacific Rim has spurred greater passenger demand in those areas.

The Corporation cannot predict when the current recession in the U.S. will end, but it believes that its substantially improved position in the global marketplace and its emphasis on cost reduction and asset management will allow it to mitigate the effects of the U.S. recession.

In addition to the traditional impacts of economic cycles, the Corporation's aerospace and defense businesses are responding to significant structural changes in government contracting. During most of the 1980s, U.S. Government expenditures for defense and space initiatives consumed an ever-increasing portion of the total spending budget. While defense contractors, including the Corporation, generally benefited from this increase in the volume of business, many defense contractors were hurt by the shifting of the financial risks of fixed-price development programs to the contractors. The technical specifications of certain major developmental programs surpassed many companies' ability to reasonably estimate the effort and costs of development.

The Corporation, which has been continually reducing its reliance on defense contracts, did enter into some fixed-price development contracts. The Corporation's current policy is to decline participation in new, significant fixed-price development programs where the financial risks to the Corporation may preclude achievement of appropriate returns. Moreover, the Corporation's continuing exposure from significant fixed-price development programs has steadily declined in recent years and is currently limited to the remaining major program discussed below.

In 1984 the Corporation's Norden subsidiary entered into a fixed-price contract to design, develop and produce an advanced radar system for a non-U.S. Government customer. A subsequent option exercise and other changes have resulted in a contract value of approximately $350 million. The program is still in the development stage at December 31, 1990, and delivery of the first production unit is scheduled for 1992.

In 1988 Norden made provisions to rebaseline this and other major radar contracts which were a significant portion of its $115.2 million restructuring charges in that year. Additional loss provisions in 1989 and 1990 were also a significant portion of Norden's operating results in those periods.

In the fourth quarter of 1990, Norden initiated discussions with its customer to restructure the contract. Norden's objective is to contain the Corporation's financial risk while meeting the customer's operational requirements.

In management's opinion, the current cost estimate and provisions recorded to date fairly represent the best current estimate of costs necessary to complete the contract at a performance level that Norden believes should be acceptable to the customer. However, the outcome of any discussions is unknown. Additionally, as progress on the contract continues, new information may arise that could adversely affect the estimated costs. Management does not expect that any additional provisions that may be required through completion of this contract represent a material financial risk to the Corporation.

The growing success of superpower peace initiatives and related political changes in Eastern Europe combined with overall government deficit spending reductions have resulted in dramatic government procurement changes, including shifts in the portion of government spending for defense and aerospace. As a result, there have been reductions in procurement for current programs and a declining number of new programs being proposed for funding.

Despite the continued prospects for reduced government spending, the Corporation believes it is well positioned as a major supplier for key programs such as the F-100 upgrade kits, C-17 transport and Black Hawk helicopters and derivatives. Further,

the Corporation has expanded its position in international markets for military products and is actively competing for certain major new programs such as the Advanced Tactical Fighter engines and the Light Helicopter. Decisions on both of these programs are expected to be made in 1991.

Results of Operations

Revenues increased:

10% or $2.0 billion from 1989 to 1990;
7% or $1.2 billion from 1988 to 1989.

Sales increased 10% in 1990 and 9% in 1989 (6% in 1990 excluding the sales of the Corporation's Sheller-Globe subsidiary, which was consolidated effective December 31, 1989, and 10% in 1989 excluding the sales of the Corporation's Essex subsidiary, which was sold in February 1988). It is estimated that increases in selling prices to customers averaged 3% in 1990 (4% in 1989). The net impact of translating sales of foreign subsidiaries was to increase 1990 sales by 3% and to reduce 1989 sales by 1%, indicating that the real volume of sales increased approximately 4% in 1990 and 6% in 1989 (1% in 1990 excluding the sales of Sheller-Globe and 7% in 1989 excluding the sales of Essex).

Revenues of the Corporation's principal business segments for the years ended December 31 were:

In Millions of Dollars	**1990**	1989	1988
Power	**$7,291.5**	$6,991.1	$6,346.7
Flight Systems	**$4,033.6**	$3,781.8	$3,700.0
Building Systems	**$7,988.1**	$7,244.3	$6,506.6
Industrial Products for the Automotive and Other Industries	**$2,621.1**	$1,931.6	$1,965.8

In 1990, 52% of Power segment sales were in the commercial airline market (48% in 1989 and 1988); 31% were for military use (36% in 1989 and 37% in 1988); 17% were in the general aviation market (15% in 1989 and 14% in 1988); and the remainder were in other markets.

Power revenues increased in 1990 by $300.4 million (4%). Increased sales of commercial aircraft engines and spares and increased revenues in the general aviation business were offset by lower revenues in the military engine business. The increase in the commercial business was due in large part to increased shipments of the PW4000 series engines. As of December 31, 1990, 49 airlines have placed firm orders for a total of 1,543 PW4000 engines. Sales and orders for this engine have placed it on all widebodied aircraft currently produced or scheduled for production. Revenues increased in 1989 by $644.4 million (10%) primarily as a result of increased sales of commercial engines. The increase in commercial engine sales was due in large part to increased sales of the PW4000 series engines, which was phased in during 1987, and continued strong demand for the JT8D engine.

Helicopter business revenues in 1990 contributed 48% of Flight Systems segment revenues (47% in 1989 and 46% in 1988); sales of defense electronics, space propulsion and other aircraft products provided the remainder of the segment's revenues. Increased 1990 segment revenues of $251.8 million (7%) arose principally from higher helicopter and aircraft product volume partially offset by decreased revenues from defense electronics programs. Segment revenues increased $81.8 million (2%) in 1989. All segment businesses other than missiles and space propulsion contributed to the improvement.

Building Systems segment 1990 revenues were derived 50% from air conditioning products and services (55% in 1989 and 54% in 1988) and 50% from elevator and escalator products and services (45% in 1989 and 46% in 1988). Revenues increased $743.8 million (10%) in 1990 and $737.7 million (11%) in 1989. The impact of foreign exchange rates versus the dollar increased sales in 1990 by approximately $421 million and reduced sales by approximately $131 million in 1989. The increased revenues in 1990, exclusive of such translation impact, were the result of increased volume and service revenues in the elevator business and increased air conditioning products and service revenues in markets outside of North America, partially offset by declines in North American air conditioning products and service revenues. 1989 revenue increases were attributable not only to increases in elevator business volume and service revenues but also to increases in air conditioning business volume.

In 1990, 97% of the Industrial Products segment revenues were from the automotive industry (85% in 1989 and 77% in 1988). 1990 segment revenues increased $689.5 (36%), of which $676.0 resulted from the addition of Sheller-Globe's revenues. This segment's revenues decreased $34.2 million (2%) in 1989. In February 1988, the Corporation sold its Essex subsidiary (wire and cable business). Excluding Essex, this segment's 1989 revenues would have increased $154.8 million, or 9%, primarily as a result of increased sales to the automotive industry.

Financing revenues and other income, less other deductions:

increased 64% or $133.2 million from 1989 to 1990;
decreased 58% or $293.1 million from 1988 to 1989.

Financing revenues and other income, less other deductions, exclusive of amounts allocated to segment operating profit, decreased $10.7 million in 1990 and $211.0 million in 1989.

The primary reason for the 1989 decline was the 1988 pretax gains, aggregating approximately $235 million, on the sales of the Corporation's leasing subsidiaries, its Essex subsidiary and its investment in Telefunken Electronic GmbH, a West German joint venture. See Note 3 in the accompanying financial statements.

Cost of goods and services sold as a percent of sales:
increased 1% from 1989 to 1990;
decreased 1% from 1988 to 1989.

The 1990 increase resulted from the inclusion of Sheller-Globe and declining profit margins in the air conditioning business, which were partially offset by improved profit margins in the commercial engine, helicopter and aircraft product businesses. The decrease in 1989 occurred primarily as a result of a restructuring charge of $148.8 million in 1988 (see Note 2 in the accompanying financial statements). Exclusive of the restructuring charge, cost of goods and services sold as a percent of sales would have been constant in 1989 and 1988.

Research and development expenses increased:
7% or $64.8 million from 1989 to 1990;
3% or $24.2 million from 1988 to 1989.

Research and development expenditures in 1990 and 1989, before the reductions described below, were 1% and 32% higher than in 1989 and 1988, respectively. The increase in 1990 was primarily attributable to higher expenditures in the Building Systems segment. Participation fees from suppliers in certain advanced commercial aircraft engine programs and partial sponsorship of military aircraft engine programs, aggregating $256 million, $304 million and $21 million in 1990, 1989 and 1988, respectively, have been applied as a reduction of research and development expenses. In 1989 supplier participation fees related to advanced commercial engines increased $72 million and partial customer sponsorship in military engine development increased $211 million.

Selling, service and administrative expenses increased:
10% or $283.0 million from 1989 to 1990;
7% or $188.3 million from 1988 to 1989.

Selling, service and administrative expenses as a percent of sales have remained relatively constant in all periods presented.

Operating profit increased:
5% or $79.6 million from 1989 to 1990;
28% or $343.0 million from 1988 to 1989.

Operating profits (losses) (before interest and general corporate expenses) of the Corporation's principal business segments for the three years ended December 31 were:

In Millions of Dollars	**1990**	1989	1988
Power	**$1,009.9**	$939.7	$679.1
Flight Systems	**$ 89.5**	$ 26.1	$ (36.9)
Building Systems	**$ 424.6**	$458.0	$386.0
Industrial Products for the Automotive and Other Industries	**$ 150.0**	$155.9	$214.8

The operating profits (losses) included in the table above reflect the effects of restructuring actions resulting in a charge to 1988 operating profits of $148.8 million (see Note 2 in the accompanying financial statements).

Power segment operating profits increased $70.2 million (7%) and $260.6 million (38%) in 1990 and 1989, respectively. The increased profitability in 1990 results primarily from increased general aviation engine and spares revenues and commercial spares revenues, partially offset by lower commercial engine program participation fees and increased product warranty costs. The 1989 increase resulted from the increased engine sales discussed above, the large increase in customer partial sponsorship funding of certain advanced commercial engine programs discussed above and the effects of cost reduction measures.

Operating profits of the Flight Systems segment increased $63.4 million (243%) in 1990 and $63.0 million (171%) in 1989. In 1990, improved profitability in the helicopter and aircraft products businesses resulted primarily from the volume increases discussed above, while 1989 operating profits were reduced by helicopter business inventory write-offs with lower royalty income being partially offset by a participation fee. Norden's losses for 1990 approximated those for 1989 and reflect continuing losses associated with performance under certain fixed-price production and development contracts. The Corporation continues to monitor Norden's activities and to take appropriate action to strengthen Norden's operating position. Operating profits increased in 1989 primarily as a result of a restructuring charge in 1988 (see Note 2 in the accompanying financial statements).

Building Systems segment operating profit decreased $33.4 million (7%) in 1990. This decrease is attributable to reduced air conditioning business operating results in Brazil and in North America partially offset by the increased elevator business

revenues discussed above. The North American market is intensely competitive and has experienced a significant downturn in the demand for air conditioning related products. This segment's operating profit increased $72.0 million (19%) in 1989. The reason for the improvement was increased profitability in the elevator and air conditioning businesses primarily as a result of the higher volume discussed above and increased margins in the elevator business. The profitability increase in the air conditioning business occurred despite intense competition in that business.

Operating profits of the Industrial Products segment decreased $5.9 million (4%) in 1990. This decrease was attributable to the adverse impact of the downturn in United States automobile production partially offset by a $46 million gain on the sale of an operating unit. Operating profits in this segment declined $58.9 million (27%) in 1989. The decline was caused by losses incurred by Sheller-Globe, the absence of operating profits of the Corporation's Essex subsidiary (which was sold in February 1988) and lower operating profits in the automotive business as a result of the general softness in the U.S. automobile market during the second half of 1989 offset to some extent by gains on sales of certain small business units.

Interest expense increased:

10% or $31.5 million from 1989 to 1990;
12% or $34.7 million from 1988 to 1989.

The 1990 increase in interest expense reflects the Corporation's higher borrowing levels during the first half of the year which were primarily attributable to the fourth-quarter 1989 acquisition of Sheller-Globe and the acquisition of shares of the Corporation's Common Stock in connection with the Employee Stock Ownership Plan discussed below. In the second half of the year reductions in commercial paper borrowings occurred due to a reduction in net operating assets while capital lease obligations associated with customer financing arrangements increased.

The increase in 1989 resulted from higher net borrowings offset slightly by lower short-term interest rates. The increased borrowings arose from the acquisition of shares of the Corporation's Common Stock in connection with the Employee Stock Ownership Plan discussed below and other investing activities.

The weighted-average interest rate paid on the Corporation's short-term borrowings in 1990 was 10.6% (11.5% in 1989 and 12.0% in 1988), and the average composite rate for short-term borrowings and long-term debt, excluding the ESOP debt guarantee (see Note 12 in the accompanying financial statements), for 1990 was 9.8% (10.2% in 1989 and 10.4% in 1988). The average rate applicable to debt outstanding at December 31, 1990 was 10.5% for the short-term borrowings, and the average composite rate including all long-term debt other than the ESOP debt guarantee was 8.9%.

Net income increased:

$48.5 million from 1989 to 1990;
$43.0 million from 1988 to 1989.

The decline in the effective income tax rate in 1990 from 39.5% to 37.1% is primarily attributable to relative increases in the portion of certain gains and earnings of international subsidiaries which have been taxed at rates lower than the statutory U.S. federal income tax rate. The effective tax rate in 1989 and 1988 was constant. The increases in net income for 1990 and 1989 are a net result of the items discussed above.

Future statutory tax rate changes will give rise to adjustments in the deferred tax accounts under Statement of Financial Accounting Standards No. 96 (FAS 96), "Accounting for Income Taxes," issued in December 1987 and originally requiring adoption no later than 1989. The Financial Accounting Standards Board has twice delayed the required adoption date, currently no later than January 1, 1992, and in 1990 has considered amending the Standard which, among other things, will delay requiring adoption until 1993 and may liberalize the current standard in respect of recognition of income tax assets. The Corporation has therefore not made a decision as to the date it will adopt FAS 96. If the Corporation had elected early adoption of FAS 96 as of January 1, 1990 and had elected to restate prior periods' financial statements as permitted by the Standard, 1988 earnings would be reduced by approximately $210 million; there would be no material impact on 1989 and 1990. Of the 1988 charge to earnings, approximately $180 million represents the cumulative effect of adoption of the Standard. The provisions of FAS 96 will have potential for producing, under certain conditions, significant distortion in the Corporation's income tax provision and effective tax rate from year to year.

In December 1990, the Financial Accounting Standards Board issued Statement of Financial Accounting Standards No. 106 (FAS 106), "Employers' Accounting for Postretirement Benefits Other Than Pensions." The effective date for required adoption of FAS 106 is 1993 for most U.S. plans and 1995 for all other plans, including non-U.S. plans. The Corporation and a number of its subsidiaries provide certain health care and life insurance benefits to retired employees and recognize the cost of providing those benefits as premiums are incurred. FAS 106 will no longer allow this approach, requiring instead the recognition of a liability as the benefits are earned during the employees' applicable years

of service. FAS 106 permits recording the entire unrecognized obligation at adoption or amortizing that unrecognized obligation over twenty years. The Corporation has not made a decision as to the method and date of adoption of FAS 106. The Corporation estimates that its current unrecognized obligation under FAS 106 is approximately $500–$600 million, of which approximately $240–$250 million is attributable to retired employees.

Economic inflation tended to produce modest increases in materials prices, employee compensation and other costs and in the Corporation's selling prices to its customers.

Financial Position

Management assesses the Corporation's liquidity in terms of its overall ability to mobilize cash to fund its operations. Of particular importance in the management of liquidity are cash flows generated from operating activities including levels of accounts receivable, inventories and accounts payable; capital expenditure levels; adequate bank lines of credit; and financial flexibility to attract long-term capital on satisfactory terms.

Set forth below is selected key cash flow data from the Consolidated Statement of Cash Flows:

In Millions of Dollars	**1990**	1989	1988
Net Cash Flows from Operating Activities	**$ 1,151.3**	$ 1,165.1	$ 736.7
Purchase of Fixed Assets	**$(1,200.4)**	$(1,023.3)	$(875.3)
Acquisitions of Business Units	**—**	(388.4)	—
Dispositions of Business Units	**304.8**	64.0	869.6
Other investments—products under lease	**(149.4)**	(48.6)	—
Other Investing Activities	**84.2**	53.4	69.2
Net Cash Flows from Investing Activities	**$ (960.8)**	$(1,342.9)	$ 63.5
Net Cash Flows from Financing Activities	**$ (254.8)**	$ 245.8	$(929.4)

As shown above, cash flows from operating activities aggregated $3,053 million for the three-year period ended December 31, 1990. During that period, the aggregate amounts of receivables and inventories increased $1,592 million reflecting increased sales levels in all of the Corporation's principal business segments.

Net cash flows from investing activities in 1989 include $367 million for the completion of the acquisition of Sheller-Globe, including debt acquired for cash. In connection with this transaction, the Corporation refinanced an additional $252.5 million of Sheller-Globe debt.

The substantial fixed asset additions during the period 1988 through 1990 have been necessary to increase productivity, to keep the Corporation's facilities modern and to provide for expansion of some product lines. The great majority of these expenditures were for machinery and equipment necessary to maintain and enhance the Corporation's competitive position and were made across all business segments (see Consolidated Summary of Business Segment Financial Data on pages 55 through 57 of this Annual Report). Cash used for financing activities during the period included dividends to preferred and common shareowners, and the purchase of the Corporation's Common Stock. During 1988 the Corporation redeemed $279 million of long-term debt.

During the years ended December 31, 1990 and 1989, the Corporation met its net financing requirements by adjusting its level of short-term borrowings as required and issuing long-term debt when conditions were considered favorable. The results of the foregoing activities upon the Corporation's financial structure are shown in the following tabulation:

In Millions of Dollars	**1990**	1989
Short-term borrowings and current portion of long-term debt	**$ 660.1**	$1,579.6
Long-term debt	**$2,602.1**	$1,959.6
Capital lease obligations	**$ 299.6**	$ 53.6
Shareowners' equity	**$5,343.1**	$4,740.3
Debt to total capitalization	**40%**	43%

The Corporation's ratio of debt to total capitalization reflects a decrease from 1989. This decrease primarily results from the reduction in commercial paper outstanding discussed above and the increase in Shareowners' Equity offset by an increase of $246 million of capital lease obligations associated with customer financing arrangements and the ESOP debt guarantee of $643.5 million.

In the second quarter of 1989, the Corporation's Board of Directors approved an Employee Stock Ownership Plan (ESOP). See Note 12 in the accompanying financial statements. The ESOP acquired 10.2 million shares of a new convertible preferred stock in exchange for promissory notes aggregating $660 million issued to the Corporation by the ESOP trust.

In February 1990, the ESOP trust arranged permanent financing guaranteed by the Corporation and repaid the notes to the Corporation. In March 1990, the Corporation issued an

additional 2.9 million shares of convertible preferred stock to the ESOP in exchange for a 10.5%, $202.3 million promissory note. The Corporation has no intention of arranging permanent financing for this transaction at this time. In 1990 and 1989, the Corporation purchased 1.7 million shares and 10.4 million shares, respectively, of its Common Stock for a total of $645.5 million to substantially satisfy the conversion feature of the outstanding ESOP preferred stock.

Principal and interest payments on the ESOP permanent financing and the note to the Corporation are funded by preferred stock dividends and Corporation contributions to the ESOP trust. In 1990 principal and interest payments on the ESOP permanent financing totaled $60 million, and the annual principal and interest payments required for each of the years in the period from 1991 to 1995 range from $73 million to $79 million.

In November 1989, the Corporation sold $300 million of its 8⅞% Debentures due November 15, 2019, the proceeds of which were used to repay short-term borrowings and for other corporate purposes.

At December 31, 1990, the Corporation had credit commitments by banks totaling $1.05 billion under a Revolving Credit Agreement through January 1, 1993. At December 31, 1990, there were no borrowings under the Revolving Credit Agreement. Long-term financing will continue to be considered in the future if conditions are advantageous, and in that regard, under an effective Registration Statement on file with the Securities and Exchange Commission at December 31, 1990, up to $336 million of medium-term and long-term debt of the Corporation might be issued.

In addition to the funds requirements discussed above, the Corporation had commitments to finance or arrange financing for customers at December 31, 1990 of approximately $3.7 billion of commercial aircraft, of which $537 million may be required to be disbursed in 1991. See Note 13 in the accompanying financial statements.

The Corporation has operations in several lines of business which involve the use, treatment, storage and disposal of substances regulated under various environmental protection laws. In this regard, the Corporation had expenditures related to environmental matters of $86 million in 1990 and $75 million in 1989. Expenditures related to environmental matters are expected to range between $100 million and $150 million in each of the next two years.

In addition, the Corporation is a potentially responsible party at approximately 100 sites, many of which relate to formerly-owned businesses. At the vast majority of these sites, there are additional parties who can be expected to contribute to the cleanup cost. Separately, the Corporation is currently involved in a number of actions at various sites to determine whether, and to what extent, remedial action is necessary to clean up hazardous wastes as required by federal and state law.

The nature of the above matters makes it difficult to estimate the exact timing and ultimate amount of future environmental expenditures (remedial and otherwise). In addition, the Corporation has instituted legal proceedings against its insurers asserting insurance coverage for pollution costs. These proceedings are expected to last several years. No prediction can be made as to the outcome of these proceedings. Notwithstanding the above, the Corporation believes that the level of capital expenditures and remedial action necessary to comply with the present laws governing environmental protection will not have a material effect upon its capital expenditures, competitive position, financial position or results of operations.

Late in 1990, amendments to the Clean Air Act were enacted. Although regulations implementing the provisions of these amendments have not been issued, changes in the Corporation's manufacturing processes and facilities may ensue. The Corporation is currently unable to estimate the nature or level of future expenditures that may be required to comply with the new law.

Like many defense contractors, the Corporation and certain of its units continue to be the subject of ongoing criminal investigations in connection with their activities as a government contractor, including the major grand jury investigation announced in 1988, known as "Operation Ill Wind," which involves defense contractors and certain of their consultants, executives and employees. As part of the latter investigation, the Corporation was one of a number of defense contractors that had premises searched at several of its units and received grand jury subpoenas. The Government's criminal investigation has led to prosecutions of certain contractors and is continuing with respect to other contractors, including Pratt & Whitney and Norden. In connection with this investigation, three of Norden's former employees pleaded guilty to violations of federal law.

If the Corporation were charged with wrongdoing as a result of any of these investigations, the Corporation or its business units could be suspended from eligibility for bidding on or for awards of new government contracts. Moreover, contracts found tainted by fraud could be voided, and the Corporation, if convicted, could be fined and debarred as a government contractor for a period generally not to exceed three years.

* * *

Management believes that available sources of funds, indicated above, should be adequate to meet its presently foreseeable cash requirements.

Comparative Stock Data

	1990			1989		
Common Stock	**High**	**Low**	**Dividend**	High	Low	Dividend
First Quarter	**59¼**	**48⅜**	**$.45**	46⅜	39⅞	$.40
Second Quarter	**60¾**	**54¼**	**.45**	53½	45⅝	.40
Third Quarter	**62½**	**40⅛**	**.45**	57⅜	49⅞	.40
Fourth Quarter	**49¾**	**41⅞**	**.45**	56⅞	50¼	.40

The Corporation's Common Stock is listed on the New York Stock Exchange.

The high and low prices are based on the Composite Tape.

There were 37,200 Common Stock shareowners of record at December 31,1990.

Five-Year Summary

In Millions of Dollars (except per share amounts)	1990	1989	1988	1987	1986
For the Year					
Sales from continuing operations	**$21,442.0**	$19,532.1	$18,000.1	$17,170.2	$15,669.2
Percent to United States Government	**22%**	24%	26%	27%	28%
Cost of goods and services sold	**$16,015.2**	$14,382.2	$13,486.0	$12,665.5	$12,391.0
Research and development	**$ 1,021.4**	$ 956.6	$ 932.4	$ 878.8	$ 852.8
Selling, service and administrative	**$ 3,093.8**	$ 2,810.8	$ 2,622.5	$ 2,468.3	$ 2,298.1
Interest expense	**$ 361.6**	$ 330.1	$ 295.4	$ 325.2	$ 282.0
Income taxes	**$ 479.1**	$ 497.8	$ 460.1	$ 458.0	$ 59.9
Income from continuing operations	**$ 750.6**	$ 702.1	$ 659.1	$ 591.7	$ 48.1
Net Income	**$ 750.6**	$ 702.1	$ 659.1	$ 591.7	$ 72.7
Earnings applicable to common stock	**$ 714.7**	$ 687.3	$ 659.1	$ 591.7	$ 32.7
Earnings per share:					
Continuing operations:					
Primary	**$ 5.91**	$ 5.34	$ 5.05	$ 4.52	$ .07
Fully diluted	**$ 5.53**	$ 5.20***	$ 5.05	$ 4.52	$ .36*
Net Income:					
Primary	**$ 5.91**	$ 5.34	$ 5.05	$ 4.52	$ .27
Fully diluted	**$ 5.53**	$ 5.20***	$ 5.05	$ 4.52	$ .54*
Cash dividends on common stock	**$ 217.6**	$ 205.7	$ 202.5	$ 183.4	$ 170.2
Per share	**$ 1.80**	$ 1.60	$ 1.55	$ 1.40	$ 1.40
Average number of shares of Common Stock outstanding:					
Primary	**120,844,666**	128,693,058	130,608,493	131,026,367	122,795,258
Fully converted	**133,192,205**	133,839,528	130,608,493	131,026,367	133,694,697
Return on sales, after tax	**3.5%**	3.6%	3.7%	3.4%	0.3%**
Asset turnover (sales/assets)	**1.47**	1.53	1.49	1.47	1.47
Return on assets, after tax	**5.1%**	5.5%	5.4%	5.1%	0.5%**
Return on equity, after tax	**15.1%**	14.5%	14.6%	14.7%	1.8%

* In the third quarter of 1986, substantially all the shares of the $2.55 Preferred Stock were converted into Common Stock. Had the conversions of those securities taken place on January 1, 1986, the primary earnings per share for 1986 would have been $.36 based on income from continuing operations and $.54 based on net income. In accordance with the provisions of Accounting Principles Board Opinion No. 15, the fully diluted earnings per share have been calculated as though such conversions had taken place at the beginning of 1986, which has the effect of increasing fully diluted earnings per share over the comparable primary amount.

** Based on income from continuing operations.

*** As discussed in Note 1 in the accompanying financial statements, the Corporation issued Series A ESOP Convertible Preferred Stock in 1989, thereby requiring the presentation of fully diluted earnings per share.

In Millions of Dollars (except per share amounts)	**1990**	1989	1988	1987	1986
At Year End					
Net working capital	**$ 3,060.8**	$ 2,130.7	$ 3,040.5	$ 2,880.9	$ 2,658.5
Current asset ratio	**1.5 to 1**	1.3 to 1	1.6 to 1	1.6 to 1	1.6 to 1
Total assets	**$15,918.3**	$14,598.2	$12,748.3	$12,873.5	$11,962.5
Short-term borrowings	**$ 342.5**	$ 1,281.0	$ 323.8	$ 702.0	$ 870.5
Long-term debt, including current portion	**$ 3,219.3**	$ 2,311.8	$ 1,904.5	$ 2,300.9	$ 2,230.1
Debt to total capitalization	**40%**	43%	32%	41%	45%
Net worth	**$ 5,343.1**	$ 4,740.3	$ 4,823.4	$ 4,292.6	$ 3,803.1
Common shareowners' equity	**$ 5,343.1**	$ 4,739.4	$ 4,822.4	$ 4,291.0	$ 3,801.4
Equity per common share	**$ 44.10**	$ 39.14	$ 36.88	$ 32.90	$ 29.14
Unfilled orders	**$20,875.0**	$20,125.0	$16,875.0	$14,700.0	$13,650.0
Number of employees:					
United States	**108,100**	115,100	109,900	115,200	120,600
International:					
Europe	**38,200**	38,300	33,400	34,300	34,600
Other	**46,300**	48,000	43,500	40,500	38,300
Total	**192,600**	201,400	186,800	190,000	193,500
Number of common shareowners	**37,200**	39,500	42,600	45,400	48,700

Notes:

Cost of goods and services sold in 1988 and 1986 includes pretax charges of $148.8 million and $592.6 million, respectively, related to restructuring and employee severance plans. See Note 2 of Notes to Financial Statements. Also in 1988, the Corporation sold stock of certain of its finance subsidiaries, its Essex subsidiary and its share of a semiconductor joint venture resulting in pretax gains of $235.3 million. See Note 3 of Notes to Financial Statements.

Equity per common share is based on shares outstanding at each year end.

Management's Responsibility for Financial Statements

The financial statements of United Technologies Corporation and subsidiaries, and all other information presented in this Annual Report, are the responsibility of the management of the Corporation. The financial statements have been prepared in accordance with generally accepted accounting principles.

Management is responsible for the integrity and objectivity of the financial statements, including estimates and judgments reflected in them. It fulfills this responsibility primarily by establishing and maintaining accounting systems and practices adequately supported by internal accounting controls. These controls include the selection and training of management and supervisory personnel; maintenance of an organizational structure providing for delegation of authority and establishment of responsibilities; communication of requirements for compliance with approved accounting, control and business practices throughout the organization; business planning and review; and a program of internal audit. Management believes the internal accounting controls in use provide reasonable assurance that the Corporation's assets are safeguarded, that transactions are executed in accordance with management's authorizations, and that the financial records are reliable for the purpose of preparing financial statements.

Independent auditors are elected annually by the Corporation's shareowners to audit the financial statements in accordance with generally accepted auditing standards. Their report appears in this Annual Report. Their audits, as well as those of the Corporation's internal audit department, include a review of internal accounting controls and selective tests of transactions.

The Audit Review Committee of the Board of Directors, consisting of five directors who are not officers or employees of the Corporation, meets regularly with management, the independent accountants and the internal auditors, to review matters relating to financial reporting, internal accounting controls and auditing.

Report of Independent Accountants

To the Shareowners of United Technologies Corporation

In our opinion, the accompanying consolidated balance sheet and the related consolidated statements of income, of changes in shareowners' equity and of cash flows present fairly, in all material respects, the financial position of United Technologies Corporation and its subsidiaries at December 31, 1990 and 1989, and the results of their operations and their cash flows for each of the three years in the period ended December 31, 1990, in conformity with generally accepted accounting principles. These financial statements are the responsibility of the Corporation's management; our responsibility is to express an opinion on these financial statements based on our audits. We conducted our audits of these statements in accordance with generally accepted auditing standards which require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements, assessing the accounting principles used and significant estimates made by management, and evaluating the overall financial statement presentation. We believe that our audits provide a reasonable basis for the opinion expressed above.

Price Waterhouse

One Financial Plaza
Hartford, Connecticut
January 18, 1991

Consolidated Statement of Income

In Millions of Dollars (except per share amounts)	Years Ended December 31, 1990	1989	1988
Revenues			
Sales	**$21,442.0**	$19,532.1	$18,000.1
Financing revenues and other income, less other deductions	**341.2**	208.0	501.1
	$21,783.2	$19,740.1	$18,501.2
Costs and Expenses			
Cost of goods and services sold	**$16,015.2**	$14,382.2	$13,486.0
Research and development	**1,021.4**	956.6	932.4
Selling, service and administrative	**3,093.8**	2,810.8	2,622.5
Interest	**361.6**	330.1	295.4
	$20,492.0	$18,479.7	$17,336.3
Income before income taxes and minority interests	**$ 1,291.2**	$ 1,260.4	$ 1,164.9
Income taxes	**479.1**	497.8	460.1
Income before minority interests	**$ 812.1**	$ 762.6	$ 704.8
Less — Minority interests in subsidiaries' earnings	**61.5**	60.5	45.7
Net Income	**$ 750.6**	$ 702.1	$ 659.1
Preferred Stock Dividend Requirement	**$ 35.9**	$ 14.8	$ —
Earnings Applicable to Common Stock	**$ 714.7**	$ 687.3	$ 659.1
Per Share of Common Stock:			
Primary	**$5.91**	$5.34	$5.05
Fully Diluted	**$5.53**	$5.20	$5.05

See accompanying Notes to Financial Statements

Consolidated Balance Sheet

In Millions of Dollars	December 31, 1990	1989
Assets		
Cash and short-term cash investments	$ 200.8	$ 266.5
Accounts receivable	3,813.9	3,455.5
Future income tax benefits	689.6	597.6
Inventories and contracts in progress	6,063.5	5,968.8
Less—Progress payments and billings on contracts in progress	(2,019.3)	(2,057.6)
Prepaid expenses	263.7	276.0
Total Current Assets	$ 9,012.2	$ 8,506.8
Accounts, notes and leases receivable, due after one year	$ 573.8	$ 437.9
Other investments	$ 520.6	$ 343.9
Fixed Assets, at cost:		
Land	$ 149.0	$ 137.7
Buildings and improvements	2,292.1	2,073.9
Machinery, tools and equipment	5,497.1	4,856.1
Under construction	651.0	636.5
	$ 8,589.2	$ 7,704.2
Less—Accumulated depreciation and amortization	(4,193.0)	(3,752.3)
	$ 4,396.2	$ 3,951.9
Deferred Charges:		
Costs in excess of net assets of acquired companies (net of amortization)	$ 700.8	$ 668.0
Prepaid pension costs and other	714.7	689.7
	$ 1,415.5	$ 1,357.7
Total Assets	$15,918.3	$14,598.2
Liabilities and Shareowners' Equity		
Short-term borrowings	$ 342.5	$ 1,281.0
Accounts payable	1,948.3	1,869.0
Accrued salaries, wages and employee benefits	878.0	768.1
Other accrued liabilities	1,475.9	1,352.0
Long-term debt—currently due	317.6	298.6
Income taxes currently payable	457.7	283.6
Advances on sales contracts	531.4	523.8
Total Current Liabilities	$ 5,951.4	$ 6,376.1
Deferred income taxes	$ 352.8	$ 404.4
Long-term debt	$ 2,901.7	$ 2,013.2
Other long-term liabilities	$ 964.5	$ 787.8
Commitments and contingent liabilities (Note 13)		
Minority interests in subsidiary companies	$ 323.4	$ 276.4
Series A ESOP Convertible Preferred Stock, $1 par value (Authorized—20,000,000 shares) Outstanding—13,011,872 and 10,153,847 shares (Note 12)	$ 859.6	$ 660.0
ESOP deferred charge and note receivable (Note 12)	(778.2)	(660.0)
	$ 81.4	$ —
Shareowners' Equity:		
Capital Stock:		
Preferred Stock, $1 par value (Authorized—230,000,000 shares) Issued and Outstanding—9,036 shares for 1989	$ —	$ .9
Common Stock, $5 par value (Authorized—500,000,000 shares) Issued—133,828,088 and 132,093,724 shares	1,850.0	1,772.7
Deferred foreign currency translation adjustments	81.2	(36.0)
Retained earnings	4,089.6	3,596.4
Less cost of 12,672,108 and 11,002,100 common shares in treasury	(677.7)	(593.7)
Total Shareowners' Equity	$ 5,343.1	$ 4,740.3
Total Liabilities and Shareowners' Equity	$15,918.3	$14,598.2

See accompanying Notes to Financial Statements

Consolidated Statement of Cash Flows

In Millions of Dollars	Years Ended December 31, 1990	1989	1988
Cash flows from operating activities:			
Net income	**$ 750.6**	$ 702.1	$ 659.1
Adjustments to reconcile net income to net cash flows from operating activities:			
Depreciation	**675.0**	590.9	536.4
Amortization of goodwill	**24.9**	29.3	25.5
(Increase) decrease in:			
Current and long-term accounts, notes and leases receivable	**(616.4)**	(595.4)	(138.8)
Inventories, net of progress payments	**(182.0)**	317.3	(377.2)
Prepaid expenses	**12.3**	(159.4)	(15.3)
Increase (decrease) in:			
Accounts and taxes payable, and accrued liabilities	**604.8**	233.4	276.5
Deferred taxes and future income tax benefits	**(141.0)**	103.4	(81.8)
Advances on sales contracts	**7.8**	(48.6)	75.2
Minority interests in subsidiaries' earnings	**61.5**	60.5	45.7
Gains from dispositions of business units	**(91.0)**	(19.9)	(235.3)
Other, net	**44.8**	(48.5)	(33.3)
Net Cash Flows from Operating Activities	**$ 1,151.3**	$ 1,165.1	$ 736.7
Cash flows from investing activities:			
Purchase of fixed assets	**$(1,200.4)**	$(1,023.3)	$(875.3)
Sale of fixed assets	**79.0**	61.0	122.5
Other investments—products under lease	**(149.4)**	(48.6)	—
Other investments—other companies	**5.2**	(9.4)	(53.3)
Acquisitions of business units	**—**	(388.4)	—
Dispositions of business units	**304.8**	64.0	869.6
Other, net	**—**	1.8	—
Net Cash Flows from Investing Activities	**$ (960.8)**	$(1,342.9)	$ 63.5
Cash flows from financing activities:			
Issuance of long-term debt	**$ 684.4**	$ 692.4	$ 34.4
Repayments of long-term debt	**(436.9)**	(307.7)	(373.0)
Increase (decrease) in short-term borrowings	**(928.9)**	703.0	(363.8)
Collection of $660 million ESOP note receivable	**660.0**	—	—
Decrease in ESOP note receivable and debt guarantee. net of $2.7 million ESOP preferred stock retirement	**81.4**	—	—
Common and Preferred stock purchases	**(84.9)**	(593.7)	—
Common Stock issued for employee stock plans and other	**77.3**	52.2	8.7
Dividends paid on Common and Preferred Stocks	**(253.5)**	(227.4)	(202.5)
Other, net	**(53.7)**	(73.0)	(33.2)
Net Cash Flows from Financing Activities	**$ (254.8)**	$ 245.8	$(929.4)
Effect of foreign exchange rate changes on cash and short-term cash investments	**$ (1.4)**	$ (44.1)	$ (58.0)
Net Increase (Decrease) in Cash and Short-Term Cash Investments	**$ (65.7)**	$ 23.9	$(187.2)

Supplemental Disclosures:

Income taxes paid in 1990, 1989 and 1988 totaled $389.7 million, $419.8 million and $460.8 million, respectively. Total interest paid, net of amounts capitalized, was $357.7 million, $331.7 million and $305.7 million in 1990, 1989 and 1988, respectively.

In 1990 and 1989, the Corporation issued 2.9 million and 10.2 million shares, respectively, of a new series of preferred stock to a newly established Employee Stock Ownership Plan (ESOP) in exchange for promissory notes aggregating $202 million and $660 million, respectively. In 1990, the $660 million promissory note was repaid to the Corporation with proceeds from permanent financing guaranteed by the Corporation. See Note 12. The Corporation also refinanced $252.5 million of debt in connection with the acquisition of Sheller-Globe. See Note 3.

In 1988, the Corporation realized cash of $22 million on the sale of notes and common stock warrants received as part of the 1987 sale of a business unit.

See accompanying Notes to Financial Statements

Consolidated Statement of Changes In Shareowners' Equity

Three Years Ended December 31, 1990

Balance December 31, 1987

Issued under employee incentive plans, and related tax benefit (351,116 shares of Common Stock, net of 87,565 shares purchased and reissued)
Redemption and purchase of 5,719 shares of Preferred Stock
Deferred foreign currency translation adjustments:
Translation and hedging adjustments, net of income taxes of $18.7 million
Sale of foreign investments

Net income
Dividends on—Common Stock ($1.55 per share)

Balance December 31, 1988

Issued under employee incentive plans, and related tax benefit (1,329,300 shares of Common Stock, net of 284,921 shares purchased and reissued)
Redemption and purchase of 17 shares of Preferred Stock
Purchase of 11,002,100 shares of Common Stock
Deferred foreign currency translation adjustments:
Translation and hedging adjustments, net of income tax benefits of $2.9 million
Sale of foreign investments

Net income
Dividends on—Common Stock ($1.60 per share)
—ESOP Preferred Stock ($4.80 per share), net of income tax benefits of $9.5 million

Balance December 31, 1989

Issued under employee incentive plans, and related tax benefit (1,734,364 shares of Common Stock, net of 374,184 shares purchased and reissued)
Redemption and purchase of 9,036 shares of Preferred Stock
Purchase of 1,670,008 shares of Common Stock
Deferred foreign currency translation adjustments:
Translation and hedging adjustments, net of income tax benefits of $11.0 million
Sale of foreign investments

Net income
Dividends on—Common Stock ($1.80 per share)
—ESOP Preferred Stock ($4.80 per share), net of income tax benefits of $23.1 million

Balance December 31, 1990

See accompanying Notes to Financial Statements

In Millions of Dollars

$4.50 Preferred Stock	Common Stock	Deferred Translation Adjustments	Treasury Stock	Retained Earnings
$1.5	$1,710.8	$(79.6)	$ —	$2,659.9
	9.7			(.5)
(.6)				
		61.7		
		3.9		
				659.1
				(202.5)
$ .9	$1,720.5	$(14.0)	$ —	$3,116.0
	52.2			(1.2)
—				
			(593.7)	
		(23.3)		
		1.3		
				702.1
				(205.7)
				(14.8)
$ .9	$1,772.7	$(36.0)	$(593.7)	$3,596.4
	77.3			(3.9)
(.9)				
			(84.0)	
		127.3		
		(10.1)		
				750.6
				(217.6)
				(35.9)
$ —	$1,850.0	$ 81.2	$(677.7)	$4,089.6

Notes to Financial Statements

Note 1

Summary of Accounting Principles: The consolidated financial statements include the accounts of the Corporation and its subsidiaries. International operating subsidiaries are included generally on the basis of fiscal years ending November 30.

Sales under government and commercial fixed-price contracts and government fixed-price-incentive contracts are recorded at the time deliveries are made or, in some cases, on a percentage of completion basis. Sales under cost-reimbursement contracts are recorded as work is performed and billed. Sales of commercial aircraft engines sometimes require significant participation by the Corporation in aircraft financing arrangements; when appropriate such sales are accounted for as operating leases. Sales under elevator and escalator installation and modernization contracts are accounted for under the percentage of completion method. Service contract revenues are recorded as sales when earned.

Inventories and contracts in progress are stated at the lower of cost or estimated realizable value. Inventories consist largely of raw materials and work in process. Materials in excess of requirements for contracts and orders currently in effect or anticipated have been eliminated. A considerable portion of the inventories is based on cost standards which are adjusted to reflect approximate current costs. The remainder of the inventories is stated either at average cost or at actual cost accumulated against specific contracts or orders or, in the case of a substantial portion of inventories in the building systems and industrial products businesses, at last-in, first-out (LIFO) cost. Manufacturing tooling costs are charged to inventories or to fixed assets depending upon their nature, general applicability and useful lives. Tooling costs included in inventory are charged to cost of sales based on usage, generally within two years after they enter productive use. All other manufacturing costs are allocated to current production; no such costs are deferred and assigned to future production.

Contracts in progress relate to elevator and escalator contracts and include standard cost of manufactured components, accumulated installation cost and estimated earnings on uncompleted contracts.

Prospective losses, if any, on contracts are provided for when the losses become anticipated. Loss provisions are based upon any anticipated excess of inventoriable manufacturing or engineering cost and estimated warranty costs over the net revenue from the products contemplated by the specific order.

Provisions for depreciation of plant and equipment related to the Corporation's aerospace operations have generally been made on accelerated methods. Provisions for depreciation of other plant and equipment have generally been made on the straight-line method. Wherever possible, accelerated methods are used for income tax purposes. Generally, estimated useful lives used for financial statement depreciation purposes range from 30 to 50 years for buildings and improvements, from 8 to 20 years for machinery and equipment, and from 5 to 10 years for office equipment. Improvements to leased property are amortized over the life of the lease.

Research and development costs not specifically covered by contracts and those related to the Corporation-sponsored share of research and development activity in connection with cost-sharing arrangements are charged against income as incurred. General and administrative expenses also are charged to income as incurred. Costs pertaining to fulfillment of the Corporation's warranty and service policies and product guarantees are estimated on the basis of past experience and current product performance and, where believed to be significant and reasonably predictable in amount, are accrued at the time products are sold.

Costs in excess of values assigned to the underlying net assets of acquired companies are included in deferred charges and are generally being amortized over periods ranging from 25 to 40 years.

The Corporation enters into a variety of interest rate futures, options, currency swaps and forward contracts in its management of interest rate and foreign currency committed exposures. Realized and unrealized gains and losses are deferred and either recognized as interest expense over the borrowing period or recognized in Shareowners' Equity depending on the exposure hedged.

The Corporation enters into forward foreign exchange contracts to hedge foreign currency denominated receivables and payables. Such contracts generally have maturities of one year or less and the counterparties are typically major international financial institutions.

Provisions for income taxes are based upon income and expenses recorded in accordance with the Corporation's regular accounting practices, and as shown in the financial statements. The income tax effects of differences in the time when income and expenses are reflected in accordance with such regular accounting practices and the time they are recognized for income tax purposes are shown in the balance sheet as future income tax benefits or as deferred income taxes, as appropriate.

Primary earnings per share computations are based on the average number of shares of Common Stock outstanding during the year. Fully diluted earnings per share reflect the maximum dilution of per share earnings which would have occurred if all the

ESOP Convertible Preferred Stock of the Corporation had been converted as of the date of issue. Each share of the ESOP preferred stock is convertible into one share of Common Stock. A reduction in earnings available to common shares is required in the calculation of fully diluted earnings per share representing the Corporation's additional contribution to the ESOP to enable it to meet its debt repayment responsibilities were the preferred dividends not available for this purpose.

Current assets and current liabilities include items expected to be, or which may be, realized or liquidated during the next year.

Short-term cash investments are highly liquid in nature and considered cash equivalents within the requirements of Financial Accounting Standard No. 95, "Statement of Cash Flows."

Note 2

Restructuring and Employee Severance Plans: In 1988, the Corporation's Board of Directors approved restructuring actions at certain operating entities resulting in charges to cost of goods and services sold aggregating $148.8 million. The restructuring charges included provisions (aggregating $115.2 million) to re-baseline major radar contracts at Norden Systems, and to write off capital equipment that became excess to Norden's needs and, at several operating units, costs ($33.6 million) of relocation of some operations and of personnel reductions.

Note 3

Acquisitions and Dispositions:

Acquisition:

In December 1988, the Corporation purchased an initial 46% equity interest in Sheller-Globe Corporation (Sheller). In the fourth quarter of 1989, the Corporation completed the acquisition of Sheller. Sheller designs, engineers, manufactures and distributes a wide range of components used as production and replacement parts in cars, trucks and other vehicles and specializes in interior components for such vehicles. The results of Sheller's operations were accounted for under the equity method in 1989. Sheller's financial position and results of operations have been consolidated in the Corporation's financial statements from December 31, 1989. Goodwill recognized in the acquisition is being amortized over 40 years. Pro forma presentation of the Corporation's earnings, as if the acquisition had been made on January 1 of the earliest period presented, would not be materially different from reported results.

Dispositions:

Included in the caption "Financing revenues and other income, less other deductions" in the accompanying Consolidated Statement of Income are gains realized by the Corporation on the sale or restructuring of certain of its investments. In 1990, these gains included the sale of an automotive products operating unit ($46 million). In 1988, these gains resulted from the sale of stock in certain finance subsidiaries ($99 million) discussed in Note 7, the sale of its Essex subsidiary ($95 million) and the sale of its share of Telefunken Electronic GmbH, a West German semiconductor joint venture ($41 million).

Note 4

International Operations: A substantial portion of the Corporation's revenues and assets relate to international operations. The Corporation has significant manufacturing facilities in Canada, Italy, France, Japan, Spain, the United Kingdom and Germany and operations of lesser size in a number of other countries. At December 31, 1990, the investment (identifiable assets) in any single country other than the United States did not exceed 5% of the Corporation's total identifiable assets, except for investments in Canada which amounted to 7% of total identifiable assets. Amounts included in the accompanying consolidated financial statements associated with operations outside the United States consist of the following:

In Millions of Dollars	**1990**	1989	1988
Sales	**$7,534.2**	$6,064.6	$5,278.6
Net income	**$ 409.6**	$ 321.6	$ 229.6
Assets	**$4,693.5**	$4,178.4	$3,776.1
Liabilities	**$2,445.6**	$2,271.2	$2,230.7
Minority interests	**$ 322.2**	$ 273.5	$ 233.6

The financial position and results of operations of substantially all of the Corporation's significant foreign subsidiaries are measured using local currency as the functional currency. The aggregate effects of translating the financial statements of these subsidiaries are deferred as a separate component of Shareowners' Equity. At December 31, 1990, the Corporation had $1.3 billion of outstanding currency swaps and forward foreign exchange contracts to hedge its foreign currency committed exposures.

The economies of Brazil and Mexico have been determined to be highly inflationary; accordingly, translation gains and losses are recognized in income currently.

Earnings were charged with foreign exchange losses, including gains and losses of operations in highly inflationary economies, of $21.4 million, $36.7 million and $8.8 million in 1990, 1989, and 1988, respectively.

Note 5

Accounts, Notes and Leases Receivable: Allowances for doubtful accounts of $119.2 million and $96.6 million have been applied as a reduction of current accounts receivable at December 31, 1990 and 1989, respectively.

Current and long-term accounts receivable at December 31, 1990 and 1989 include approximately $309 million and $289 million, respectively, representing retainage under contract provisions and amounts which are not presently billable because of lack of funding or final prices or contractual documents under government contracts or for other reasons. These items are expected to be collected in the normal course of business.

Accounts, notes and leases receivable, due after one year, consist of the following at December 31:

In Millions of Dollars	**1990**	1989
Accounts receivable	**$315.6**	$247.5
Notes receivable	**204.6**	131.0
Leases receivable:		
Financing leases, net of unearned income of $17.3 and $19.5, respectively	**53.6**	59.4
	$573.8	$437.9

Scheduled maturities, in millions of dollars, of the accounts, notes and leases receivable, due after one year for the next five years are $184.7 in 1992, $140.7 in 1993, $53.5 in 1994, $50.6 in 1995 and $144.3 in 1996 and thereafter.

Note 6

Inventories and Contracts in Progress: Inventories and contracts in progress at December 31, 1990 consist of inventories of $4,764.8 million ($4,866.3 million at December 31, 1989) and elevator and escalator contracts in progress of $1,298.7 million ($1,102.5 million at December 31, 1989).

The principal elements of cost included in inventories are materials, purchased components, direct labor and manufacturing overhead (engineering overhead in the case of engineering contracts). Tooling and other costs are an insignificant portion of inventories.

A substantial portion of the Corporation's inventories in its building systems and industrial products businesses is valued under the LIFO method. If these inventories had been valued at the lower of replacement value or cost under the first-in, first-out method, they would have been higher by $143.4 million at December 31, 1990 ($127.7 million at December 31, 1989).

The book basis of LIFO inventories exceeded the tax basis of such inventories by approximately $58.5 million at December 31, 1990 and 1989, resulting from the assignment of fair value to inventories acquired in a business acquisition accounted for under the purchase method of accounting.

The methods of accounting followed by the Corporation do not permit classification of inventories by categories of finished goods, work in process and raw materials. The Corporation's sales contracts in many cases are long-term contracts expected to be performed over periods exceeding twelve months. Approximately 65% (62% at December 31, 1989) of total inventories and contracts in progress has been acquired or manufactured under such long-term contracts. It is impracticable for the Corporation to determine the amounts of inventory scheduled for delivery under long-term contracts within the next twelve months.

Progress payments, secured by lien, on United States Government contracts and billings on contracts in progress amounted to $521.4 million ($809.8 million at December 31, 1989) and $1,497.9 million ($1,247.8 million at December 31, 1989), respectively, at December 31, 1990.

Note 7

Consolidated Subsidiaries and Other Investments: As of December 31, 1990, customer aircraft financing activities are conducted principally through UT Finance Corporation, its two consolidated subsidiaries and certain other customer financing operations. In 1988, the Corporation sold the stock of two subsidiaries, which conducted substantially all of the finance subsidiaries' leasing activities at that time. These sales resulted in the recognition in 1988 of consolidated pretax gains of $99 million, including $72 million recognized by the consolidated subsidiaries shown below.

Summary financial data for these subsidiaries is shown below:

In Millions of Dollars	**1990**	1989	1988
Revenues:			
Operating	**$107.5**	$107.8	$107.2
Gain on sales of leasing subsidiaries	**—**	—	71.8
Total expenses	**85.0**	88.3	103.6
Net Income	**$ 22.5**	$ 19.5	$ 75.4
Assets:			
Intercompany receivables, net	**$288.9**	$396.7	
Financing assets	**592.6**	344.2	
Other assets	**10.8**	12.7	
Total Assets	**$892.3**	$753.6	
Liabilities and Shareholder's Equity:			
Long-term debt	**$503.5**	$389.8	
Other Liabilities	**45.8**	43.3	
Total Liabilities	**$549.3**	$433.1	
Shareholder's Equity	**$343.0**	$320.5	
Total Liabilities and Shareholder's Equity	**$892.3**	$753.6	

The Corporation's customer finance activities include leasing aircraft under operating lease agreements and subleasing the aircraft to customers. At December 31, 1990, rental commitments under those long-term noncancelable leases aggregated $536.1 million ($42.3 million in each of the years 1991 through 1995), and sublease rentals under noncancelable agreements totaled $378.9 million ($26.3 million in each of the years 1991 through 1995).

The aircraft sublease rentals above are principally from a customer that entered into reorganization proceedings subsequent to December 31, 1990. The proceedings are in the early stages; the Corporation is presently unable to predict their outcome and the impact that outcome may have on the sublease agreement. However, the Corporation believes any ultimate loss that may result from resolution of this matter would not be material to its financial position or results of operations.

Other investments consist of the following:

In Millions of Dollars	**1990**	1989
Products under lease	**$310.6**	$169.7
Other companies	**210.0**	174.2
	$520.6	$343.9

Note 8

Deferred Charges: Included in deferred charges are costs in excess of the net assets of acquired companies (goodwill), net of amortization as follows:

In Millions of Dollars	**1990**	1989
Goodwill	**$ 898.3**	$ 834.2
Accumulated amortization	**(197.5)**	(166.2)
	$ 700.8	$ 668.0

Goodwill increased $436.3 million in 1989 principally as a result of the completion of the acquisition of Sheller-Globe.

Note 9

Borrowings and Lines of Credit: The following summarizes the short-term borrowings and lines of credit, long-term debt and interest expense of the Corporation and its subsidiaries.

Short-term borrowings:

In Millions of Dollars	**1990**	1989
Foreign bank borrowings	**$156.3**	$ 149.0
Commercial paper and notes	**186.2**	1,132.0
	$342.5	$1,281.0

At December 31, 1990, the Corporation had credit commitments by banks totaling $1.05 billion under a Revolving Credit Agreement. The Revolving Credit Agreement provides for borrowings through January 1, 1993, at interest rates up to the prime rate and for a facility fee of 1/8% per year on the aggregate commitment. There were no borrowings under the Revolving Credit Agreement at December 31, 1990 and 1989.

Long-term debt:

Type of Issue	1990 Debt: Weighted Average Interest Rate	1990 Debt: Maturity	Amount (in millions) 1990	Amount (in millions) 1989
Denominated in U.S. Dollars:				
Notes and other debt	9.06%	1992–2019	**$1,511.0**	$1,232.5
Sinking fund debt	8.82	1996–2016	**255.0**	434.1
Denominated in foreign currency:				
Notes and other debt	7.08	1992–2002	**217.4**	293.0
Capital lease obligations	7.60	1992–2002	**299.6**	53.6
ESOP debt guarantee	7.55	1992–2009	**618.7**	—
Total long-term debt			**$2,901.7**	$2,013.2

At December 31, 1990, the Corporation had entered into various interest rate collars and swap contracts (including options thereon) related to approximately $623 million of its outstanding borrowings. The effect of the interest rate collars is to limit the range of the effective interest rate to 7.45%–8.25% on $200 million of borrowings. Additionally, the Corporation has entered into a U.S. dollar currency swap relating to indebtedness of 25 billion yen, effectively fixing the exchange rate on the debt at 246.75 yen/dollar. The expiration dates of the various contracts are tied to scheduled debt or capital lease obligation payment dates and extend to 2000.

Principal payments required on long-term debt for the next five years, excluding amounts for the ESOP debt guarantee, are $292.8 million in 1991, $477.0 million in 1992, $339.5 million in 1993, $104.3 million in 1994 and $213.8 million in 1995. Principal payments required under the ESOP debt guarantee are $24.8 million in 1991, $32.2 million in 1992, $33.9 million in 1993, $35.1 million in 1994 and $35.9 million in 1995.

Interest expense:

During 1990, the Corporation and its consolidated subsidiaries capitalized $60.0 million ($60.8 million in 1989 and $57.7 million in 1988) of interest, to be depreciated over the lives of the related fixed assets.

Note 10

Taxes on Income: The provision for income taxes for each of the three years ended December 31 comprises the following:

In Millions of Dollars	1990	1989	1988
Current:			
United States:			
Federal	**$ 261.9**	$165.2	$ 275.6
State	**72.9**	53.6	46.1
Foreign	**280.5**	247.8	233.1
	$ 615.3	$466.6	$ 554.8
Deferred:			
United States:			
Federal	**$(125.7)**	$ 22.2	$(101.9)
State	**(28.2)**	7.6	(8.3)
Foreign	**17.7**	1.4	15.5
	$(136.2)	$ 31.2	$ (94.7)
Total	**$ 479.1**	$497.8	$ 460.1

Deferred income taxes represent the tax effects of transactions which are reported in different periods for financial and tax reporting purposes. Changes in deferred U.S. federal, state and foreign income taxes shown in the income tax provisions include the income tax effects of:

In Millions of Dollars	1990	1989	1988
Use of completed-contract method for reporting taxable income	**$ (50.2)**	$ 32.8	$ (69.1)
Tax depreciation and foreign capital allowances in excess of financial statement amounts	**13.6**	29.5	28.1
Capitalization of interest cost, less related depreciation	**8.7**	10.5	11.2
Adjustment of inventories and contract losses to tax basis	**(4.6)**	(103.0)	(74.8)
Expenditures (provisions) for warranty	**(13.0)**	(22.6)	4.7
Insurance and employee benefits deductible on different bases for book and tax purposes	**(92.1)**	63.6	4.9
Customer allowances	**40.5**	14.0	(7.7)
Restructuring and employee severance provisions	**(13.8)**	1.6	6.0
Lease transactions, finance subsidiaries	**15.0**	.7	(1.2)
Alternative minimum tax	**11.3**	(15.0)	12.4
Other items, net	**(51.6)**	19.1	(9.2)
	$(136.2)	$ 31.2	$ (94.7)

The sources of income before income taxes were:

In Millions of Dollars	1990	1989	1988
United States	**$ 558.7**	$ 633.9	$ 667.1
Foreign	**732.5**	626.5	497.8
	$1,291.2	$1,260.4	$1,164.9

Deferred income taxes generally have not been provided on undistributed earnings of international subsidiaries, of $967.7 million, which are included in consolidated retained earnings at December 31, 1990. A substantial portion of the undistributed earnings of the international subsidiaries has been reinvested, and the Corporation believes that income taxes otherwise payable upon repatriation of earnings not reinvested would be largely offset by available foreign tax credits.

Differences between effective income tax rates and the statutory U.S. federal income tax rates are as follows:

	1990	1989	1988
Statutory U.S. federal income tax rate	**34.0%**	34.0%	34.0%
State and local income taxes, net of federal tax benefit	**2.3**	3.2	2.1
Varying tax rates of consolidated subsidiaries (including Foreign Sales Corporation)	**(.5)**	.2	3.7
Amortization of excess purchase accounting adjustments, without tax effect	**.2**	.6	.8
Other	**1.1**	1.5	(1.1)
Effective income tax rates	**37.1%**	39.5%	39.5%

The statutory tax rate decrease to 34% in 1988 from 40% in 1987 will give rise to adjustments in the deferred tax accounts under Financial Accounting Standard No. 96, "Accounting for Income Taxes," issued in December 1987 and originally requiring adoption no later than January 1, 1989. The Financial Accounting Standards Board has twice delayed the required adoption date, currently no later than January 1, 1992, and in 1990 has considered amending the Standard which, among other things, may delay requiring adoption until 1993 and will liberalize the current standard in respect of recognition of income tax assets. The Corporation has therefore not made a decision as to the date it will adopt FAS 96. If the Corporation had elected early adoption of FAS 96 as of January 1, 1990 and had elected to restate prior periods' financial statements as permitted by the Standard, 1988 earnings would be reduced by approximately $210 million; there would be no material impact on 1989 and 1990 earnings. Of the 1988 charge to earnings, approximately $180 million represents the cumulative effect of the adoption of the Standard. The provisions of FAS 96 will have potential for producing, under certain conditions, significant distortion in the Corporation's income tax provision and effective tax rate from year to year.

Note 11

Shareowners' Equity: At December 31, 1990 8,356,948 shares of Common Stock were reserved for issuance under various employee incentive plans. See Note 12.

A Common Stock Purchase Right is attached to each share of Common Stock. Each Right entitles shareowners to buy, under certain circumstances, one newly issued share of the Corporation's Common Stock at an exercise price of $150. The Rights will be exercisable only if a person or group acquires 20% or more of the Corporation's Common Stock or announces a tender or exchange offer for 30% or more of the Common Stock. If the Corporation is acquired in a merger or other business combination transaction, each Right will entitle its holder to purchase, for $150, a number of the acquiring company's common shares having a market value of $300. The Corporation will be entitled to redeem the Rights at 10 cents per Right prior to the earlier of the expiration of the Rights in January 1996 or the time that a 20% position has been acquired. Until the Rights become exercisable, they have no dilutive effect on the earnings per share of the Corporation. At December 31, 1990, 129,512,928 shares of Common Stock were reserved for issuance upon the exercise of these Rights.

The terms of the indentures relating to certain issues of long-term debt include provisions intended to restrict, under certain conditions, the availability of retained earnings for payment of dividends on the Common Stock. At December 31, 1990, all of the Corporation's retained earnings were free of such restrictions.

Note 12

Employee Benefit Plans:

Employee Pension Benefits:

The Corporation and its domestic subsidiaries have a number of defined benefit pension plans covering substantially all U.S. employees. Plan benefits are generally based on years of service and the employee's compensation during the last several years of employment. The Corporation's funding policy is based on an actuarially determined cost method allowable under Internal Revenue Service regulations. The funds are invested either in various securities by trustees or in insurance annuity contracts. Certain foreign subsidiaries have defined benefit pension plans or severance indemnity plans covering their employees. The Corporation accounts for the cost of its defined benefit plans in accordance with Financial Accounting Standard No. 87, "Employers' Accounting for Pensions" (FAS 87).

In addition to the defined benefit plans covering U.S. and foreign employees discussed above, the Corporation makes contributions to multiemployer plans (predominantly defined benefit plans) covering certain employees in some of its U.S. operations. Certain additional employees, primarily located in foreign countries, are covered by retirement arrangements which do not meet the reporting requirements of FAS 87.

Summarized below are the components of net periodic pension cost for defined benefit plans, net pension cost for multiemployer plans and other costs for pension and severance indemnity plans:

In Millions of Dollars	**1990**	1989	1988
Defined benefit plans:			
Service cost-benefits earned during the period	**$ 218.0**	$ 182.2	$ 176.8
Interest cost on projected benefit obligation	**492.5**	422.0	374.4
Actual return on plan assets—investment losses/(gains)	**425.5**	(1,042.1)	158.3
Net amortization and deferral of actuarial (losses)/gains	**(1,088.3)**	443.6	(726.8)
Net periodic pension cost	**$ 47.7**	$ 5.7	$ (17.3)
Net pension cost:			
Multiemployer plans	**$ 23.4**	$ 23.2	$ 24.1
Other costs	**$ 12.9**	$ 13.0	$ 13.1

Summarized below is the funded status of the defined benefit pension plans and the related amounts that are recognized in the consolidated balance sheet at December 31:

In Millions of Dollars	**December 31, 1990**		December 31, 1989	
	Assets Exceed Accumulated Benefits	Accumulated Benefits Exceed Assets	Assets Exceed Accumulated Benefits	Accumulated Benefits Exceed Assets
Actuarial present value of benefit obligations:				
Vested	**$4,451.6**	**$ 160.3**	$4,130.1	$ 256.7
Nonvested	**269.7**	**12.0**	298.9	17.7
Accumulated benefit obligation	**4,721.3**	**172.3**	4,429.0	274.4
Effect of projected future salary increases	**1,020.1**	**63.2**	1,014.0	67.4
Projected benefit obligation for services rendered to date	**5,741.4**	**235.5**	5,443.0	341.8
Plan assets available for benefits	**5,927.5**	**60.7**	6,478.3	121.1
Plan assets in excess of (less than) projected benefit obligation	**186.1**	**(174.8)**	1,035.3	(220.7)
Unrecognized net loss (gain)	**39.6**	**(8.8)**	(592.6)	(14.7)
Prior service cost not yet recognized in net periodic pension cost	**260.4**	**12.0**	133.9	14.0
Unrecognized net (asset) obligation at transition	**(269.6)**	**67.4**	(344.5)	94.6
Additional minimum liability recognized	**—**	**(22.4)**	—	(60.2)
Prepaid pension cost (pension liability) included in deferred charges (other long-term liabilities)	**$ 216.5**	**$(126.6)**	$ 232.1	$(187.0)

The pension funds are valued at September 30 of the respective years in the table above. In 1990, certain U.S. plans were merged, the result of which was to reduce the additional minimum liability recognized in 1989 by $37.8 million.

Major assumptions used in the accounting for the defined benefit pension plans are shown in the following table. Net periodic pension cost is determined using these factors as of the end of the prior year, whereas the funded status of the plans uses only the first two factors as of the end of the current year.

	December 31,			
	1990	1989	1988	1987
Weighted-average discount rate	**9.0%**	8.5%	8.5%	8.2%
Rate of increase in future compensation	**7.0%**	7.0%	7.0%	7.0%
Expected long-term rate of return on assets	**10.5%**	10.5%	10.5%	10.5%

In 1990, 1989 and 1988, in accordance with FAS 88, the Corporation recognized net gains/(losses) of $.6 million, $(6.3) million, and $13.1 million, respectively. These financial impacts resulted from the settlement of benefit obligations for retirees of certain plans through the purchase of annuity contracts with insurance companies (1988), from lump-sum cash payments to plan participants in exchange for their rights to receive specified pension benefits (1988), from the reduction in the projected benefit obligations for certain employees affected by reductions in personnel at several operating units (1990 and 1988) and from granting special termination benefits (1989).

Certain of the Corporation's international subsidiaries generally do not determine the actuarial value of accumulated benefits and the value of net assets on the basis shown above. For these plans, unfunded vested benefits as of December 31, 1990 and 1989 were $.4 million. Unfunded liabilities for pension plans of certain international subsidiaries and for employee severance benefits, including those accruing to employees under foreign government regulations, are included in other long-term liabilities in the accompanying balance sheet.

Employee Health Care and Insurance Benefits:

In addition to providing pension benefits, the Corporation and a number of its subsidiaries provide certain health care and life insurance benefits for active and retired employees. Such benefits are provided through insurance companies whose premiums are based upon the benefits paid during the year. The Corporation recognizes the cost of providing those benefits by charging to expense the annual insurance premiums less any employee contributions, which in 1990 were approximately $480 million ($430 million in 1989 and $350 million in 1988). The cost of providing those benefits for the retirees is insignificant.

In December 1990, the Financial Accounting Standards Board issued Statement of Financial Accounting Standards No. 106 (FAS 106), "Employers' Accounting for Postretirement Benefits Other Than Pensions." The effective date for required adoption of FAS 106 is 1993 for most U.S. plans and 1995 for all other plans, including non-U.S. plans. FAS 106 will no longer

allow the Corporation to recognize retiree benefits as net premiums are incurred, requiring instead the recognition of a liability as the benefits are earned during the employees' applicable years of service. FAS 106 permits recording the entire unrecognized obligation at adoption or amortizing that unrecognized obligation over twenty years. The Corporation has not made a decision as to the method and date of adoption of FAS 106. The Corporation estimates that its current unrecognized obligation is approximately $500–$600 million, of which approximately $240–$250 million is attributable to retired employees.

Employee Incentive Plans:

On April 24, 1989, the Corporation's shareowners approved the Long-Term Incentive Plan (1989 Plan) under which shares of Common Stock may be sold or awarded to officers and key employees. The 1989 Plan in effect replaced the 1979 Long-Term Incentive Plan (1979 Plan). The 1989 Plan also had the effect of amending the terms of all grants and awards under the 1979 Plan that remain outstanding inasmuch as they shall be administered in accordance with the terms and provisions of the 1989 Plan.

The 1989 Plan authorized various types of market-based incentive and performance-based awards. The exercise price of an option, which will be set at the time of the grant, will not be less than the fair market value of the shares subject thereto on the date of grant. The maximum number of shares which may be utilized for awards granted during a given calendar year may not exceed 2% of the aggregate shares of Common Stock, Common Stock equivalents and Treasury shares as reported outstanding in the Annual Report on Form 10-K for the preceding fiscal year.

The 1979 Plan provided for the granting of Stock Appreciation Rights linked with stock options granted under either the 1979 Plan or the 1976 Plan. The exercise of either a Stock Appreciation Right or a stock option automatically cancels the connected option or right. The 1979 Plan also provided for the granting of Performance Units. All such Stock Appreciation Rights and Performance Units were either exercised or cancelled in 1989.

A summary of the transactions under all Plans for the three years ended December 31 follows:

	Stock Options		Stock Appreciation Rights		Other Incentive Awards
	Shares	Average Price	Rights	Average Price	Awards
Outstanding—December 31, 1987:	9,402,880	$38.55	800,659	$42.27	1,151,490
Granted	1,687,915	$40.07	—		—
Exercised	(429,651)	$25.68	—		—
Cancelled	(289,005)	$38.97	(254,512)	$37.69	(644,400)
Outstanding—December 31, 1988:	10,372,139	$39.32	546,147	$44.41	507,090
Granted	1,390,305	$51.25	—		133,569
Exercised	(1,595,086)	$35.33	(44,635)	$46.85	—
Cancelled	(148,548)	$42.52	(501,512)	$44.19	(515,890)
Outstanding—December 31, 1989:	10,018,810	$41.56	—		124,769
Granted	427,950	$50.05	—		238,149
Exercised or earned	(1,998,332)	$39.94	—		(89,082)
Cancelled	(284,423)	$43.86	—		(26,737)
Outstanding—December 31, 1990	8,164,005	$42.32	—		247,099

At December 31, 1990, stock options for 4,682,995 shares of Common Stock were exercisable at an average price of $39.27 per share.

For 1990, $38.9 million ($40.5 million in 1989 and $40.7 million in 1988) was charged to income with respect to employee incentive plans of the Corporation and certain of its subsidiaries, of which $34.3 million ($32.5 million in 1989 and $31.0 million in 1988) was accrued under the Corporation's principal incentive compensation plan, and the remainder was accrued under the 1989 Plan and other plans.

Employee Savings Plans:

In the second quarter of 1989, the Corporation established an Employee Stock Ownership Plan (ESOP) to serve as the vehicle for the Corporation's match of employee contributions within one of its existing savings plans. The Corporation's Board of Directors authorized 20,000,000 shares of preferred stock, par value $1.00 per share, designated as Series A ESOP Convertible Preferred Stock, having a 7.38 percent dividend rate per annum. Each share of ESOP preferred stock is convertible into one share of common stock. On June 30, 1989, the ESOP Trust acquired 10,153,847 shares of this new series of preferred stock, at an acquisition price of $65.00 per share, in exchange for promissory notes aggregating $660 million issued to the Corporation by the ESOP trust. In February 1990, the ESOP trust arranged permanent financing guaranteed by the Corporation and repaid the notes to the Corporation. In March 1990, the ESOP trust acquired an additional 2,900,000 shares of ESOP preferred stock in exchange for a 10.5%, $202.3 million promissory note issued to the Corporation. The Corporation has no intention of arranging permanent financing for this transaction at this time.

The guarantee of the ESOP's debt resulted in the Corporation recording such debt in its consolidated balance sheet with a corresponding offset to the ESOP preferred stock. Similarly, the ESOP preferred stock amount was reduced by the initial amount of the ESOP trust's promissory notes to the Corporation. The Corporation is required to contribute sufficient funds, when combined with dividends paid on the ESOP Preferred Stock, to meet the ESOP trust's debt service requirements on the permanent financing and promissory notes. In 1990 and 1989, the ESOP incurred interest expense aggregating $66.3 million and $32.3 million, respectively, on its outstanding indebtedness. In 1990, the ESOP made principal payments of $16.5 million and $67.6 million on its permanent financing and promissory notes, respectively.

Shares of ESOP preferred stock are held by the ESOP Trustee with the number of shares allocated to each employee determined annually in accordance with a method approved by the Internal Revenue Service. To the extent that allocated shares are not sufficient to meet the matching requirement of the savings plan, the Corporation will contribute additional ESOP preferred stock, common stock or cash.

Shares allocated to employees generally may not be withdrawn until the employee's termination, disability, retirement or death. Upon withdrawal, shares of ESOP preferred stock must be converted into one share of the Corporation's common stock or, if the value of the common stock is less than the original cost of the ESOP preferred stock, the ESOP Trustee may require the Corporation to repurchase the ESOP preferred stock at its original cost. Because of the guaranteed value, the ESOP preferred stock is classified outside of permanent equity. In conjunction with the establishment of the ESOP, the Corporation purchased approximately 1.7 million shares and 10.4 million shares of its common stock in 1990 and 1989, respectively, at a combined average cost of $53.48 per share to substantially provide for the conversion feature of the preferred stock.

Dividends on ESOP preferred stock are deductible for U.S. income tax purposes. The tax benefit to the Corporation resulting from such dividends has been applied as a reduction of the preferred stock dividends in the financial statements.

The ESOP preferred stock is redeemable, in whole or in part, generally at the option of the Corporation at redemption prices ranging from $69.32–$69.77 per share plus accrued and unpaid dividends. At December 31, 1990, the aggregate redemption value of the ESOP preferred stock was $903.3 million.

Contributions to the ESOP together with the value of additional ESOP preferred stock, common stock or cash necessary to satisfy the savings plan matching requirement are charged to expense. The Corporation and a number of its subsidiaries have additional savings plans in which a portion of employee contributions is matched in cash by the employer. The amount expensed related to all savings plans totaled $91.2 million in 1990 ($63.5 million in 1989 and $63.6 million in 1988).

Note 13

Commitments and Contingent Liabilities: The Corporation and its consolidated subsidiaries occupy space and use certain equipment under lease arrangements. Rent expense in 1990, 1989 and 1988 under such arrangements totaled $380.4 million, $343.1 million and $341.2 million, respectively. Rental commitments at December 31, 1990 under long-term noncancelable operating leases are as follows (See Note 7 for lease commitments associated with customer financing arrangements):

In Millions of Dollars	Land, Buildings and Office Space	Machinery, Tools and Equipment
1991	$135.9	$123.4
1992	114.5	102.3
1993	92.8	61.4
1994	68.5	11.7
1995	56.1	3.4
After 1995	245.3	3.7
	$713.1	$305.9

The competitive commercial aircraft engine market often requires significant customer financing commitments. These commitments may be in the form of guarantees, secured debt or lease financing. At December 31, 1990, the Corporation had commitments to finance or arrange financing for approximately $3.7 billion of commercial aircraft. The Corporation cannot currently predict the extent to which these commitments will be utilized since certain customers may be able to obtain more favorable terms using traditional financing sources. In addition, the Corporation may arrange for third party investors to assume a portion of the remaining commitments.

However, should all current commitments be exercised, the maximum amounts that will be disbursed are as follows: $537 million in 1991, $448 million in 1992, $1.3 billion in 1994, $300 million in 1995, $872 million in 1996 and $300 million in 1997 and beyond.

At December 31, 1990, the Corporation had approximately $186 million of guarantees outstanding related to various customer financing arrangements, principally commercial aircraft engine customers. These guarantees may extend for fifteen years or more and may have been used by the customers to obtain more favorable financing terms than would otherwise be available. Where applicable, the estimated fair market values at December 31, 1990 of the assets securing these guarantees equaled or exceeded the related guarantee amount.

During the fourth quarter of 1990, Norden initiated discussions with its customer to restructure the contract for its most advanced radar program. Norden's objective is to contain the Corporation's financial risk while meeting the customer's operational requirements. In management's opinion, the current cost estimate and provisions recorded to date fairly represent the best current estimate of cost necessary to complete the contract at a performance level that Norden believes should be acceptable to the customer. However, the outcome of any discussions is unknown. Additionally, as progress on the contract continues, new information may arise that could adversely affect the estimated costs. Management does not expect that additional provisions that may be required through completion represent a material financial risk to the Corporation.

The Corporation extends performance and operating cost guarantees, which are beyond its normal warranty and service policies, for extended periods on some of its products, particularly commercial aircraft engines. Liability under such guarantees is contingent upon future product performance and durability. Management has no present reason to believe that such guarantees will result in material losses to the Corporation.

The Corporation is a potentially responsible party at approximately 100 sites, many of which relate to formerly-owned businesses. At the vast majority of these sites, there are additional parties who can be expected to contribute to the cleanup cost. Separately, the Corporation is currently involved in a number of actions at various sites to determine whether, and to what extent, remedial action is necessary to clean up hazardous wastes as required by federal and state law.

The nature of the above matters makes it difficult to estimate the exact timing and ultimate amount of future environmental expenditures (remedial and otherwise). In addition, the Corporation has instituted legal proceedings against its insurers asserting insurance coverage for pollution costs. These proceedings are expected to last several years. No prediction can be made as to the outcome of these proceedings. Notwithstanding the above, the Corporation believes that the level of capital expenditures and remedial action necessary to comply with the present laws governing environmental protection will not have a material effect upon its financial position or results of operations.

Like many defense contractors, the Corporation has received allegations from the U.S. Government that some contract prices should be reduced because cost or pricing data submitted in negotiation of the contract prices may not have been in conformance with government regulations. The Corporation has made voluntary refunds in those cases it believes appropriate, has settled some allegations, and does not believe that any further price reductions that may be required will have a material effect upon its financial position or results of operations.

The Corporation also has other commitments and contingent liabilities related to legal proceedings and matters arising out of the normal course of business. Management does not expect that amounts, if any, which may be required to be paid by reason of commitments, guarantees, legal proceedings or other contingencies will be of material importance to the financial position or results of operations of the Corporation.

Note 14

Business Segment Financial Data: Business segment information for the three years ended December 31, 1990, required by Financial Accounting Standard No. 14, appears in the Consolidated Summary of Business Segment Financial Data on pages 55 through 57. In 1990, the Corporation reclassified certain components of its business segments as a result of a realignment of its radar activities and a refinement of corporate sponsored research and development allocations. The segment data for prior periods has been appropriately reclassified.

Consolidated Summary of Business Segment Financial Data

Industry Segments

In Millions of Dollars	Years Ended December 31, 1990	1989	1988
Revenues			
Power	**$ 7,291.5**	$ 6,991.1	$ 6,346.7
Flight Systems	**4,033.6**	3,781.8	3,700.0
Building Systems	**7,988.1**	7,244.3	6,506.6
Industrial Products for the Automotive and Other Industries	**2,621.1**	1,931.6	1,965.8
Other	**32.7**	27.4	23.2
Corporate items and eliminations	**(183.8)**	(236.1)	(41.1)
Consolidated revenue	**$21,783.2**	$19,740.1	$18,501.2
Operating Profit			
Power	**$ 1,009.9**	$ 939.7	$ 679.1
Flight Systems	**89.5**	26.1	(36.9)
Building Systems	**424.6**	458.0	386.0
Industrial Products for the Automotive and Other Industries	**150.0**	155.9	214.8
Other	**(12.5)**	(9.2)	(11.7)
Eliminations	**(8.3)**	3.1	(.7)
Operating profit	**1,653.2**	1,573.6	1,230.6
Financing revenues and other income, less other deductions	**38.6**	49.3	260.3
Interest expense	**(361.6)**	(330.1)	(295.4)
General corporate expenses	**(39.0)**	(32.4)	(30.6)
Consolidated income before income taxes	**$ 1,291.2**	$ 1,260.4	$ 1,164.9
Identifiable Assets			
Power	**$ 5,441.5**	$ 4,766.8	$ 4,140.9
Flight Systems	**2,456.1**	2,400.1	2,506.3
Building Systems	**4,141.6**	3,642.6	3,496.5
Industrial Products for the Automotive and Other Industries	**1,646.0**	2,005.5	907.3
General corporate assets and other	**2,233.1**	1,783.2	1,697.3
Consolidated assets	**$15,918.3**	$14,598.2	$12,748.3
Capital Expenditures			
Power	**$ 459.4**	$ 422.5	$ 328.1
Flight Systems	**173.1**	159.5	182.5
Building Systems	**315.8**	243.5	230.1
Industrial Products for the Automotive and Other Industries	**174.1**	138.6	115.1
General corporate assets and other	**78.0**	59.2	19.5
Consolidated additions to fixed assets	**$ 1,200.4**	$ 1,023.3	$ 875.3

See accompanying Notes to Consolidated Summary of Business Segment Financial Data.

Consolidated Summary of Business Segment Financial Data continued

Geographic Areas

In Millions of Dollars	Years Ended December 31, 1990	1989	1988
Revenues			
United States operations	**$15,015.3**	$14,403.2	$13,451.4
International operations:			
Europe	**3,986.5**	3,101.0	2,753.0
Other	**3,853.5**	3,389.2	2,698.0
Corporate items and eliminations	**(1,072.1)**	(1,153.3)	(401.2)
Consolidated revenue	**$21,783.2**	$19,740.1	$18,501.2
Operating Profit			
United States operations	**$ 909.2**	$ 880.6	$ 658.8
International operations:			
Europe	**523.7**	360.6	298.5
Other	**349.4**	374.8	299.6
Eliminations	**(129.1)**	(42.4)	(26.3)
Operating profit	**1,653.2**	1,573.6	1,230.6
Financing revenues and other income, less other deductions	**38.6**	49.3	260.3
Interest expense	**(361.6)**	(330.1)	(295.4)
General corporate expenses	**(39.0)**	(32.4)	(30.6)
Consolidated income before income taxes	**$ 1,291.2**	$ 1,260.4	$ 1,164.9
Identifiable Assets			
United States operations	**$ 9,597.8**	$ 9,255.7	$ 7,755.7
International operations:			
Europe	**2,256.2**	1,925.2	1,679.3
Other	**2,123.2**	1,975.8	1,852.1
General corporate assets and other	**1,941.1**	1,441.5	1,461.2
Consolidated assets	**$15,918.3**	$14,598.2	$12,748.3

See accompanying Notes to Consolidated Summary of Business Segment Financial Data.

Notes to Consolidated Summary of Business Segment Financial Data

(A) The Corporation and its subsidiaries design, develop, manufacture and sell high-technology products, classified in four principal industry segments or lines of business in accordance with Financial Accounting Standard No. 14.

Power products are principally aircraft engines and substantial spare parts sold to a diversified customer base including international and domestic commercial airlines and aircraft leasing companies, aircraft manufacturers, regional and commuter airlines, and U.S. and non-U.S. governments. Modified aircraft engines and related equipment for electrical power generation and other applications are also included.

Flight Systems products include helicopters and spare parts, propellers, rocket motors, and fuel control, environmental, radar, cockpit and integrated display and other airborne and space systems sold primarily to U.S. and non-U.S. governments, aerospace and defense prime contractors, and airframe and jet engine manufacturers.

Building Systems products include air conditioning equipment, elevators and escalators, substantial service, maintenance and spare parts sold to a diversified international customer base in commercial and residential real estate development.

Industrial Products for the Automotive and Other Industries include electrical wiring systems, electromechanical and hydraulic devices, electric motors, car and truck interior trim components, steering wheels, instrument panels and other products for the automotive industry principally in the United States and Canada; and controls and control systems for the appliance and related industries. Also included is the Corporation's wire and cable business, including magnet wire and winding machinery for the electric motor, transformer and electromagnetic equipment industries, and a variety of wire and cable products (through February 1988, when the business was sold).

Activities classified as "Other" consist of a variety of business and developmental activities, including the design and manufacture of microelectronics circuits.

(B) Revenue by industry segment, and geographic area, includes intersegment sales and transfers between geographic areas. Generally, such sales and transfers are made at prices approximating those which the selling or transferring entity is able to obtain on sales of similar products to unaffiliated customers.

Revenues include sales under prime contracts and subcontracts to the U.S. Government, for the most part Power and Flight Systems products, as follows:

In Millions of Dollars	**1990**	1989	1988
Power	**$2,018.4**	$2,338.6	$2,163.5
Flight Systems	**$2,623.5**	$2,324.0	$2,416.5

Revenues from United States operations include export sales of $3,606.0 million in 1990, $3,307.4 million in 1989 and $2,848.1 million in 1988. Export sales to Europe were $457.1 million, $786.1 million and $568.0 million of the 1990, 1989, and 1988 amounts, respectively. Export sales include direct sales to commercial customers outside the United States and sales to the U.S. Government, commercial and affiliated customers outside the United States.

(C) Identifiable assets are those which are specifically identified with the industry segments and geographic areas in which operations are conducted. General corporate assets consist principally of cash and short-term cash investments, customer financing subsidiaries, and investments in other companies.

Depreciation charges are as follows:

In Millions of Dollars	**1990**	1989	1988
Power	**$275.8**	$266.3	$240.9
Flight Systems	**$126.9**	$120.9	$111.2
Building Systems	**$155.3**	$128.4	$112.6
Industrial Products	**$ 85.9**	$ 51.5	$ 48.7

(D) Eliminations made in reconciling industry and geographic area data with the related consolidated amounts include intersegment sales and transfers between geographic areas, unrealized profits in inventory and similar items.

(E) The Summary of Business Segment Financial Data should be read in conjunction with the consolidated financial statements of the Corporation and notes thereto appearing elsewhere in this Annual Report.

Selected Quarterly Financial Data

In Millions of Dollars (except per share amounts)	Quarter Ended March 31	June 30	September 30	December 31	For the Year
1990					
Sales	**$4,730.7**	**$5,602.4**	**$5,212.9**	**$5,896.0**	**$21,442.0**
Financing revenues and other income, less other deductions	**70.8**	**87.4**	**133.4**	**49.6**	**341.2**
Gross profit	**1,241.6**	**1,380.1**	**1,400.1**	**1,405.0**	**5,426.8**
Net income	**134.5**	**207.5**	**239.8**	**168.8**	**750.6**
Earnings per share—primary	**1.05**	**1.64**	**1.90**	**1.32**	**5.91**
—fully diluted	**1.01**	**1.52**	**1.76**	**1.24**	**5.53**
1989					
Sales	$4,415.4	$5,237.5	$4,709.9	$5,169.3	$19,532.1
Financing revenues and other income, less other deductions	42.4	33.9	40.4	91.3	208.0
Gross profit	1,198.7	1,356.8	1,266.2	1,328.2	5,149.9
Net income	123.7	197.3	196.7	184.4	702.1
Earnings per share—primary	.95	1.50	1.46	1.43	5.34
—fully diluted	.95	1.50	1.39	1.36	5.20

Notes:

Beginning in 1990, translation gains related to Brazilian debt have been credited to interest expense in order to reflect the approximate real rate of interest on such debt. Prior year amounts have been accordingly restated resulting in a reclassification which reduced revenues, operating profit and interest expense.

Directors

Board of Directors

Howard H. Baker, Jr.
Partner,
Baker, Worthington, Crossley,
Stansberry & Woolf
(Attorneys)

Antonia Handler Chayes
Chairman,
Endispute Incorporated
(Legal Consultation and
Alternative Dispute Resolution)

Robert F. Daniell
Chairman and
Chief Executive Officer

Robert F. Dee
Retired Chairman of the Board,
SmithKline Beckman Corporation
(Pharmaceuticals)

Charles W. Duncan, Jr.
(Private Investments)

T. Mitchell Ford
Retired Chairman of the Board
and Chief Executive Officer,
Emhart Corporation
(Diversified Manufacturer)
Of Counsel, Shipman & Goodwin
(Attorneys)

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Executive Chairman,
AB Volvo
(Automotive, Aerospace,
Food and Finance)

Gerald D. Hines
Owner,
Gerald D. Hines Interests
(Real Estate Development)

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Chairman of the Board
and Chief Executive Officer,
FMC Corporation
(Machinery and Chemicals)

John S. Reed
Chairman and
Chief Executive Officer,
Citicorp and Citibank, N.A.
(Financial Institution)

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National Intergroup, Inc.
(Metal Products)

Jacqueline G. Wexler
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Conference of Christians and Jews

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Antonia Handler Chayes
T. Mitchell Ford
Robert H. Malott
Richard S. Smith

Audit Review Committee
Richard S. Smith, Chairman
Antonia Handler Chayes
Pehr G. Gyllenhammar
Robert H. Malott
Jacqueline G. Wexler

Committee on Compensation and Executive Development
T. Mitchell Ford, Chairman
Howard H. Baker, Jr.
Robert F. Dee
John S. Reed
Jacqueline G. Wexler

Nominating Committee
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Chairman
Robert F. Daniell
Robert F. Dee
T. Mitchell Ford
John S. Reed

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Antonia Handler Chayes
Robert F. Dee
Charles W. Duncan, Jr.
Pehr G. Gyllenhammar
Gerald D. Hines

Finance Committee
John S. Reed, Chairman
Robert F. Daniell
Charles W. Duncan, Jr.
Pehr G. Gyllenhammar
Gerald D. Hines
Robert H. Malott

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Group Vice President and President, Commercial Engine Business, Pratt & Whitney Group

Norman R. Bodine
President, Automotive Products Division, UT Automotive

William R. Brown
President, Latin American Operations, Carrier

Eugene Buckley
President, Sikorsky Aircraft

Franklyn A. Caine
Senior Vice President, Human Resources and Organization

L. David Caplan
President and Chief Executive Officer, Pratt & Whitney Canada, Inc.

Mark S. Coran
Vice President, Controller

John A. Cosentino, Jr.
President, North American Operations, Otis

Robert F. Daniell
Chairman and Chief Executive Officer

George A.L. David
Executive Vice President and President, Commercial/Industrial

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Senior Vice President, Communications

Frederick C. Flynn, Jr.
Vice President, Treasurer

Pierre J. Fougeron
President, European and Transcontinental Operations, Otis

F. Mark Granato
Vice President, Communications

J. Colin Green
Vice President

John M. Hammitt
Vice President, Information Systems

Frederick D. Hay
President, Engineered Systems Division, UT Automotive

Robert J. Hermann
Vice President, Science and Technology

Bernard Hertel
President, Carrier Transicold Division

David M. Kelly
President, North American Operations, Carrier

Karl J. Krapek
Chairman, President and Chief Executive Officer, Carrier

Jeffrey L. Kushner
Vice President

Jesse M. Liebman
Vice President, Strategic Planning

Frank W. McAbee, Jr.
Senior Vice President, Environmental and Business Practices

Brian D. McMahon
President, European Transcontinental Operations, Carrier

William C. Missimer, Jr.
Group Vice President and President, Government Engine Business, Pratt & Whitney Group

Jean H. Mordo
Vice President, Finance and President, Latin American Operations, Otis

Daniel R. Nuzzo
President, Norden Systems

James G. O'Connor
Executive Vice President, Pratt & Whitney Group

William F. Paul
Senior Vice President, Washington Office

Nicholas T. Pinchuk
President, Asia Pacific Operations, Carrier

Lawrence R. Purtell
Secretary and Associate General Counsel

Ralph E. Reins
President, UT Automotive

John A. Rolls
Executive Vice President and Chief Financial Officer

George J. Sanford, Jr.
Vice President, Corporate Purchasing

Jonathan M. Schofield
President, United Technologies International Corporation

Vernon K. Stait
President, Pacific Area Operations, Otis

Terry D. Stinson
President, Hamilton Standard

Karl M. Thomas
Group Vice President, Operations, Pratt & Whitney Group

William H. Trachsel
Vice President and Deputy General Counsel

Jean-Pierre van Rooy
Executive Vice President and Chief Operating Officer, Otis

Arthur E. Wegner
Executive Vice President and President, Aerospace/Defense; President, Pratt & Whitney Group

William A. Wilson
Senior Vice President, Commercial/Industrial

Irving B. Yoskowitz
Executive Vice President and General Counsel

Shareowner Information

Corporate Office
United Technologies Building
Hartford, Connecticut 06101
Telephone (203) 728-7000

This annual report is sent to shareowners in advance of the proxy statement for the annual meeting to be held at 1 p.m., April 22, 1991, in Titusville, Florida. The proxy statement will be sent to holders of Common Stock on or about March 13, 1991, at which time proxies for the meeting will be requested.

Stock Listing
Common

New York, London, Paris, Frankfurt, Geneva, Lausanne, Basel, Zurich, Brussels and Amsterdam Stock Exchanges

Ticker Symbol
Common UTX

Transfer Agent
For the Common Stock:
First Chicago
Trust Company of New York
30 West Broadway
New York, New York 10007

Registrar
For the Common Stock:
First Chicago
Trust Company of New York
30 West Broadway
New York, New York 10007

The financial section of this report is printed on recycled paper.

Dividends
Dividends are usually declared the first month of each calendar quarter and are usually paid on the 10th day of March, June, September and December.

The dividend disbursing agent for the Common Stock is:
First Chicago
Trust Company of New York
Stock Transfer Department
30 West Broadway
New York, New York 10007
Dividend and Transfer inquiries:
(212) 791-6422

Consolidation of Accounts
Shareowners who receive multiple copies of the annual report and other financial documents because they have more than one UTC Common Stock account listing can help reduce the cost of printing and mailing these materials by having their accounts consolidated. Please advise:
First Chicago
Trust Company of New York
30 West Broadway
New York, New York 10007

Additional Information
Shareowners may obtain a copy of the 1990 United Technologies 10-K report filed with the Securities and Exchange Commission by writing to:
Lawrence R. Purtell, Secretary
United Technologies Corporation
United Technologies Building
Hartford, Connecticut 06101.

Shareowners may obtain a list of United Technologies' charitable contributions for 1990 by writing to the above address.

For additional information about United Technologies, please contact the Investor Relations Department at the above Corporate Office address.

APPENDIX H-1
CLOSURE PLAN FOR THE BURN-ZOL HAZARDOUS WASTE INCINERATOR

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203-2211

September 11, 1989

APPROVAL

Mr. John G. Whitehead, Plant Manager
UTC Pratt & Whitney Aircraft
400 Main Street
East Hartford, Connecticut 06108

RE: Approval of partial closure plan for incinerator at Pratt & Whitney Aircraft, East Hartford, Connecticut CTD 990672081

Dear Mr. Whitehead:

The partial closure plan dated May 2, 1988 as amended July 7, 1989 and August 17, 1989 that was prepared for Pratt & Whitney Aircraft, 400 Main Street, East Hartford, Connecticut has been reviewed by the Connecticut Department of Environmental Protection (DEP) and the U.S. Environmental Protection Agency (EPA) Region I.

The DEP and EPA have determined that these plans comply with the closure requirements pursuant to Section 22a-449(c)-29 of the regulations of Connecticut State Agencies and with Title 40 Part 265 Subparts G and O of the Code of Federal Regulations. Both agencies hereby approve the plan as submitted provided the following conditions are met:

1. Pratt and Whitney Aircraft shall contact DEP/EPA for review of the following closure plan events at least 14 days prior to their implementation:

   a. Prior to sampling for hazardous constituents.

2. The background decontamination standard must be the lowest value obtained of the two samples taken.

All work shall be subject to the review of the DEP and the EPA. They shall decide all questions as to interpretations of approved plans and specifications.

FACILITIES & SERVICES
RECEIVED
SEP 15 1989
R.C. WEISS

Mr. John C. Whitehead
UTC Pratt & Whitney Aircraft
Approval

September 11, 1989

The Regional Administrator of the EPA and the Commissioner of the DEP may authorize changes to the approved closure plan upon written request pursuant to 40 CFR 265.112(c).

This approval does not relieve the facility of the obligation to obtain any other authorization as may be required by other provisions of the Connecticut General Statues, Regulations of Connecticut State Agencies, Code of Federal Regulations, or Federal Statutes.

Sincerely,

Stephen W. Hitchcock, Director
Hazardous Material Management Unit
Connecticut Department of
Environmental Protection

Merrill S. Hohman, Director
Waste Management Division
Region I
U. S. Environmental
Protection Agency

UNITED TECHNOLOGIES PRATT&WHITNEY

400 Main Street
East Hartford, Connecticut 06108

August 17, 1989

Mr. George Dews
Senior Sanitary Engineer
Hazardous Waste Management Section
Department of Environmental Protection
165 Capitol Avenue
Hartford, CT 06106

Mr. Stephen Yee
Environmental Engineer
Waste Management Division
US EPA
90 Canal Street - 3rd Floor
Boston, MA 02114

Re: **Letter Addendum to the Burn-Zol Hazardous Waste Incinerator Closure Plan**
UTC - Pratt & Whitney East Hartford, CT
EPA ID # CT D990672081

Dear Sirs:

Pratt & Whitney is pleased to submit a letter addendum to the latest submittal of the Burn-Zol Hazardous Waste Closure Plan. This addendum was requested in a joint comment letter from EPA/DEP dated August 1, 1989. We have responded to each agency comment in sequence as presented below:

COMMENT 1

The proposed analytical parameter list for environmental sampling is presented as Table 2 in Section 11.0 of the closure plan. We believe that this list represents all of the Appendix VIII constituents potentially present in either the wax/solvent or the cyanide waste streams. It should be emphasized that these two waste streams were the only wastes incinerated during the final burns.

The parameter list was developed based on a review of waste stream analytical data (Appendix C of the closure plan), and the applicable process solutions that, upon disposal, constitute the subject waste streams. A discussion of each waste stream is presented below.

Wax/Solvent Mixture

The wax/solvent mixture waste stream is generated during the cleaning of machine parts in which selected areas are covered by a

film of wax. The wax is removed in a solvent dewaxing operation and the resulting wax/solvent mixture is periodically removed to a solvent reclamation area. Material that cannot be reclaimed is collected and stored as a hazardous waste at Pratt & Whitney's Concentrated Waste Treatment Plant (CWTP).

The two solvents utilized during the dewaxing operation are tetrachloroethylene and 1,1,1-trichloroethane. A review of available material safety data sheets (MSDSs) for these solvents and the wax resulted in identifying no Appendix VIII constituents beyond the analytical parameter proposed in the closure plan. Copies of the applicable MSDSs are presented as Attachment A.

Cyanide Solution

The cyanide solution waste stream is generated from spent process solutions relating to electroplating operations. Representative Pratt & Whitney process solutions have been identified and the applicable MSDSs for the solutions have been reviewed. Copies of these MSDSs are presented as Attachment B. No Appendix VIII constituents beyond the proposed analytical parameter list have been identified.

COMMENT 2

Analytical results from ceiling wipe sampling will function as the quantitative criteria for the determination that non-porous ceiling surfaces cleaned by hydroblasting are decontaminated properly. The approach, sample methodology and data evaluation are described in detail as follows:

Approach

As specified in Section 2.0 of the closure plan, hydroblasting of the ceiling will be the method employed to decontaminate the ceiling in the building formerly housing a portion of the incinerator train. Hydroblasting will proceed to the plastic sheeting barrier which separates the incinerator closure activities from the active wax/solvent storage area.

The ceiling area included during closure activities totals approximately 1100 square feet. An additional 550 square feet of ceiling area is present outside of the decontamination area. This area is considered separate from all closure activities and representative of ambient background conditions within the building.

A total of six discrete sample locations are proposed based on a systematic sampling grid presented as Attachment C. Four of the sample locations are present within the hydroblasting area. Analytical results for these samples will be used to evaluate the decontamination effort. Two sample locations are present outside of the hydroblasting area. Analytical results for these samples will represent background conditions removed from the hydroblasting; therefore, these results will function as the closure performance standard for non-porous surface decontamination.

Each sample will be analyzed for the compounds presented in Table 2 of Section 7.0 of the closure plan. Quality assurance/quality control measures proposed for wipe sampling activities will include the analysis of field blanks and trip blanks.

Sample Methodology

A matrix and constituent specific sample methodology has been developed for ceiling wipe sampling activities. This methodology has been formulated following the review of existing wipe sampling methodologies and the proposed analytical parameter list in the closure plan.

A total of three 100 cm^2 areas will be included at each sample location. The three areas have been segregated based on the analytical parameter list for volatile organic compounds, cyanide and metal compounds. The areas to be included during sample collection will be defined by a 100 cm^2 template. Magnets will be used to secure the template to the ceiling surface.

The wipe medium will consist of 0.8 micron glass fiber filters supplied by the laboratory. Clean, laboratory supplied, disposable latex gloves will be used at each sample location. The wipe extraction solvent will be unique for each template at a given sample location. A description of the sequence of sampling is presented below.

- The wipe area designated for volatile organic compounds will be sampled first. The 100 cm^2 template will be positioned over this area and a total of three wipes will be conducted. Two of the wipes will utilize an extraction solvent and the third wipe will be dry. The extraction solvent will be laboratory supplied methanol furnished in a wide mouth glass jar. Wipe #1 will be dipped into the methanol using a dedicated pair of stainless steel tweezers. The area within

the template is wiped and the wipe is immediately placed into a wide mouthed sample jar with a teflon lined cap. The cap will be temporarily secured to the sample jar to limit exposure to the atmosphere. Wipe #2 will be performed exactly as the first. Wipe #3 is used dry to absorb any methanol left within the template sample area. This final wipe will also be immediately transferred to the same jar as wipes #1 & #2.

The wipe area designated for cyanide will be sampled second. A new template will be positioned adjacent to the volatile organic compound sample area. The procedure for cyanide sampling is the same as for volatile organic compounds; however, the extraction solvent during wet wipe sampling will consist of a caustic solution comprised of 3.0 milliliters of 20% caustic solution to two liters of laboratory supplied distilled water.

The wipe area designated for metals will be sampled last. A new template will be positioned adjacent to the cyanide and volatile organic compound areas. The procedure for metals sampling is the same as for volatile organic compounds; however, the extraction solvent used during wet wipe sampling will consist of an acidic solution comprised of 8.0 milliliters of 1-1 nitric acid to 2 liters of laboratory supplied distilled water. In addition, plastic tweezers will be used to dip the wipe into the extraction solvent.

The field quality assurance/quality control program will consist of a field blank and a trip blank. The field blank will be collected in the same manner as field samples; however, the wipes will simply be exposed to the atmosphere and immediately transferred to the sample jars. The trip blank will consist of laboratory supplied dionized water in a 40 milliliter glass vial with a teflon lined cap. This sample will accompany the sample jars to and from the laboratory.

Immediately following sample collection, each sample will be labelled and placed in an iced cooler. The samples will be transported under full chain-of-custody to a State of Connecticut approved laboratory.

Data Evaluation

Analytical results for wipe samples will be reported as the mass of constituent tested per unit sample area (100 cm^2). The internal laboratory QA/QC program will consist of customary laboratory precision controls and matrix spike sample analysis. The matrix spike sample will consist of one wipe sample set in which each wipe fraction is spiked with a known concentration of a specified contaminant. The sample will then be analyzed to determine the percent recovery of the known contaminant.

Initially, sample data will be evaluated through data validation procedures. Data points that are not supported by the QA/QC procedures will be referred to the sampling team and/or laboratory for appropriate corrective actions.

Upon completion of data validation, the results will be compared to background data points and to the established laboratory method detection limits. Decontamination of the ceiling will be deemed complete if analytical results in the hydroblasting area fall below the method detection limits (non-detectable). If any parameter is quantified above the method detection limit but below the background sample concentration for that parameter then decontamination is deemed complete. If any parameter is quantified above the method detection limit and above the background sample concentration for that parameter then decontamination is deemed incomplete and must continue until subsequent sampling results meet the background sample concentrations.

COMMENT 3

Concrete chip sampling procedures are referenced in Section 10.0 of the closure plan (page 13). The fifth paragraph, fourth sentence of this section will be changed to read "A chisel will be used to dislodge the concrete chips".

COMMENT 4

This observation is correct. The word "equipment" will be added to the 3rd paragraph, 4th sentence of Section 3.0.

COMMENT 5

Review of available manufacturer's specifications indicates the casing construction of the incinerator combustion chamber is double walled with an inner steel wall and an outer stainless steel wall. The interstitial space between the two walls totals approximately three inches. This air space is isolated to form a forced air distribution jacket for external skin cooling.

COMMENT 6

As stated in Section 7.0 of the closure plan, all rinsates generated during incinerator closure activities will be collected and treated as a hazardous waste at Pratt & Whitney's Concentrated Waste Treatment Plant. An expanded discussion of our proposed rinsate handling is presented below.

All rinsate generated during incinerator closure activities will be collected in portable hazardous waste storage containers provided by the CWTP. Accumulated liquids will then be transferred to stationary storage containers currently operated by the CWTP. The rinsates from the cyanide waste feed line decontamination and hydroblasting operations will be stored together. The accumulated liquid will ultimately be vendored off to a RCRA permitted facility for final treatment. The rinsate generated from the blended oil waste feed line decontamination will be stored separately. This liquid will ultimately be vendored off to a RCRA permitted facility for final disposal (incineration).

The CWTP will only function as the interim storage facility prior to vendor disposal. No rinsates will be disposed of at the CWTP. In addition, no rinsates will be discharged under the CWTP's NPDES permit.

COMMENT 7

Yes, a secure landfill disposal facility refers to a RCRA permitted disposal facility.

COMMENT 8

The current layout of incinerator train components is depicted in the closure plan as Appendix B, Figure 3. The components can be segregated into three distinct areas of which two areas are outside of the building. For incinerator train components inside the building, a safe perimeter will be established at the building entrance. For incinerator train components outside of the building, the safe perimeter will be a minimum of fifteen feet on all sides of the equipment. This perimeter will be marked using plastic barricade tape.

The final Site Health and Safety Plan will address this issue and provisions will be incorporated to account for incinerator train components located outside of the building.

We are eager to begin closure activities promptly upon final closure plan approval. In anticipation of this approval, we are currently identifying the qualified contractors necessary to perform these specialized closure activities.

If you have any questions or comments regarding the enclosed, please contact Scott Singer at (203) 565-2016.

Sincerely,

John G. Whitehead
Plant Manager

SLS/JGW/bab

s-s3o

BURN-ZOL LETTER ADDENDUM

ATTACHMENTS

August 17, 1989

Material Safety Data Sheet

MSD 8208.22

rev. 11/85

DETREX CORPORATION P.O. Box 511, Southfield, MI 48086-511

RECEIVED JAN 07 1988 INDUSTRIAL HYGIENE

9015

Approved by U.S. Dept. of Labor as "Essentially similar" to Form OSHA-20

Date: November, 1985	Edition: Second
Chemical Name and Synonyms: Perchloroethylene; tetrachloroethylene CAS No.: 127-18-4	Trade Name and Synonyms: DETREX PERK GOLD SHIELD PERK Perchlor, Perchloroethylene
Chemical Family: Halogenated Hydrocarbons	Formula: $CCl_2=CCl_2$
DOT Shipping Name: Tetrachloroethylene	DOT Hazard Class: ORM-A UN1897

SECTION 1 · PHYSICAL DATA

Boiling Point @ 760 mm Hg: 121°C 250°F	Vapor Density (Air=1): 5.83	Specific Gravity (H_2O=1): 1.6 @ 20/20°C	pH of Solutions: 6.8 to 8.4
Freezing/Melting Point: -22.3°C -8.2F	Solubility (Weight % in Water): 0.015% @ 25°C	Bulk Density: 13.6 lbs./gal. @ 20°C	Volume % Volatile: 100
Vapor Pressure: 14.2mmHg @ 20°C	Evaporation Rate (ethyl ether-1):0.09	Heat of Solution: Not Applicable	Appearance and Odor: Clear, colorless liquid with ether-like odor.

SECTION 2 · HAZARDOUS INGREDIENTS

	%	Hazard Data
Perchloroethylene (Stabilized)	100	See Section 4 & 5

SECTION 3 · FIRE AND EXPLOSION HAZARD DATA

Flash Point °F (Method Used) None when tested in accordance with DOT requirements	Flammable Limits in Air (% by Volume) LEL: none UEL: none	Extinguishing Media: For fires involving perchloroethylene, use water, dry chemical or carbon dioxide.

Special Fire Fighting Procedures: Fire fighters should wear NIOSH/MSHA-approved pressure-demand self-contained breathing apparatus for possible exposure to hydrogen chloride and possible traces of phosgene.

Unusual Fire and Explosion Hazards: Perchloroethylene involved in fires can decompose to hydrogen chloride and possible traces of phosgene.

SECTION 4 · HEALTH HAZARD DATA

Toxicity Data See Reference 1	Classification (Poison, Irritant, Etc.)
LC_{50} Inhalation (rat) 4,000 ppm (4 hours)	Inhalation: Moderately Toxic
LD_{50} Dermal Not Determined	Skin Not Determined
Skin/Eye Irritation See Section 5	Skin/Eye: Mildly irritating to skin; eye irritant
LD_{50} Ingestion (rabbit) 5000 mg/kg	Ingestion: Slightly Toxic
Fish, LC_{50} (Lethal Concentration) 96hr. TLM 100-10 ppm	Aquatic: Toxic

Human Exposure Information/Data: Unconfirmed data' exists which indicate that perchloroethylene by ingestion may be more toxic to humans than indicated by the available data. Such unconfirmed data report poisonings at doses as low as 500 mg/kg.

24-HOUR EMERGENCY ASSISTANCE: (313) 358-5800

PML 9015 [redacted]

SECTION 5 · EFFECTS OF OVEREXPOSURE

This section covers effects of overexposure for inhalation, eye/skin contact, ingestion and other types of overexposure information in the order of the most hazardous and the most likely route of overexposure.

Permissible Exposure Limits The individual permissible exposure limits are as follows:

OSHA: 100 ppm, 8-hour TWA (time-weighted average); 100-200 ppm periodic excursions are allowed providing 8-hour TWA is at or below 100 ppm; 200-300 ppm excursions allowed only for maximum of 5 minutes in any 3-hour period; 300 ppm maximum allowable concentration (must not be exceeded); 29CFR 1910.1000.

ACGIH: 50 ppm, 8-hour TWA (time-weighted average); 200 ppm, STEL (15-minute short-term exposure limit)

ACUTE

Inhalation: Perchloroethylene is primarily a central nervous system depressant and can cause possible central nervous system damage with overexposure. Inhalation can cause irritation of the respiratory tract, dizziness, nausea, headache, loss of coordination and equilibrium, unconsciousness and even death in confined or poorly ventilated area. Fatalities following severe acute exposure to various chlorinated solvents have been attributed to ventricular fibrillation.

Eye/Skin: Liquid splashed in the eye can result in discomfort, pain and irritation. Prolonged or repeated contact with liquid on the skin can cause irritation and dermatitis. The problem may be accentuated by liquid becoming trapped against the skin by contaminated clothing and shoes, and skin absorption can occur.

Ingestion: Swallowing of this material may result in irritation of the mouth and GI tract along with other effects as listed above for Inhalation. Vomiting and subsequent aspiration into the lungs may lead to chemical pneumonia and pulmonary edema which is a potentially fatal condition.

CHRONIC

Prolonged exposure above the OSHA permissible exposure limits may result in liver and kidney damage. Perchloroethylene has been extensively studied for its cancer potential. There is no documented evidence to suggest that perchloroethylene causes an increased cancer incidence in humans, nor does available information from animal studies suggest that this material poses a carcinogenic risk to humans under conditions adhering to recommended occupational guidelines.

PMC 901

EMERGENCY AND FIRST AID PROCEDURES:

Inhalation: Remove to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Call a physician.

Eye or Skin Contact: Flush eyes and skin with plenty of water (soap and water for skin) for at least 15 minutes, while removing contaminated clothing and shoes. If irritation occurs, consult a physician. Thoroughly clean contaminated clothing and shoes before reuse or discard.

Ingestion: If conscious, drink large quantities of water. DO NOT induce vomiting. Take immediately to a hospital or physician. If unconscious, or in convulsions, take immediately to a hospital. DO NOT attempt to give anything by mouth to an unconscious person.

Notes to Physician (Including Antidotes): NEVER administer adrenalin following perchloroethyle overexposure. Increased sensitivity of the heart to adrenalin may be caused by over-exposure to perchloroethylene.

SECTION 6 · REACTIVITY DATA

Stability: Stable	**Conditions to Avoid:** Avoid open flames, hot glowing surfaces or electric arcs.
Hazardous Polymerization: Will not occur	**Conditions to Avoid:** None

Incompatibility (Materials to Avoid): Avoid contamination with caustic soda, caustic potash or oxidizing materials. Shock sensitive explosives may be formed.

Hazardous Decomposition Products: Hydrogen chloride and possibly traces of phosgene.

SECTION 7 · SPILL OR LEAK PROCEDURES

Steps to be Taken if Material is Spilled or Released: Immediately evacuate the area and provide maximum ventilation. Unprotected personnel should move upwind of spill. Only personnel equipped with proper respiratory and skin/eye protection (See Section 8) should be permitted in area. Dike area to contain spill. Take precautions as necessary to prevent contamination of ground and surface waters. Recover spilled material on adsorbents, such as sawdust or vermiculite, and sweep into closed containers for disposal. After all visible traces, including ignitable vapors, have been removed, thoroughly wet vacuum the area. DO NOT flush to sewer. If area of spill is porous, remove as much earth and gravel, etc. as necessary and place in closed containers for disposal.

Waste Disposal Method: Contaminated sawdust, vermiculite or porous surface must be disposed of in a permitted hazardous waste management facility. Recovered liquids may be reprocessed or incinerated or must be treated in a permitted hazardous waste management facility. Care must be taken when using or disposing of chemical materials and/or their containers in accordance with the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act as well as any other relevant federal, state, or local laws/regulations regarding disposal.

RCRA - Hazardous Waste Number - U-210

PMC 9615

SECTION 8 · SPECIAL PROTECTION INFORMATION

Respiratory Protection: Use a half or full facepiece organic vapor chemical cartridge or canister respirator when concentrations exceed permissible limits. Use self-contained breathing apparatus (SCBA) or full facepiece airline respirator with auxiliary SCBA operated in the pressure-demand mode for emergencies and for all work performed in storage vessels, poorly ventilated rooms, and other confined areas. Respirators must be approved by NIOSH or MSHA. The respirator use limitations made by NIOSH/MSHS[6,7] and by the manufacturer must be observed. Respiratory protection programs must be observed. Respiratory protection programs must be in accordance with 29CFR 1910.134.

Ventilation (Type): Use local exhaust or dilution ventilation as appropriate to control exposures to below permissible limits.

Eye Protection: Splashproof goggles

Gloves: Viton , Polyvinyl alcohol*.
For limited service only: Nitrile.
(*degrades in water)

Other Protective Equipment: Boots, aprons, or chemical suits should be used when necessary to prevent skin contact. Personnel protective clothing and use of equipment must be in accordance with 29CFR 1910.133 and 29CFR 1910.132.

SECTION 9 · SPECIAL PRECAUTIONS

Precautions to be Taken During Handling and Storing:

- Do not use in poorly ventilated or confined spaces without proper respiratory protection (See Section 8).
- Perchloroethylene vapors are heavier than air and will collect in low areas.
- Keep container closed when not in use.
- Store only in closed, properly labeled containers.
- This material or its vapors when in contact with flames, hot glowing surfaces or electric arcs can decompose to form hydrogen chloride gas and traces of phosgene.
- AVOID CONTAMINATION OF WATER SUPPLIES. Handling, storage and use procedures must be carefully monitored to avoid spills or leaks. Any spill or leak has the potential to cause underground water contamination which may, if sufficiently severe, render a drinking water source unfit for human consumption. Contamination that does occur cannot be easily corrected.
- A chlorinated solvent used as a flashpoint suppressant must be added in sufficient quantity or the resultant mixture may have a flashpoint lower than the flammable component.
- Do not use cutting or welding torches on drums that contained perchloroethylene unless properly purged and cleaned.

Other Precautions:

- Do not breathe vapors. High vapor concentrations can cause dizziness, unconsciousness, possible central nervous system damage or death. Long-term overexposure may cause liver/kidney injury.
- Use only with adequate ventilation. Ventilation must be sufficient to limit employee exposure to perchloroethylene below permissible exposure limits. Observance of lower limits (outlined in Section 5) is advisable.
- Avoid contact with eyes. Will cause irritation and pain
- Avoid prolonged or repeated contact with skin. May cause irritation or dermatitis.
- Do not swallow. Swallowing may cause injury or death.
- Do not eat, drink, or smoke in work areas.

References:

1. NIOSH registry of Toxic Effects of Chemical Substances, 1978
2. Industrial Hygiene and Toxicology, Volume II, Second Edition, F. A. Patty, 1963
3. Dangerous Properties of Industrial Materials, Fifth Edition, N. I. Sax, 1979
4. EPA Science Advisory Board, Subcommittee on Airborne Carcinogens, September, 1980
5. Encyclopedia of Chemical Technology, Volume 5, Third Edition, Kirk-Othmer, 1979
6. NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards, DHHS (NIOSH) Publication No. 81-123, January, 1981
7. NIOSH/OSHA Pocket Guide to Chemical Hazards, DHEW (NIOSH) Publication No. 78-210 September, 1978

Comments: As this solvent (perchloroethylene) is used to clean and/or degrease a wide variety of metal and plastic parts, it should always be used in conjunction with properly designed and fully controlled solvent vapor degreasing equipment that is in compliance with the U. S. Environmental Protection Agency, OAQPS Guidelines, "Control of Volatile Organic Emissions from Solvent Metal Cleaning", and/or any other applicable federal, state or local regulatory guidelines.

Perchloroethylene is also used extensively in the commercial drycleaning of clothes. It should always be used in conjunction with properly designed and fully controlled equipment that is in compliance with all applicable federal, state and local regulatory guidelines.

DETREX AUTHORIZED SIGNATURE James R. Goodrich

UTCIHL 8 Pmc 9015

Material Safety Data Sheet

MSD 8208.22

RECEIVED BY
JUL 18 1983
G. E. PARSONS

DETREX CHEMICAL INDUSTRIES, INC.
P.O. BOX 501,
DETROIT, MICHIGAN 48232

Approved by U.S. Dept. of Labor as "Essentially similar" to Form OSHA-20

Date: August, 1982	Edition: First
Chemical Name and Synonyms: Perchloroethylene; tetrachloroethylene CAS No.: 127-18-4	Trade Name and Synonyms: DETREX PERK, Perchlor, Perchloroethylene
Chemical Family: Halogenated Hydrocarbons	Formula: $CCl_2=CCl_2$
DOT Shipping Name: Tetrachloroethylene	DOT Hazard Class: ORM-A-UN1897

SECTION 1 · PHYSICAL DATA

Boiling Point @ 760 mm Hg:	Vapor Density (Air=1):	Specific Gravity (H_2O=1):	pH of Solutions:
250°F 121°C	5.83	(20°/20°C) 1.6	6.8 to 8.4
Freezing/Melting Point:	**Solubility (Weight % in Water):**	**Bulk Density:**	**Volume % Volatile:**
-8.2°F -22.3°C	@25°C 0.015%	13.6 lbs./gal. @ 20°C	Essentially 100
Vapor Pressure:	**Evaporation Rate**	**Heat of Solution:**	**Appearance and Odor:**
@ 20°C = 14.2mmHg	(ethyl ether=1): 0.09	Not Applicable	Clear, colorless liquid with ether-like odor.

SECTION 2 · HAZARDOUS INGREDIENTS

	%	Hazard Data
Perchloroethylene (Stabilized)	100	See Sections 4 & 5

SECTION 3 · FIRE AND EXPLOSION HAZARD DATA

Flash Point °F (Method Used)	Flammable Limits in Air (% by Volume)	Extinguishing Media:
None	None LEL: UEL:	For fires involving perchloroethylene, use water, dry chemical or carbon dioxide.

Special Fire Fighting Procedures: Fire fighters should wear pressure-demand self-contained breathing apparatus for possible exposure to hydrogen chloride and possible traces of phosgene.

Unusual Fire and Explosion Hazards: Perchloroethylene involved in fires can decompose to hydrogen chloride and possible traces of phosgene. See Detrex warning letter Form SoL 8208.21 attached.

SECTION 4 · HEALTH HAZARD DATA

Permissible Exposure Limits (TLV): See Section 5

Toxicity Data Ref. (1)	Classification (Poison, Irritant, Etc.)
LC_{Lo} Inhalation (rat) 4,000 ppm (4 hours)	Inhalation: Moderately Toxic
LD_{50} Dermal	Skin/Eye: Liquid mildly irritating to skin; eye irritant
LD_{50} Ingestion (rabbit) - 5,000 mg/kg	Ingestion: Slightly Toxic
Fish, LC_{50} (Lethal Concentration) 96hr. TLM 100-10 ppm	Aquatic: Toxic

Human Exposure Information/Data: Unconfirmed data' exists which indicate that perchloroethylene by ingestion may be more toxic to humans than indicated by the available data. Such unconfirmed data report poisonings at doses as low as 500 mg/kg.

24-HOUR EMERGENCY ASSISTANCE: (313) 358-5800

PMC 9015

Section 4 (Cont'd)- Permissible Exposure Limits

Current OSHA permissible exposure limits (29CFR 1910.1000) are 100 ppm (8-hour TWA); 200-200 ppm periodic excursions are allowed providing 8-hour TWA is at or below 100 ppm; 200-300 ppm excursions allowed only for maximum of 5 minutes in any 3-hour period; 300 ppm maximum allowable concentration (must not be exceeded).

SECTION 5 · EFFECTS OF OVEREXPOSURE

This section covers effects of overexposure for inhalation, eye/skin contact, ingestion and other types of overexposure information in the order of the most hazardous and the most likely route of overexposure.

Acute: Primarily a central nervous system depressant. Inhalation can cause irritation of the respiratory tract, dizziness, nausea, headache, loss of coordination and equilibrium, unconsciousness and if exposed to high concentrations in confined or poorly ventilated areas, even death.

Liquid splashed in the eye can result in discomfort, pain and irritation. Prolonged or repeated contact with liquid on the skin can cause irritation and dermatitis. The problem may be accentuated by liquid becoming trapped against the skin by contaminated clothing and shoes. Skin absorption can occur.

Chronic: Prolonged exposure above the OSHA permissible exposure limits may result in liver and kidney damage. Perchloroethylene has been extensively studied for cancer both in the U.S. and Europe by government, industry and academia. There is no documented evidence that perchloroethylene causes an increased cancer incidence in humans

EMERGENCY AND FIRST AID PROCEDURES: PMC 9015

Inhalation: Remove to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Call a physician.

Eye or Skin Contact: Flush eyes and skin with plenty of water (soap and water for skin) for at least 15 minutes, while removing contaminated clothing and shoes. If irritation occurs, consult a physician.

Ingestion: If conscious, drink a quart of water. DO NOT induce vomiting. Take immediately to a hospital or physician. If unconscious, or in convulstions, take immediately to a hospital or physician. DO NOT give anything by mouth to an unconscious person.

Notes to Physician (Including Antidotes): NEVER administer adrenalin following perchloroethylene overexposure. Increased sensitivity of the heart to adrenalin may be caused by over-exposure to perchloroethylene.

SECTION 6 - REACTIVITY DATA

Stability: Stable	**Conditions to Avoid:** Avoid open flames, hot glowing surfaces or electric arc.
Hazardous Polymerization: Will not occur	**Conditions to Avoid:** None

Incompatibility (Materials to Avoid): Avoid contamination with caustic soda, caustic potash or oxidizing materials. Shock sensitive explosives may be formed. Also see Detrex warning letter Form SoL 8208.21 attached.

Hazardous Decomposition Products: Hydrogen chloride and possibly traces of phosgene.

SECTION 7 - SPILL OR LEAK PROCEDURES (See Detrex Forms SoL 8208.14 and SoL 8208.15 attached)

Steps to be Taken If Material is Spilled or Released: Immediately evacuate the area and provide maximum ventilation. Unprotected personnel should move upwind of spill. Only personnel equipped with proper repiratory and skin/eye protection should be permitted in area. Dike area to contain spill. Take precautions as necessary to prevent contamination of ground and surface waters. Recover or absorb spilled material on sawdust or vermiculite and sweep into closed containers for disposal. After all visible traces have been removed, thoroughly wet vacuum the area. DO NOT flush to sewer. If area of spill is porous, remove as much contaminated earth and gravel, etc., as necessary and place in closed containers for disposal. (See Below)

Waste Disposal Method:

Contaminated sawdust, vermiculite or porous surface must be disposed of in a permitted hazardous waste management facility. Recovered liquids may be reprocessed or incinerated or must be treated in a permitted hazardous waste management facility. Care must be taken when using or disposing of chemical materials and/or their containers to prevent environmental contamination. It is your duty to dispose of the chemical materials and/or their containers in accordance with the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act and all relevant state or local laws/regulations regarding disposal.

PMC 9015

SECTION 8 · SPECIAL PROTECTION INFORMATION

Respiratory Protection: For emergencies or working in confined areas, wear self-contained breathing apparatus or supplied air respiratory protection (use the "buddy system" and r a safety harness with a lifeline). In other circumstances involving potential overexposures, use NIOSH/MSHA-approved organic vapor respirator. (Observe limitations directed by manufacturer.) Respiratory protection program must be in accordance with 29CFR 1910.134.

Ventilation (Type): Mechanical (General) - Sufficient to maintain workplace concentration below permissible exposure limits.

Eye Protection: Splashproof goggles

Gloves: Polyethylene, neoprene or polyvinyl

Other Protective Equipment: Safety shower and eye-wash fountain in immediate area. Personnel protective clothing and use of equipment must be in accordance with 29CFR 1910.133 and 29CFR 1910.132.

SECTION 9 · SPECIAL PRECAUTIONS

Precautions to be Taken During Handling and Storing:

- Do not use in poorly ventilated or confined spaces.
- Perchloroethylene vapors are heavier than air and will collect in low areas.
- Keep container closed when not in use.
- Do not store in open, unlabeled or mislabeled containers.
- Liquid oxygen or other strong oxidants may form explosive mixtures with perchloroethylene.
- This material or its vapors when in contact with flames, hot glowing surfaces or electric arcs can decompose to form hydrogen chloride gas and traces of phosgene.
- AVOID CONTAMINATION OF WATER SUPPLIES: Handling, storage and use procedures must be carefully monitored to avoid spills or leaks. Any spill or leak has the potential to cause underground water contamination which may, if sufficiently severe, render a drinking water source unfit for human consumption. Contamination that does occur cannot be easily corrected.

Other Precautions:

- VOID PROLONGED OR REPEATED BREATHING OF VAPORS. High vapor concentrations can cause dizziness, unconsciousness or death. Long-term overexposure may cause liver/kidney injury.
- USE ONLY WITH ADEQUATE VENTILATION. Ventilation must be sufficient to limit exployee exposure to perchloroethylene below OSHA permissible exposure limit (8-hour TWA - 100 ppm; ceiling 200 ppm; maximum peak 300 ppm, 5 minutes in any 3 hours). Observance of lower limits (outlined in Section 4) is advisable.
- AVOID CONTACT WITH EYES. Will cause irritation and pain.
- AVOID PROLONGED OR REPEATED CONTACT WITH SKIN. May cause irritation or dermatitis.
- DO NOT TAKE INTERNALLY. Swallowing may cause injury or death.
- DO NOT EAT, DRINK OR SMOKE IN WORK AREAS.

References:

1. NIOSH Registry of Toxic Effectos of Chemical Substances. 1978
2. Industrial Hygiene and Toxicology, Volume II, Second Edition, F.A. Patty, 1963
3. Dangerous Properties of Industrial Materials, Fifth Edition, N. I. Sax, 1979
4. Federal Register, 45FR Hazardous Waste Management Systems Part III, Identification and Listing of Hazardous Wastes, Page 33084, May 19, 1980
5. EPA Science Advisory Board, Subcommittee on Airborne Carcinogens, September, 1980

Comments: As this solvent (perchloroethylene) is used to clean and/or degrease a wide variety of metal and plastic parts, it should always be used in conjunction with properly designed and fully controlled solvent vapor degreasing equipment that is in compliance with the U. S. Environmental Protection Agency, OAQPS Guidelines, "Control of Volatile Organic Emissions from Solvent Metal Cleaning", and/or any other applicable federal, state or local regulatory guidelines.

Perchloroethylene is also used extensively in the commercial drycleaning clothes. It should always be used in conjunction with properly designed and fully controlled equipment that is in compliance with all applicable federal, state and local regulatory guidelines.

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G. E. PARSONS

MATERIAL SAFETY DATA SHEET PAGE: 1

DOW CHEMICAL.U.S.A. MIDLAND MICHIGAN 48640 EMERGENCY PHONE: 517-636-4400

EFFECTIVE DATE: 12 FEB 80 PRODUCT CODE: 59010

PRODUCT NAME: PERCHLOROETHYLENE SVG MSD: 0475

INGREDIENTS (TYPICAL VALUES-NOT SPECIFICATIONS)	%
PERCHLOROETHYLENE	55

SECTION 1 PHYSICAL DATA

BOILING POINT: 250F (121C) : SOL. IN WATER: 0.0150/100G 25C
VAP PRESS: 13 MMHG @ 20C : SP. GRAVITY: 1.612-1.619 @ 25/25C
VAP DENSITY (AIR=1): 5.76 : % VOLATILE BY VOL: 100 (ESSENTIALLY)
APPEARANCE AND ODOR: COLORLESS LIQUID.

SECTION 2 FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: NONE : FLAMMABLE LIMITS (STP IN AIR)
METHOD USED: TOC, TCC, COC : LFL: NONE UFL: NONE
EXTINGUISHING MEDIA: NON-FLAMMABLE MATERIAL.
SPECIAL FIRE FIGHTING EQUIPMENT AND HAZARDS: PRESSURE DEMAND SELF-CONTAINED RESPIRATORY EQUIPMENT.

SECTION 3 REACTIVITY DATA

STABILITY: AVOID OPEN FLAMES, WELDING ARCS, OR OTHER HIGH TEMPERATURE SOURCES WHICH INDUCE THERMAL DECOMPOSITION.
INCOMPATIBILITY: ----
HAZARDOUS DECOMPOSITION PRODUCTS: INVOLVEMENT IN FIRE FORMS HYDROGEN CHLORIDE AND SMALL AMOUNTS OF PHOSGENE AND CHLORINE.
HAZARDOUS POLYMERIZATION: WILL NOT OCCUR.

SECTION 4 SPILL, LEAK, AND DISPOSAL PROCEDURES

ACTION TO TAKE FOR SPILLS (USE APPROPRIATE SAFETY EQUIPMENT): 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: SEND SOLVENT TO RECLAIMER. IN SOME CASES, SMALL AMOUNTS MAY BE TRANSPORTED TO AN AREA WHERE IT CAN BE PLACED ON THE GROUND AND ALLOWED TO EVAPORATE SAFELY IF LOCAL, STATE AND FEDERAL REGULATIONS PERMIT.

(CONTINUED ON PAGE 2)
(R) INDICATES A REGISTERED OR TRADEMARK NAME OF THE DOW CHEMICAL COMPANY

DOW CHEMICAL U.S.A. MIDLAND MICHIGAN 48640 EMERGENCY PHONE: 517-636-4400

EFFECTIVE DATE: 12 FEB 80 PRODUCT CODE: 59010
PRODUCT (CONT'D): PERCHLOROETHYLENE SVG MSD: 0475

SECTION 5 HEALTH HAZARD DATA

INGESTION: LOW IN SINGLE DOSE ORAL TOXICITY. LD50 (RAT) GREATER THAN 5000; (MOUSE) IN RANGE OF 8000 TO 11000 MG/KG.
EYE CONTACT: PAIN AND IRRITATION, BUT NO CORNEAL INJURY SHOULD OCCUR.
SKIN CONTACT: SHORT CONTACT - NO IRRITATION. PROLONGED OR FREQUENTLY REPEATED CONTACT - MODERATE IRRITATION AND DRYING. IF CONFINED TO SKIN - PAIN AND IRRITATION, EVEN A BURN.
SKIN ABSORPTION: LOW TOXICITY. LD50 (RABBIT) GREATER THAN 10 G/KG.
INHALATION: ACGIH TLV AND OSHA GUIDE IS 100 PPM.
EFFECTS OF OVEREXPOSURE: POSSIBLE ORGANIC INJURY FROM PROLONGED OR REPEATED EXPOSURES; IRRITATION, CENTRAL NERVOUS SYSTEM DEPRESSION. CAN CAUSE DEATH IF TOO MUCH IS BREATHED.

SECTION 6 FIRST AID--NOTE TO PHYSICIAN

FIRST AID PROCEDURES:

EYES: IRRIGATION OF THE EYES IMMEDIATELY WITH WATER FOR FIVE MINUTES IS GOOD SAFETY PRACTICE.
SKIN: WASH OFF IN FLOWING WATER OR SHOWER 15 MINUTES. CONSULT MEDICAL. THOROUGHLY AIR DRY OR WASH GROSSLY CONTAMINATED CLOTHES BEFORE REUSE.
INHALATION: REMOVE TO FRESH AIR IF EFFECTS OCCUR. IF RESPIRATION STOPS, GIVE MOUTH-TO-MOUTH RESUSCITATION. CALL PHYSICIAN AND/OR TRANSPORT TO MEDICAL FACILITY.
INGESTION: DO NOT INDUCE VOMITING. CALL A PHYSICIAN OR TRANSPORT TO EMERGENCY FACILITY.

NOTE TO PHYSICIAN:
EYES: MAY PRODUCE CONJUNCTIVITIS. STAIN FOR EVIDENCE OF CORNEAL ABRASION OR INJURY.
SKIN: CHRONIC EXPOSURE MAY PRODUCE DEFATTING TYPE OF DERMATITIS. TREAT AS ANY CONTACT DERMATITIS; INHIBITOR IS KNOWN OR SUSPECTED SKIN SENSITIZER.
RESPIRATORY: MODERATE IRRITANT. BRONCHODILATORS, EXPECTORANTS AND ANTITUSSIVES MAY BE OF HELP. OXYGEN MAY BE HELPFUL. MECHANICAL SUPPORT OF RESPIRATION MAY BE NEEDED.
ORAL: MAY CAUSE CHEMICAL PNEUMONITIS IF ASPIRATED INTO LUNGS. PRODUCT LOW IN TOXICITY. DANGER OF CHEMICAL PNEUMONIA MUST BE WEIGHED AGAINST TOXICITY. IF LAVAGE IS PERFORMED, SUGGEST ENDO-TRACHEAL AND/OR ESOPHAGOSCOPIC CONTROL.
SYSTEMIC: ANESTHETIC OR NARCOTIC EFFECT MAY OCCUR. MAY INCREASE MYOCARDIAL IRRITABILITY. AVOID EPINEPHRINE OR SIMILAR ACTING DRUGS IF AT ALL POSSIBLE. MAY CAUSE NAUSEA OR VOMITING. ALCOHOL CONSUMED BEFORE OR AFTER EXPOSURE MAY INCREASE INJURY. NO SPECIFIC ANTIDOTE. LIVER AND KIDNEY CHANGES SHOWN IN ANIMAL STUDIES. OTHER STUDIES SUGGEST IT MAY BE CARCINOGENIC AND EMBRYOTOXIC IN ANIMALS. CONSULT STANDARD LITERATURE.

(CONTINUED ON PAGE 3)
(R) INDICATES A REGISTERED OR TRADEMARK NAME OF THE DOW CHEMICAL COMPANY

DOW CHEMICAL U.S.A. MIDLAND MICHIGAN 48640 EMERGENCY PHONE: 517-636-4400

EFFECTIVE DATE: 12 FEB 80 PRODUCT CODE: 59010
PRODUCT (CONT'D): PERCHLOROETHYLENE SVG MSD: 0475

SECTION 7 SPECIAL HANDLING INFORMATION

VENTILATION: RECOMMEND CONTROL OF VAPORS TO SUGGESTED GUIDE. GOOD ROOM VENTILATION USUALLY ADEQUATE FOR MOST OPERATIONS.
RESPIRATORY PROTECTION: APPROVED RESPIRATORY PROTECTION REQUIRED IN ABSENCE OF PROPER ENVIRONMENTAL CONTROL. FOR EMERGENCIES, A SELF-CONTAINED BREATHING APPARATUS OR A FULL-FACE RESPIRATOR IS RECOMMENDED.
PROTECTIVE CLOTHING: NONE REQUIRED.
EYE PROTECTION: SAFETY GLASSES WITHOUT SIDE SHIELDS.

SECTION 8 SPECIAL PRECAUTIONS AND ADDITIONAL INFORMATION

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: HANDLE WITH REASONABLE CARE AND CAUTION. AVOID BREATHING VAPORS. VAPORS OF THIS PRODUCT ARE HEAVIER THAN AIR AND WILL COLLECT IN LOW AREAS SUCH AS PITS, DEGREASERS, STORAGE TANKS, AND OTHER CONFINED AREAS. DO NOT ENTER THESE AREAS WHERE VAPORS OF THIS PRODUCT ARE SUSPECTED UNLESS SPECIAL BREATHING APPARATUS IS USED AND AN OBSERVER IS PRESENT FOR ASSISTANCE.
ADDITIONAL INFORMATION: REVISIONS 2/12/80 -- SECTIONS 6 AND 7.

LAST PAGE

(R) INDICATES A REGISTERED OR TRADEMARK NAME OF THE DOW CHEMICAL COMPANY

THE INFORMATION HEREIN IS GIVEN IN GOOD FAITH, BUT NO WARRANTY, EXPRESSED OR IMPLIED, IS MADE.

UTC I — SEP 9 '82 07 — PMC [redacted] 9088

PMC 9015

Ethyl Corporation

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APR 21 1980

G. E. PARSONS

MATERIAL SAFETY DATA SHEET[1]

(Essentially Similar To Form OSHA-20)

Rev. May 72

SECTION I

ETHYL CORPORATION	EMERGENCY TELEPHONE NO. 504/344-7147
ADDRESS P.O. Box 341, Baton Rouge, Louisiana 70821	
CHEMICAL NAME AND SYNONYMS Tetrachloroethylene (Perchloroethylene)	TRADE NAME AND SYNONYMS Perchlorethylene; Per
CHEMICAL FAMILY Chloroethylene	FORMULA $CCl_2:CCl_2$

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES Stabilizers			OTHERS		
OTHERS					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)

SECTION III - PHYSICAL DATA

BOILING POINT (°F.) (760 mm)	250.16	SPECIFIC GRAVITY (H_2O=1) 15°/4°C	1.631
VAPOR PRESSURE (mm Hg.) 22°C(72°F)	15.8	PERCENT, VOLATILE BY VOLUME (%)	100
VAPOR DENSITY (AIR=1)	5.83	EVAPORATION RATE (CCl_4 =1)	0.25
SOLUBILITY IN WATER 77°F, wt %	0.015		
APPEARANCE AND ODOR Colorless, clear, heavy liquid with a pleasant ethereal odor.			

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used) None	FLAMMABLE LIMITS Nonflammable	Lel	Uel
EXTINGUISHING MEDIA			
SPECIAL FIRE FIGHTING PROCEDURES			
UNUSUAL FIRE AND EXPLOSION HAZARDS With outside fuel source, combustion products can contain HCl and traces of phosgene.			

PMC 9015 9 38

CHEMICAL OR TRADE NAME Perchloroethylene; Per

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE For 8-hour day - 100 ppm time-weighted average; 200 ppm ceiling (OSHA). ACGIH (1979) - 100 ppm TWA (can be absorbed through skin).

EFFECTS OF OVEREXPOSURE Irritation, lacrymation and burning of the eyes, vomiting, nausea, drowsiness; acts as an intoxicant and an anesthetic. Avoid prolonged or repeated contact with skin to prevent skin irritation and dermatitis. Limited gavage studies suggest Per may be a cancer-suspect agent in animals.

EMERGENCY AND FIRST AID PROCEDURES Remove person from contaminated area; apply artificial respiration and oxygen if breathing has stopped. Consult a physician (NOTE: Epinephrine is contraindicated). Remove contaminated clothing and wash skin with warm soap and water If taken internally, do not induce vomiting. If eyes have been contacted, wash with copious quantities of water-call a physician.

SECTION VI - REACTIVITY DATA

STABILITY			CONDITIONS TO AVOID
	UNSTABLE		Open flames, electric heaters, etc.
	STABLE	x	

INCOMPATABILITY (Materials to avoid) Rubber and plastic are damaged by long contact.

HAZARDOUS DECOMPOSITION PRODUCTS At very high temperatures, can decompose to toxic chlorinated products.

HAZARDOUS POLYMERIZATION			CONDITIONS TO AVOID
	MAY OCCUR		
	WILL NOT OCCUR	x	

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Spilled perchloroethylene may be removed by mopping or absorbing with rags. Provide adequate ventilation. Clothing wet with perchloroethylene should be removed immediately and the affected area washed with soap and water.

WASTE DISPOSAL METHOD Residue from distillations of perchlorethylene may be poured on dry sand, earth, or ashes at a safe distance from occupied areas and allowed to evaporate. An impermeable barrier such as metal or concrete should be placed between the dry sand, earth or ashes and the soil. State and local pollution control agencies should be consulted.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type)
Canister type gas mask, self-contained air mask.

VENTILATION		
	LOCAL EXHAUST: Floor level ventilation	SPECIAL
	MECHANICAL (General): Downdraft	OTHER

PROTECTIVE GLOVES Neoprene, PVC-coated or Viton

EYE PROTECTION Chemical safety goggles

OTHER PROTECTIVE EQUIPMENT
Protective headgear and apron when splashing could be a problem.

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING
Storage tanks should be adequately vented for filling and pressure equalization. Vents from indoor tanks should terminate outdoors.

OTHER PRECAUTIONS
Floor level ventilation should be provided. Avoid contact with skin and avoid vapors. No smoking in presence of vapors.

DATE Nov. 12, 1979

PMC 9088

M A T E R I A L S A F E T Y D A T A S H E E T 41

PPG INDUSTRIES, INC. ONE PPG PLACE PITTSBURGH, PA 15272
24-HOUR EMERGENCY ASSISTANCE: (304) 843-1300

PMC 9015

APPROVED BY U.S. DEPT. OF LABOR AS 'ESSENTIALLY SIMILAR' TO FORM OSHA-20

EFFECTIVE DATE: NOVEMBER 1, 1985 EDITION: 6 UTCIHL 16

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INDUSTRIAL HYGIENE

CHEMICAL NAME AND SYNONYMS:
PERCHLOROETHYLENE
TETRACHLOROETHYLENE
CAS NO. 127-18-4

TRADE NAME:
PERCHLOR-DGREAS H

CHEMICAL FAMILY:
HALOGENATED HYDROCARBONS

FORMULA:
CCL2=CCL2

DOT SHIPPING NAME:
PERCHLOR-DGREAS HD

DOT HAZARD CLASS:
SEE COMMENTS.

REPORTABLE QUANTITY:
N/A

I.D. NUMBER:
COMNTS

SUBSIDIARY RISK:
N/A

SECTION 1 PHYSICAL DATA

BOILING POINT @760MM HG	VAPOR DENSITY (AIR=1)	SPECIFIC GRAVITY (H2O=1)	PH OF SOLUTIONS
121 C	5.83	1.6 @ 20/20 C	6.8 TO 8.4
FREEZING/MELTING POINT	**SOLUBILITY (WEIGHT% IN WATER)**	**BULK DENSITY**	**VOLUME % VOLATIL**
-22.3 C	0.015% @ 25 C	13.6 LB/G @20 C	100

VAPOR PRESSURE:
14.2 MMHG @ 20 C

EVAPORATION RATE:
(ETHYL ETHER=1): 0.09

HEAT OF SOLUTION:
N/A

APPEARANCE AND ODOR:
CLEAR, COLORLESS LIQUID WITH ETHER-LIKE ODOR.

SECTION 2 INGREDIENTS

INGREDIENT:	%	INGREDIENT:	%
PERCHLOROETHYLENE (STABLILIZED)	99	NOTE: HAZARD INFO IS BASED ON TEST MIX & NOT INDIV INGRED	

SECTION 3 FIRE AND EXPLOSION HAZARD DATA

FLASH POINT DEG F
(METHOD USED)
NONE PER DOT TEST

FLAMMABLE LIMITS IN AIR(% BY VOLUME)
LEL: NONE
UEL: NONE

EXTINGUISHING MEDIA:
WATER, DRY CHEMICALS, OR CARBON DIOXIDE

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SPECIAL FIRE FIGHTING PROCEDURES:
FIRE FIGHTERS SHOULD WEAR NIOSH/MSHA-APPROVED PRESSURE-DEMAND SELF CONTAINED BREATHING APPARATUS FOR POSSIBLE EXPOSURE TO HYDROGEN CHLORIDE AND POSSIBLE TRACES OF PHOSGENE

UNUSUAL FIRE AND EXPLOSION HAZARDS:
PERCHLOR INVOLVED IN FIRES CAN DECOMPOSE TO HYDROGEN CHLORIDE AND POSSIBLE TRACES OF PHOSGENE.

****
* SECTION 4 HEALTH HAZARD DATA
****

TOXICITY DATA: SEE REFERENCE (1)

CLASSIFICATION(POISON,IRRITANT,ETC.)

LC50 INHALATION:
(RAT) 4000 PPM (4 HOURS)

INHALATION:
MODERATELY TOXIC

LD50 DERMAL:
NOT DETERMINED

SKIN:
NOT DETERMINED

SKIN/EYE IRRITATION:
SEE SECTION 5

SKIN:
MILDLY IRRITATING

EYE:
IRRITANT

LD50 INGESTION:
(RABBIT) 5000 MG/KG

INGESTION:
SLIGHTLY TOXIC

FISH LC50(LETHAL CONCENTRATION):
96 HR TLM: 100-10 PPM

AQUATIC:
TOXIC

****
* SECTION 5 EFFECTS OF OVEREXPOSURE
****

THIS SECTION COVERS EFFECTS OF OVEREXPOSURE FOR INHALATION, EYE/SKIN CONTACT, INGESTION AND OTHER TYPES OF OVEREXPOSURE INFORMATION IN THE ORDER OF THE MOST HAZARDOUS AND THE MOST LIKELY ROUTE OF OVEREXPOSURE

PERMISSIBLE EXPOSURE LIMITS:
THE INDIVIDUAL PERMISSIBLE EXPOSURE LIMITS ARE AS FOLLOWS:

OSHA: 100 PPM, 8-HOUR TWA(TIME-WEIGHTED AVERAGE); 100-200 PPM PERIODIC EX-
OSHA: 200 PPM, 8-HOUR TWA (TIME-WEIGHTED AVERAGE); 100-200 PPM PERIODIC EXCURSIONS ARE ALLOWED PROVIDING 8-HOUR TWA IS AT OR BELOW 100 PPM; 200-300 PPM EXCURSIONS ALLOWED ONLY FOR MAXIMUM OF 5 MINUTES IN ANY 3-HOUR PERIOD; 300 PPM MAXIMUM ALLOWABLE CONCENTRATION (MUST NOT BE EXCEEDED); 29CFR 1910.1000.
ACGIH: 50 PPM, 8-HOUR TWA (TIME-WEIGHTED AVERAGE); 200 PPM, STEL (15-MINUTE SHORT-TERM EXPOSURE LIMIT)

PPG INTERNAL PERMISSIBLE EXPOSURE LIMIT: 50 PPM, 8-HOUR TWA(TIME WEIGHTED AVERAGE); 100 PPM, STEL (15-MINUTE SHORT-TERM EXPOSURE LIMIT)

ACUTE

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INHALATION: PERCHLOROETHYLENE IS PRIMARILY A CENTRAL NERVOUS SYSTEM DEPRESSANT AND CAN CAUSE POSSIBLE CENTRAL NERVOUS SYSTEM DAMAGE WITH OVEREXPOSURE. INHALATION CAN CAUSE IRRITATION OF THE RESPIRATORY TRACT, DIZZINESS, NAUSEA, HEADACHE, LOSS OF COORDINATION AND EQUILIBRIUM, UNCONSCIOUSNESS AND EVEN DEATH IN CONFINED OR POORLY VENTILATED AREA. FATALITIES FOLLOWING SEVERE ACUTE EXPOSURE TO VARIOUS CHLORINATED SOLVENTS HAVE BEEN ATTRIBUTED TO VENTRICULAR FIBRILLATION.
EYE/SKIN: LIQUID SPLASHED IN THE EYE CAN RESULT IN DISCOMFORT, PAIN & IRRITATION. PROLONGED OR REPEATED CONTACT WITH LIQUID ON THE SKIN CAN CAUSE IRRITATION AND DERMATITIS. THE PROBLEM MAY BE ACCENTUATED BY LIQUID BECOMING TRAPPED AGAINST THE SKIN BY CONTAMINATED CLOTHING AND SHOES, AND SKIN ABSORPTION CAN OCCUR.

INGESTION: SWALLOWING OF THIS MATERIAL MAY RESULT IN IRRITATION OF THE MOUTH AND GI TRACT ALONG WITH OTHER EFFECTS AS LISTED ABOVE FOR INHALATION. VOMITING AND SUBSEQUENT ASPIRATION INTO THE LUNGS MAY LEAD TO CHEMICAL PNEUMONIA AND PULMONARY EDEMA WHICH IS A POTENTIALLY FATAL CONDITION.

CHRONIC
A RECENT NTP STUDY HAS DETERMINED THAT THERE IS CLEAR EVIDENCE OF CARCINOGENICITY (LIVER) IN BOTH MALE & FEMALE MICE, CLEAR EVIDENCE OF LUKEMIA IN MALE & FEMALE RATS & SOME EVIDENCE OF ANIMAL CARCINOGENICITY (KIDNEY TUMORS) IN MALE RATS. THE NTP STUDY EXPOSED RATS TO 200 & 400 PPM & MICE TO 100 TO 200 PPM IN A LIFETIME STUDY. AT THE PRESENT TIME, IARC LISTS PERCHLOR IN GROUP 3 (8). UNTIL MORE INFORMATION REGARDING THIS NTP STUDY IS AVAILABLE, PRUDENT HANDLING PRACTICE SHOULD MINIMIZE HUMAN EXPOSURE.

****

EMERGENCY AND FIRST AID PROCEDURES

****

INHALATION:
REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION, PREFERABLY MOUTH-TO-MOUTH. IF BREATHING IS DIFFICULT, GIVE OXYGEN. CALL A PHYSICIAN.

EYE OR SKIN CONTACT:
FLUSH EYES AND SKIN WITH PLENTY OF WATER (SOAP AND WATER FOR SKIN) FOR AT LEAST 15 MINUTES, WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. IF IRRITATION OCCURS, CONSULT A PHYSICIAN. THOROUGHLY CLEAN CONTAMINATED CLOTHING AND SHOES BEFORE REUSE OR DISCARD.

INGESTION:
IF CONSCIOUS, DRINK LARGE QUANTITIES OF WATER. DO NOT INDUCE VOMITING. TAKE IMMEDIATELY TO A HOSPITAL OR PHYSICIAN. IF UNCONSCIOUS, OR IN CONVULSIONS, TAKE IMMEDIATELY TO A HOSPITAL. DO NOT ATTEMPT TO GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

NOTES TO PHYSICIAN INCLUDING ANTIDOTES:
NEVER ADMINISTER ADRENALIN FOLLOWING PERCHLOROETHYLENE OVEREXPOSURE. INCREASED SENSITIVITY OF THE HEART TO ADRENALIN MAY BE CAUSED BY OVER - EXPOSURE TO PERCHLOROETHYLENE.

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****
* SECTION 6 REACTIVITY DATA
****

STABILITY:
STABLE
CONDITIONS TO AVOID:
AVOID OPEN FLAMES, HOT GLOWING SURFACES OR ELECTRIC ARCS.

HAZARDOUS POLYMERIZATION:
WILL NOT OCCUR.

CONDITIONS TO AVOID:
NONE

INCOMPATIBILITY (MATERIALS TO AVOID):
NONE

HAZARDOUS DECOMPOSITION PRODUCTS:
HYDROGEN CHLORIDE AND POSSIBLY TRACES OF PHOSGENE.

****
* SECTION 7 SPILL OR LEAK PROCEDURES
****

STEPS TO BE TAKEN IF MATERIAL IS SPILLED OR RELEASED:
IMMEDIATELY EVACUATE THE AREA AND PROVIDE MAXIMUM VENTILATION. UNPROTECTED PERSONNEL SHOULD MOVE UPWIND OF SPILL. ONLY PERSONNEL EQUIPPED WITH PROPER RESPIRATORY AND SKIN/EYE PROTECTION (SEE SECTION 8) SHOULD BE PERMITTED IN AREA. DIKE AREA TO CONTAIIN SPILL. TAKE PRECAUTIONS AS NECESSARY TO PREVENT CONTAMINATION OF GROUND AND SURFACE WATERS. RECOVER SPILLED MATERIAL ON ABSORBENTS, SUCH AS SAWDUST OR VERMICULITE, AND SWEEP INTO CLOSED CONTAINERS FOR DISPOSAL. AFTER ALL VISIBLE TRACES, INCLUDING IGNITABLE VAPORS, HAVE BEEN REMOVED, THUROUGHLY WET VACCUM THE AREA. DO NOT FLUSH TO SEWER. IF AREA OF SPILL IS POROUS, REMOVE AS MUCH EARTH AND GRAVEL, ETC. AS NECESSARY AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.

WASTE DISPOSAL METHOD:
CONTAMINATED SAWDUST, VERMICULITE OR POROUS SURFACE MUST BE DISPOSED OF IN A PERMITTED HAZARDOUS WASTE MANAGEMENT FACILITY. RECOVERED LIQUIDS MAY BE REPROCESSED OR INCINERATED OR MUST BE TREATED IN A PERMITTED HAZARDOUS WASTE MANAGEMENT FACILITY. CARE MUST BE TAKEN WHEN USING OR DISPOSING OF CHEMICAL MATERIALS AND/OR THEIR CONTAINERS TO PREVENT ENVIRONMENTAL CONTAMINATION. IT IS YOUR DUTY TO DISPOSE OF THE CHEMICAL MATERIALS AND/OR THEIR CONTAINERS IN ACCORDANCE WITH THE CLEAN AIR ACT, THE CLEAN WATER ACT, THE RESOURCE CONSERVATION AND RECOVERY ACT AS WELL AS ANY OTHER RELEVANT FEDERAL, STATE, OR LOCAL LAWS/REGULATIONS REGARDING DISPOSAL.

RCRA - HAZARDOUS WASTE NUMBER - U-210

****
* SECTION 8 SPECIAL PROTECTION INFORMATION
****

RESPIRATORY PROTECTION:
USE A HALF OR FULL FACEPIECE ORGANIC VAPOR CHEMICAL CARTRIDGE OR CANISTER RESPIRATOR WHEN CONCENTRATIONS EXCEED PERMISSIBLE LIMITS. USE SELF-CONTAINED

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BREATHING APPARATUS (SCBA) OR FULL FACEPIECE AIRLINE RESPIRATOR WITH AUXILARY SCBA OPERATED IN THE PRESSURE-DEMAND MODE FOR EMERGENCIES AND FOR ALL WORK PERFORMED IN STORAGE VESSELS, POORLY VENTILATED ROOMS, AND OTHER CONFINED AREAS. RESPIRATORS MUST BE APPROVED BY NIOSH OR MSHA. THE RESPIRATOR USE LIMITATIONS MADE BY NIOSH/MSHA (6)(7) AND BY THE MANUFACTURER MUST BE OBSERVED. RESPIRATORY PROTECTION PROGRAMS MUST BE IN ACCORDANCE WITH 26CFR 1910.134.

VENTILATION(TYPE):
USE LOCAL EXHAUST OR DILUTION VENTILATION AS APPROPRIATE TO CONTROL EXPOSURES TO BELOW PERMISSIBLE LIMITS

EYE PROTECTION:
SPLASHPROOF GOGGLES

GLOVES:
SEE COMMENTS

OTHER PROTECTIVE EQUIPMENT:
BOOTS, APRONS, OR CHEMICAL SUITS SHOULD BE USED WHEN NECESSARY TO PREVENT SKIN CONTACT. PERSONAL PROTECTIVE CLOTHING AND USE OF EQUIPMENT MUST BE IN ACCORDANCE WITH 29CFR 1910.133 AND 29CFR 1910.132.

****
* SECTION 9 SPECIAL PRECAUTIONS
****

PRECAUTIONS TO BE TAKEN DURING HANDLING AND STORING:
1. DO NOT USE IN POORLY VENTILATED OR CONFINED SPACES WITHOUT PROPER RESPIRATORY PROTECTION (SEE SECTION 8).
2. PERCHLOROETHYLENE VAPORS ARE HEAVIER THAN AIR AND WILL COLLECT IN LOW AREAS.
3. KEEP CONTAINER CLOSED WHEN NOT IN USE.
4. STORE ONLY IN CLOSED, PROPERLY LABELED CONTAINERS.
5. THIS MATERIAL OR ITS VAPORS WHEN IN CONTACT WITH FLAMES, HOT GLOWING SURFACES OR ELECTRIC ARCS CAN DECOMPOSE TO FORM HYDROGEN CHLORIDE GAS AND TRACES OF PHOSGENE.
6. AVOID CONTAMINATION OF WATER SUPPLIES. HANDLING, STORAGE AND USE PROCEDURES MUST BE CAREFULLY MONITORED TO AVOID SPILLS OR LEAKS. ANY SPILL OR LEAK HAS THE POTENTIAL TO CAUSE UNDERGROUND WATER CONTAMINATION WHICH MAY, IF SUFFICIENTLY SEVERE, RENDER A DRINKING WATER SOURCE UNFIT FOR HUMAN CONSUMPTION. CONTAMINATION THAT DOES OCCUR CANNOT BE EASILY CORRECTED
7. A CHLORINATED SOLVENT USED AS A FLASHPOINT SUPPRESSANT MUST BE ADDED IN SUFFICIENT QUANTITY OR THE RESULTANT MIXTURE MAY HAVE A FLASHPOINT LOWER THAN THE FLAMMABLE COMPONENT.
8. DO NOT USE CUTTING OR WELDING TORCHES ON DRUMS THAT CONTAINED PERCHLOROETHYLENE UNLESS PROPERLY PURGED AND CLEANED.

OTHER PRECAUTIONS:
1. DO NOT BREATHE VAPORS. HIGH VAPOR CONCENTRATIONS CAN CAUSE DIZZINESS, UNCONSCIOUSNESS, POSSIBLE CENTRAL NERVOUS SYSTEM DAMAGE OR DEATH. LONG-TERM OVEREXPOSURE MAY CAUSE LIVER/KIDNEY INJURY.
2. USE ONLY WITH ADEQUATE VENTILATION. VENTILATION MUST BE SUFFICIENT TO LIMIT EMPLOYEE EXPOSURE TO PERCHLOROETHYLENE BELOW PERMISSIBLE EXPOSURE LIMITS. OBSERVANCE OF LOWER LIMITS (OUTLINED IN SECTION 5) IS ADVISABLE.
3. AVOID CONTACT WITH EYES. WILL CAUSE IRRITATION AND PAIN.

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4. AVOID PROLONGED OR REPEATED CONTACTS WITH SKIN. MAY CAUSE IRRITATION OR DERMATITIS.
5. DO NOT SWALLOW. SWALLOWING MAY CAUSE INJURY OR DEATH.
6. DO NOT EAT, DRINK, OR SMOKE IN WORK AREAS.

REFERENCES:

1. NIOSH REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES, 1978
2. INDUSTRIAL HYGIENE AND TOXICOLOGY, VOLUME II, SECOND EDITION, F.A. PATTY, 1963.
3. DANGEROUS PROPERTIES OF INDUSTRIAL MATERIALS, FIFTH EDITION, N. I. SAX, 1979
4. EPA SCIENCE ADVISORY BOARD, SUBCOMMITTEE ON AIRBORNE CARCINOGENS, SEPTEMBER, 1980
5. ENCYCLOPEDIA OF CHEMICAL TECHNOLOGY, VOLUME 5, THIRD EDITION, KIRK-OTHMER, 1979
6. NIOSH/OSHA OCCUPATIONAL HEALTH GUIDELINES FOR CHEMICAL HAZARDS, DHHS (NIOSH) PUBLICATION NO. 81-123, JANUARY, 1981
7. NIOSH/OSHA POCKET GUIDE TO CHEMICAL HAZARDS, DHEW (NIOSH) PUBLICATION NO. 78-210, SEPTEMBER, 1978
8. INTERNATIONAL AGENCY FOR RESEARCH OF CANCER, ANNUAL REPORT, 1982

COMMENTS:
DOT HAZARD CLASS

ONLY REGULATED WHEN SHIPPED BY AIR. DOT SHIPPING NAME IS TETRACHLOROETHYLENE DOT HAZARD CLASS IS ORM-A, AND UN NUMBER IS UN1897.

SECTION 8 - SPECIAL PROTECTION INFORMATION

GLOVES: VITON, POLYVINYL ALCOHOL*. FOR LIMITED SERVICE ONLY: NITRILE * (DEGRADES IN WATER)

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VII. SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (specify type)		Air-supplied mask		
VENTILATION	LOCAL EXHAUST	Preferable	SPECIAL	—
	MECHANICAL (general)	Acceptable	OTHER	—
PROTECTIVE GLOVES		Plastic gloves	EYE PROTECTION	Monogoggles
OTHER PROTECTIVE EQUIPMENT		Face shield, apron, eyebath, and safety shower		

VIII. SPECIAL PRECAUTIONS

PRECAUTIONARY LABELING

EPICHLORHYDRIN

DANGER! MAY BE HARMFUL OR FATAL IF INHALED OR SWALLOWED.
MAY CAUSE EYE AND SKIN IRRITATION.
COMBUSTIBLE.

Do not breathe vapor.
Do not take internally.
Do not get on skin, on clothing, or in eyes.
Do not rely on rubber or other gloves for protection.
Keep away from heat, sparks, and fire.

IN CASE OF CONTACT:
CLOTHING — Remove contaminated clothing and shoes at once. Wash thoroughly before reuse.
SKIN — Immediately wash skin with soap and plenty of water.
EYES — Immediately flush with plenty of water for at least 15 minutes. Get medical attention.

POISON

FIRST AID TREATMENT

IF SWALLOWED: Make patient vomit immediately (finger down throat or, if conscious, give warm mustard water or salt water freely).

GENERAL: Keep patient warm; if conscious, give coffee; call physician. Do not give Adrenalin.

FOR INDUSTRY USE ONLY

OTHER HANDLING AND STORAGE CONDITIONS

--

COPY TO LOCAL I.A.M.

JUL 8 '82 1746

UTC -HL

MATERIAL SAFETY DATA SHEET

(Approved by U.S. Department of Labor "Essentially Similar" to Form LSB-008-4)

Used in Detrex PMC 9088 9015

SEP 9 '82 07

CHEMICAL NAME: EPICHLORHYDRIN

SYNONYMS: α-Epichlorhydrin; 1-Chloro-2,3-epoxypropane; γ-Chloropropylene Oxide; (Chloromethyl)oxirane

CHEMICAL FAMILY: Chlorine Compounds and Oxides

FORMULA: OCH_2CHCH_2Cl

MOLECULAR WEIGHT: 92.53

TRADE NAME AND SYNONYMS: Epichlorhydrin

I. PHYSICAL DATA

BOILING POINT, 760 mm. Hg	115.2°C. (239.4°F.)	FREEZING POINT	−58.1°C.
SPECIFIC GRAVITY (H_2O = 1)	1.1825 at 20/20°C.	VAPOR PRESSURE at 20°C.	13 mm. Hg
VAPOR DENSITY (air = 1)	3.29	SOLUBILITY IN WATER, % by wt. at 20°C.	6.4
PER CENT VOLATILES BY VOLUME	100	EVAPORATION RATE (Butyl Acetate = 1)	1.35
APPEARANCE AND ODOR	Water-white liquid; characteristic odor.		

II. HAZARDOUS INGREDIENTS

MATERIAL	%	TLV (Units)
Not applicable		
COPY TO LOCAL I.A.M.		
JUL 8 '82 1746		

III. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (test method)	93°F., Tag open cup	AUTOIGNITION TEMPERATURE		804°F.	
FLAMMABLE LIMITS IN AIR, % by volume		LOWER	3.3 (calculated)	UPPER	14.5 (calculated

EXTINGUISHING MEDIA	Carbon dioxide or dry chemical for small fires. Polymer foam for large fires.
SPECIAL FIRE FIGHTING PROCEDURES	Avoid use of dry chemical extinguishing agents if fire occurs in container with confined vent. Avoid use of carbon tetrachloride extinguishing agents.
UNUSUAL FIRE AND EXPLOSION HAZARDS	Avoid contamination with copper or lead. Avoid mixing with acids, alkalies, and metal halides.

EMERGENCY PHONE NUMBERS

Dr. C. U. Dernehl, 212/551-4785; 914/946-0646 (night)
Dr. K. S. Lane, 212/551-4787; 914/666-3656 (night)
C. P. Carpenter, Ph.D., 412/327-1020; 412/241-7896 (night)

Legal responsibility is assumed only for the fact that all studies reported here and all opinions are those of qualified experts.

UNION CARBIDE CORPORATION • CHEMICALS AND PLASTICS • 270 PARK AVENUE, NEW YORK, N.Y. 10017

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IV. HEALTH HAZARD DATA

SEP 9 '82 07

THRESHOLD LIMIT VALUE	5 ppm. (Skin)
EFFECTS OF OVEREXPOSURE	Vapor is irritating to eyes, nose, and throat. Causes sore throat, headache, nausea, and vomiting. Skin contact is irritating. Rapidly fatal if swallowed; i.e., nausea, vomiting, and collapse.
EMERGENCY AND FIRST AID PROCEDURES	If swallowed, induce vomiting immediately and call a physician. If inhaled, remove to fresh air. Give oxygen if breathing is difficult. Call a physician. Flush skin and eye contact with water for at least 15 minutes. Get medical care for eyes. Remove contaminated clothing.

V. REACTIVITY DATA

STABILITY			
UNSTABLE	STABLE	CONDITIONS TO AVOID	Heat and flames.
—	✓		
INCOMPATIBILITY (materials to avoid)		Avoid contamination with alkalies, acids, and metal halides.	
HAZARDOUS DECOMPOSITION PRODUCTS		None	
HAZARDOUS POLYMERIZATION		CONDITIONS TO AVOID	Presence of alkalies, acids, polymerization catalysts, and high temperatures.
May Occur	Will not Occur		
✓	—		

VI. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED	Flush away spilled material with large volumes of water.
WASTE DISPOSAL METHOD	Incinerate in a furnace. Care should be exercised to dissipate combustion products. Hydrogen chloride is generated.

COPY TO LOCAL I.A.M.

JUL 8 '82 1746

UTC IHL SEP 9 '82 0 PMC 9088 9015

Form Approved
Budget Bureau No. 44-R1387
Approval Expires April 30, 1971

Form No. LSB-005-2
May 1969

U.S. DEPARTMENT OF LABOR

WORKPLACE STANDARDS ADMINISTRATION

Bureau of Labor Standards

MATERIAL SAFETY DATA SHEET

rec'd. 9-22-75
old MSDS in file

R.C. White, Genl. Mgr. Solvent Div.

SECTION I

MANUFACTURER'S NAME: Source of Data: DETREX CHEMICAL IND., INC.	EMERGENCY TELEPHONE NO.: Area 313 868-8600
ADDRESS (Number, Street, City, State, and ZIP Code): Box 501 Detroit, Michigan 48232	
CHEMICAL NAME AND SYNONYMS: Perchloroethylene (tetrachloroethylene)	TRADE NAME AND SYNONYMS: DETREX PERX or Kem-O-Dry
CHEMICAL FAMILY: Chlorinated Hydrocarbon	FORMULA: CCl_2CCl_2

SECTION II HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS	100	100	FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
Perchlorethylene	99.76	%
Epichlorhydrin	0.24	%

SECTION III PHYSICAL DATA

BOILING POINT (°F.)	250	SPECIFIC GRAVITY (H_2O=1)	1.62
VAPOR PRESSURE (mm Hg.)	15	PERCENT VOLATILE BY VOLUME (%)	100
VAPOR DENSITY (AIR=1)	5.83	EVAPORATION RATE (ether =1)	.09
SOLUBILITY IN WATER	Negligible		
APPEARANCE AND ODOR	Clear, colorless liquid with a characteristic mild ethereal odor.		

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used): None	FLAMMABLE LIMITS: N.A.	Lel	Uel
EXTINGUISHING MEDIA			
SPECIAL FIRE FIGHTING PROCEDURES	COPY TO LOCAL I.A.M.		
UNUSUAL FIRE AND EXPLOSION HAZARDS	1746		

COPY TO LOCAL I.A.M.

COPY TO LOCAL I.A.M.

JUL 8 '82 1746

PMC 9015

SECTION V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE: 100 ppm

EFFECTS OF OVEREXPOSURE: Over exposure may lead to slight anesthetic feeling, possible irritation to eyes, nose and throat. Continued exposure can result in headaches, fatigue, dizziness, nausea and gradual suppression of consciousness.

EMERGENCY AND FIRST AID PROCEDURES: Move patient to fresh air and if unconscious give artificial respiration or oxygen. Any clothing that has been wet with the solvent liquid should be removed, the skin dried and later treated with a lanolin cream. If liquid has entered the eyes they should be immediately flushed with lukewarm water for at least 15 minutes.

SECTION VI REACTIVITY DATA

STABILITY			CONDITIONS TO AVOID
	UNSTABLE		Welding, open flames and infra red heaters.
	STABLE	X	

INCOMPATABILITY (Materials to avoid):

HAZARDOUS DECOMPOSITION PRODUCTS: Small amounts of HCl from thermal decomposition.

HAZARDOUS POLYMERIZATION			CONDITIONS TO AVOID
	MAY OCCUR		
	WILL NOT OCCUR	X	

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Avoid breathing high concentrations of the vapors and avoid repeated contact of the liquid with the skin and clothing. Flush spilled areas with water. Be sure sufficient fresh air enters the area or it should be vacated.

WASTE DISPOSAL METHOD: Used solvent should be recovered by distillation. The residue from distillation may be incinerated, dry welled etc. Check local requirements.

SECTION VIII SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type): None necessary when the perchloroethylene is used in a properly designed and operated degreaser or machine.

VENTILATION		
	LOCAL EXHAUST: Sufficient to maintain TLV	SPECIAL: During Clean-outs: Tanks are to be completely emptied and aired or flushed with water.
	MECHANICAL (General): Avoid drafts over or at degreasers	

PROTECTIVE GLOVES: Normally not necessary (Neoprene)

EYE PROTECTION: Normally not necessary (glasses/goggles)

OTHER PROTECTIVE EQUIPMENT: When cleaning tanks never enter until safe or use air respirator. Use buddy system

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Avoid spillage and leak causing accidents.

OTHER PRECAUTIONS: Avoid spillage, repeated contact with the skin and prolonged breathing of the vapors.

RECEIVED
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INDUSTRIAL HYGIENE

PPG INDUSTRIES, INC. ONE PPG PLACE PITTSBURGH, PA 15272

* * * PERCHLOR, PERCHLOROETHYLENE

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PMC 9088

MSDS NUMBER:	0041
DATE:	06/01/88
EDITION:	008
TRADE NAME:	PERCHLOR, PERCHLOROETHYLENE
CHEMICAL NAME/SYNONYMS:	TETRACHLOROETHYLENE
CHEMICAL FAMILY:	HALOGENATED HYDROCARBON
FORMULA:	CCL2=CCL2
U.S. DOT SHIPPING NAME:	PERCHLOROETHYLENE
U.S. DOT HAZARD CLASS:	ORM-A
SUBSIDIARY RISK:	N/A
I.D. NUMBER:	UN1897
REPORTABLE QUANTITY:	N/A

CAS NUMBER: 00127 18 4

SECTION 1 * PHYSICAL DATA

BOILING POINT @ 760 MM HG:	121 C
VAPOR DENSITY (AIR=1):	5.83
SPECIFIC GRAVITY (H20=1):	1.6 @ 20/20 C
PH OF SOLUTIONS:	6.8 TO 8.4
FREEZING/MELTING POINT:	-22.3 C
SOLUBILITY (WEIGHT % IN WATER):	0.015% @ 25 C
BULK DENSITY:	13.6 LBS/GAL @ 20 C
VOLUME % VOLATILE:	100
VAPOR PRESSURE:	14.2 MM HG @ 20 C
EVAPORATION RATE:	(ETHYL ETHER=1): 0.09
HEAT OF SOLUTION:	N/A

APPEARANCE AND ODOR:
CLEAR, COLORLESS LIQUID WITH ETHER-LIKE ODOR.

SECTION 2 * INGREDIENTS

MATERIAL	PERCENT
PERCHLOROETHYLENE (STABILIZED)	> 99

SECTION 3 * FIRE/EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED):
NONE

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FLAMMABLE LIMITS IN AIR (% BY VOLUME)
LEL: NONE
UEL: NONE

EXTINGUISHING MEDIA:
WATER, DRY CHEMICALS, OR CARBON DIOXIDE

SPECIAL FIRE FIGHTING PROCEDURES:
FIRE FIGHTERS SHOULD WEAR NIOSH/MSHA APPROVED PRESSURE DEMAND SELF-CONTAINED BREATHING APPARATUS FOR POSSIBLE EXPOSURE TO HYDROGEN CHLORIDE AND POSSIBLE TRACES OF PHOSGENE.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
PERCHLOR INVOLVED IN FIRES CAN DECOMPOSE TO HYDROGEN CHLORIDE AND POSSIBLE TRACES OF PHOSGENE.

SECTION 4 * HEALTH HAZARD DATA

TOXICITY DATA:

LC50 INHALATION:	(RAT) 4000 PPM (4 HOURS)
LD50 DERMAL:	NOT DETERMINED
SKIN/EYE IRRITATION:	SEE SECTION 5
LD50 INGESTION:	(RABBIT) 5000 MG/KG
FISH,LC50 (LETHAL CONCENTRATION):	96 HR TLM: 100-10 PPM

CLASSIFICATION: (POISON, IRRITANT, ETC.)

INHALATION:	MODERATELY TOXIC
SKIN:	NOT DETERMINED
SKIN/EYE:	MILDLY IRRITATING / IRRITANT
INGESTION:	SLIGHTLY TOXIC
AQUATIC:	TOXIC

SECTION 5 * EFFECTS OF OVEREXPOSURE

THIS SECTION COVERS EFFECTS OF OVEREXPOSURE FOR INHALATION, EYE/SKIN CONTACT, INGESTION AND OTHER TYPES OF OVEREXPOSURE INFORMATION IN THE ORDER OF THE MOST HAZARDOUS AND THE MOST LIKELY ROUTE OF OVEREXPOSURE.

IS CHEMICAL LISTED AS A CARCINOGEN OR POTENTIAL CARCINOGEN?

NTP - NO IARC - YES OSHA - NO

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE:
PROLONGED EXPOSURE ABOVE THE OSHA PERMISSIBLE EXPOSURE LIMIT MAY COMPLICATE EXISTING LIVER AND KIDNEY DISEASES.

PERMISSIBLE EXPOSURE LIMITS:
OSHA: 100 PPM, 8-HOUR TIME WEIGHTED AVERAGE.
200 PPM, ACCEPTABLE CEILING CONCENTRATION.
300 PPM, ACCEPTABLE MAXIMUM PEAK ABOVE THE CEILING CONCENTRATION FOR AN 8-HOUR SHIFT. THE MAXIMUM DURATION FOR THIS EXPOSURE IS 5 MINUTES IN ANY 3 HOURS (29 CFR 1910.1000, TABLE Z-2).
ACGIH: 50 PPM, 8-HOUR TWA (TIME WEIGHTED AVERAGE);
200 PPM, STEL (SHORT-TERM EXPOSURE LIMIT).
PPG INTERNAL PERMISSIBLE EXPOSURE LIMIT: 50 PPM, 8-HOUR TWA (TIME WEIGHTED AVERAGE); 100 PPM, STEL (SHORT-TERM EXPOSURE LIMIT).

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ACUTE:
INHALATION: PERCHLOROETHYLENE IS PRIMARILY A CENTRAL NERVOUS SYSTEM DEPRESSANT AND CAN CAUSE POSSIBLE CENTRAL NERVOUS SYSTEM DAMAGE WITH OVEREXPOSURE. INHALATION CAN CAUSE IRRITATION OF THE RESPIRATORY TRACT, DIZZINESS, NAUSEA, HEADACHE, LOSS OF COORDINATION AND EQUILIBRIUM, UNCONSCIOUSNESS AND EVEN DEATH IN CONFINED OR POORLY VENTILATED AREA. FATALITIES FOLLOWING SEVERE ACUTE EXPOSURE TO VARIOUS CHLORINATED SOLVENTS HAVE BEEN ATTRIBUTED TO VENTRICULAR FIBRILLATION.

EYE/SKIN: LIQUID SPLASHED IN THE EYE CAN RESULT IN DISCOMFORT, PAIN AND IRRITATION. PROLONGED OR REPEATED CONTACT WITH LIQUID ON THE SKIN CAN CAUSE IRRITATION AND DERMATITIS. THE PROBLEM MAY BE ACCENTUATED BY LIQUID BECOMING TRAPPED AGAINST THE SKIN BY CONTAMINATED CLOTHING AND SHOES, AND SKIN ABSORPTION CAN OCCUR.

INGESTION: SWALLOWING OF THIS MATERIAL MAY RESULT IN IRRITATION OF THE MOUTH AND GI TRACT ALONG WITH OTHER EFFECTS AS LISTED ABOVE FOR INHALATION. VOMITING AND SUBSEQUENT ASPIRATION INTO THE LUNGS MAY LEAD TO CHEMICAL PNEUMONIA AND PULMONARY EDEMA WHICH IS A POTENTIALLY FATAL CONDITION.

CHRONIC:
PROLONGED EXPOSURE ABOVE THE OSHA PERMISSIBLE EXPOSURE LIMITS MAY RESULT IN LIVER AND KIDNEY DAMAGE. PERCHLOROETHYLENE HAS BEEN EXTENSIVELY STUDIED FOR ITS CANCER POTENTIAL. A RECENT NTP STUDY HAS DETERMINED THAT THERE IS CLEAR EVIDENCE OF CARCINOGENICITY (LIVER) IN BOTH MALE AND FEMALE MICE, CLEAR EVIDENCE OF LEUKEMIA IN MALE AND FEMALE RATS AND SOME EVIDENCE OF ANIMAL CARCINOGENICITY (KIDNEY TUMORS) IN MALE RATS. THE

NTP STUDY EXPOSED RATS TO 200 AND 400 PPM AND MICE TO 100 AND 200 PPM IN A LIFETIME STUDY. PRUDENT HANDLING PRACTICES SHOULD BE FOLLOWED TO MINIMIZE HUMAN EXPOSURE.

PERCHLOROETHYLENE IS LISTED UNDER IARC AS A 2B.

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* EMERGENCY AND FIRST AID PROCEDURES

INHALATION:
REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION, PREFERABLY MOUTH-TO-MOUTH. IF BREATHING IS DIFFICULT, GIVE OXYGEN. CALL A PHYSICIAN.

EYE OR SKIN CONTACT:
FLUSH EYES AND SKIN WITH PLENTY OF WATER (SOAP AND WATER FOR SKIN) FOR AT LEAST 15 MINUTES, WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. IF IRRITATION OCCURS, CONSULT A PHYSICIAN. THOROUGHLY CLEAN CONTAMINATED CLOTHING AND SHOES BEFORE REUSE OR DISCARD.

INGESTION:
IF CONSCIOUS, DRINK LARGE QUANTITIES OF WATER. DO NOT INDUCE VOMITING. TAKE IMMEDIATELY TO A HOSPITAL OR PHYSICIAN. IF UNCONSCIOUS, OR IN CONVULSIONS, TAKE IMMEDIATELY TO A HOSPITAL. DO NOT ATTEMPT TO GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

NOTES TO PHYSICIAN (INCLUDING ANTIDOTES):
NEVER ADMINISTER ADRENALINE FOLLOWING PERCHLOROETHYLENE OVEREXPOSURE. INCREASED SENSITIVITY OF THE HEART TO ADRENALINE MAY BE CAUSED BY OVEREXPOSURE TO PERCHLOROETHYLENE.

SECTION 6 * REACTIVITY DATA

STABILITY: STABLE
CONDITIONS TO AVOID: OPEN FLAMES, HOT GLOWING SURFACES OR ELECTRIC ARCS

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR
CONDITIONS TO AVOID: NONE

INCOMPATIBILITY (MATERIALS TO AVOID):
NONE

HAZARDOUS DECOMPOSITION PRODUCTS:
HYDROGEN CHLORIDE AND POSSIBLE TRACES OF PHOSGENE

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SECTION 7 * SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS SPILLED OR RELEASED:

IMMEDIATELY EVACUATE THE AREA AND PROVIDE MAXIMUM VENTILATION. UNPROTECTED PERSONNEL SHOULD MOVE UPWIND OF SPILL. ONLY PERSONNEL EQUIPPED WITH PROPER RESPIRATORY AND SKIN/EYE PROTECTION (SEE SECTION 8) SHOULD BE PERMITTED IN AREA. DIKE AREA TO CONTAIN SPILL. TAKE PRECAUTIONS AS NECESSARY TO PREVENT CONTAMINATION OF GROUND AND SURFACE WATERS. RECOVER SPILLED MATERIAL ON ADSORBENTS, SUCH AS SAWDUST OR VERMICULITE, AND SWEEP INTO CLOSED CONTAINERS FOR DISPOSAL. AFTER ALL VISIBLE TRACES, INCLUDING IGNITABLE VAPORS, HAVE BEEN REMOVED, THOROUGHLY WET VACUUM THE AREA. DO NOT FLUSH TO SEWER. IF AREA OF SPILL IS POROUS, REMOVE AS MUCH EARTH AND GRAVEL, ETC. AS NECESSARY AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.

WASTE DISPOSAL METHOD:

CONTAMINATED SAWDUST,VERMICULITE,SOIL OR POROUS SURFACE MUST BE DISPOSED OF IN A PERMITTED HAZARDOUS WASTE MANAGEMENT FACILITY. RECOVERED LIQUIDS MAY BE REPROCESSED OR INCINERATED OR MUST BE TREATED IN A PERMITTED HAZARDOUS WASTE MANAGEMENT FACILITY. CARE MUST BE TAKEN WHEN USING OR DISPOSING OF CHEMICAL MATERIALS AND/OR THEIR CONTAINERS TO PREVENT ENVIRONMENTAL CONTAMINATION. IT IS YOUR DUTY TO DISPOSE OF THE CHEMICAL MATERIALS AND/OR THEIR CONTAINERS IN ACCORDANCE WITH THE CLEAN AIR ACT, THE CLEAN WATER ACT, THE RESOURCE CONSERVATION AND RECOVERY ACT, AS WELL AS ANY OTHER RELEVANT FEDERAL, STATE, OR LOCAL LAWS/REGULATIONS REGARDING DISPOSAL.

SECTION 8 * SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:

USE A HALF OR FULL FACEPIECE ORGANIC VAPOR CHEMICAL CARTRIDGE OR CANISTER RESPIRATOR WHEN CONCENTRATIONS EXCEED PERMISSIBLE LIMITS. USE SELF-CONTAINED BREATHING APPARATUS (SCBA) OR FULL FACEPIECE AIRLINE RESPIRATOR WITH AUXILIARY SCBA OPERATED IN THE PRESSURE DEMAND MODE FOR EMERGENCIES AND FOR ALL WORK PERFORMED IN STORAGE VESSELS, POORLY VENTILATED ROOMS, AND OTHER CONFINED AREAS. RESPIRATORS MUST BE APPROVED BY NIOSH OR MSHA. THE RESPIRATOR USE LIMITATIONS MADE BY NIOSH/MSHA AND BY THE MANUFACTURER MUST BE OBSERVED. RESPIRATORY PROTECTION PROGRAMS MUST BE IN ACCORDANCE WITH 29 CFR 1910.134.

VENTILATION(TYPE):

USE LOCAL EXHAUST OR DILUTION VENTILATION AS APPROPRIATE TO CONTROL EXPOSURES TO BELOW PERMISSIBLE LIMITS.

EYE PROTECTION:
SPLASHPROOF GOGGLES
GLOVES:
VITON(R), SILVER SHIELD(R).
FOR LIMITED SERVICE ONLY: NITRILE AND POLYVINYL ALCOHOL (DEGRADES IN WATER).
OTHER PROTECTIVE EQUIPMENT:
BOOTS, APRONS, OR CHEMICAL SUITS SHOULD BE USED WHEN NECESSARY TO PREVENT SKIN CONTACT. PERSONAL PROTECTIVE CLOTHING AND USE OF EQUIPMENT MUST BE IN ACCORDANCE WITH 29 CFR 1910.132 AND 29 CFR 1910.133.

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SECTION 9 * SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN DURING HANDLING AND STORING:

* CANCER INFORMATION: HAS CAUSED CANCER IN CERTAIN LABORATORY ANIMALS, OF QUESTIONABLE RELEVANCE TO HUMANS.
* DO NOT USE IN POORLY VENTILATED OR CONFINED SPACES WITHOUT PROPER RESPIRATORY PROTECTION (SEE SECTION 8).
* PERCHLOROETHYLENE VAPORS ARE HEAVIER THAN AIR AND WILL COLLECT IN LOW AREAS.
* KEEP CONTAINER CLOSED WHEN NOT IN USE.
* STORE ONLY IN CLOSED, PROPERLY LABELED CONTAINERS.
* THIS MATERIAL OR ITS VAPORS WHEN IN CONTACT WITH FLAMES, HOT GLOWING SURFACES OR ELECTRIC ARCS CAN DECOMPOSE TO FORM HYDROGEN CHLORIDE GAS AND TRACES OF PHOSGENE.
* AVOID CONTAMINATION OF WATER SUPPLIES. HANDLING, STORAGE AND USE PROCEDURES MUST BE CAREFULLY MONITORED TO AVOID SPILLS OR LEAKS. ANY SPILL OR LEAK HAS THE POTENTIAL TO CAUSE UNDERGROUND WATER CONTAMINATION WHICH MAY, IF SUFFICIENTLY SEVERE, RENDER A DRINKING WATER SOURCE UNFIT FOR HUMAN CONSUMPTION. CONTAMINATION THAT DOES OCCUR CANNOT BE EASILY CORRECTED.
* A CHLORINATED SOLVENT USED AS A FLASHPOINT SUPPRESSANT MUST BE ADDED IN SUFFICIENT QUANTITY OR THE RESULTANT MIXTURE MAY HAVE A FLASHPOINT LOWER THAN THE FLAMMABLE COMPONENT.
* DO NOT USE CUTTING OR WELDING TORCHES ON DRUMS THAT CONTAINED PERCHLOROETHYLENE UNLESS PROPERLY PURGED AND CLEANED.

OTHER PRECAUTIONS:

* DO NOT BREATHE VAPORS. HIGH VAPOR CONCENTRATIONS CAN CAUSE DIZZINESS, UNCONSCIOUSNESS, POSSIBLE CENTRAL NERVOUS SYSTEM DAMAGE OR DEATH. LONG-TERM OVEREXPOSURE MAY CAUSE LIVER/KIDNEY INJURY.

* USE ONLY WITH ADEQUATE VENTILATION. VENTILATION MUST BE SUFFICIENT TO LIMIT EMPLOYEE EXPOSURE TO PERCHLOROETHYLENE BELOW PERMISSIBLE EXPOSURE LIMITS. OBSERVANCE OF LOWER LIMITS (OUTLINED IN SECTION 5) IS ADVISABLE.
* AVOID CONTACT WITH EYES. WILL CAUSE IRRITATION AND PAIN.
* AVOID PROLONGED OR REPEATED CONTACT WITH SKIN. MAY CAUSE IRRITATION OR DERMATITIS.
* DO NOT SWALLOW. SWALLOWING MAY CAUSE INJURY OR DEATH.
* DO NOT EAT, DRINK, OR SMOKE IN WORK AREA.

COMMENTS:

TSCA - PERCHLOROETHYLENE IS LISTED ON THE TSCA INVENTORY UNDER CAS NO. 127-18-4.

SARA TITLE III - A) 311/312 CATEGORIES - ACUTE, CHRONIC, B) LISTED IN SECTION 313 UNDER TETRACHLOROETHYLENE, C) LISTED IN SECTION 302 AS A HAZARDOUS SUBSTANCE WITH REPORTABLE QUANTITY OF 1# (PROPOSED RQ REVISION TO 100#'S).

RCRA - WASTE PERCHLOROETHYLENE AND CONTAMINATED SOILS/MATERIALS FROM SPILL CLEAN-UP ARE U210 HAZARDOUS WASTE AS PER 40 CFR 261.33 AND MUST BE DISPOSED OF ACCORDINGLY UNDER RCRA. SEE 40 CFR 261.33(C) AND 261.7(B)(3) FOR TRIPLE RINSING REQUIREMENTS FOR EMPTY DRUMS.

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R. KENNETH LEE
MANAGER, PRODUCT SAFETY

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Vulcan CHEMICALS

MATERIAL SAFETY DATA SHEET

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24 Hour Emergency Phone (316) 524-5751

FEB 17 1988

Division of Vulcan Materials Company P.O. Box 7689 • Birmingham, AL 35253-0689

I – IDENTIFICATION

INDUSTRIAL HYGIENE

CHEMICAL NAME	CHEMICAL FORMULA	MOLECULAR WEIGHT
1,1,1 Trichloroethane	$C_2H_3Cl_3$	133.4

TRADE NAME
Solvent 111®, General Purpose Grade, Industrial Grade

SYNONYMS
Methyl Chloroform

DOT IDENTIFICATION NO
UN 2831

II – PRODUCT AND COMPONENT DATA

COMPONENT(S) CHEMICAL NAME	CAS REGISTRY NO.	% (Approx)	ACGIH TLV-TWA
1,1,1 Trichloroethane	71-55-6	95.5	350 ppm
Diethylene ether	123-91-1		

The hazard information presented is based on tests conducted on this or similar mixtures.

III – PHYSICAL DATA

APPEARANCE AND ODOR Clear, colorless liquid, mildly sweet odor	SPECIFIC GRAVITY 1.32 @ 25°/25°C
BOILING POINT 165°F (74°C)	VAPOR DENSITY IN AIR (Air = 1) 4.6
VAPOR PRESSURE 100 mm Hg @ 20°C	% VOLATILE BY VOLUME 100
EVAPORATION RATE (ether = 1): 0.4	SOLUBILITY IN WATER 0.07 gm/100 gm @ 25°C

IV – REACTIVITY DATA

STABILITY	CONDITIONS TO AVOID
Stable	Avoid contact with open flame, electric arcs, or other hot surfaces which can cause thermal decomposition.

INCOMPATIBILITY (Materials to avoid)

Strong alkalies, oxidizers, and reactive metals (i.e., aluminum, potassium, sodium, etc.). Refer to Section VIII for additional information on aluminum.

HAZARDOUS DECOMPOSITION PRODUCTS

Hydrogen chloride, phosgene, chlorine.

HAZARDOUS POLYMERIZATION
Will not occur.

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CHRONIC TOXICITY

The finding of chronic toxic effects in laboratory animals may indicate toxicity to humans. Over-exposure should be avoided, failure to do so could result in injury, illness or even death.

Chronic overexposures to 1,1,1 trichloroethane have caused liver toxic effects in experimental animals.

Carcinogenicity - The available data indicates that 1,1,1 trichloroethane is not carcinogenic in laboratory animals.

1,1,1 trichloroethane is not listed on the OSHA, IARC, or NTP carcinogen lists.

Reproductive Toxicity - Three studies have been performed on laboratory animals to evaluate the effects of 1,1,1 trichloroethane on reproduction and fetal development. Two of the three studies indicate no reproductive toxicity. The third study noted delays in normal development, but these delays did not affect later life.

VII – PERSONAL PROTECTION AND CONTROLS

RESPIRATORY PROTECTION

Where vapor concentration exceeds or is likely to exceed 350 ppm, an approved organic vapor type respirator is acceptable. Approved self-contained breathing apparatus or air line respirator, with full face piece, is required for vapor concentrations above 1,000 ppm and for spills and/or emergencies. Follow any applicable respirator use standards or regulations.

VENTILATION

Do not use in closed or confined space. Open doors and/or windows. Use ventilation to maintain exposure levels below 350 ppm.

SKIN PROTECTION

Wear solvent-resistant gloves such as Viton, polyvinyl alcohol, or equivalent. Solvent-resistant boots, apron, headgear and/or faceshield should be worn where splashing is possible.

EYE PROTECTION

Wear safety glasses. Contact lenses should not be worn. Chemical goggles and/or face shields should be worn where splashing is possible.

HYGIENE

Avoid contact with skin and avoid breathing vapors. Do not eat, drink, or smoke in work area. Wash hands prior to eating, drinking, or using restroom.

OTHER CONTROL MEASURES

To determine exposure level(s), monitoring should be performed regularly. Safety shower and eyewash station should be available.

NOTE: Protective equipment and clothing should be selected, used, and maintained according to applicable standards and regulations. For further information, contact the clothing or equipment manufacturer or the Vulcan Chemicals Technical Service department.

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Vulcan CHEMICALS

MATERIAL SAFETY DATA SHEET

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24 Hour Emergency Phone (316) 524-5751

FEB 17 1988

Division of Vulcan Materials Company P.O. Box 7689 • Birmingham, AL 35253-0689

I – IDENTIFICATION

INDUSTRIAL HYGIENE

CHEMICAL NAME	CHEMICAL FORMULA	MOLECULAR WEIGHT
1,1,1 Trichloroethane	$C_2H_3Cl_3$	133.4

TRADE NAME
Solvent 111®, General Purpose Grade, Industrial Grade

SYNONYMS
Methyl Chloroform

DOT IDENTIFICATION NO
UN 2831

II – PRODUCT AND COMPONENT DATA

COMPONENT(S) CHEMICAL NAME	CAS REGISTRY NO.	% (Approx)	ACGIH TLV-TWA
1,1,1 Trichloroethane	71-55-6	95.5	350 ppm
Diethylene ether	123-91-1		

The hazard information presented is based on tests conducted on this or similar mixtures.

III – PHYSICAL DATA

APPEARANCE AND ODOR Clear, colorless liquid, mildly sweet odor	SPECIFIC GRAVITY 1.32 @ 25°/25°C
BOILING POINT 165°F (74°C)	VAPOR DENSITY IN AIR (Air = 1) 4.6
VAPOR PRESSURE 100 mm Hg @ 20°C	% VOLATILE BY VOLUME 100
EVAPORATION RATE (ether = 1): 0.4	SOLUBILITY IN WATER 0.07 gm/100 gm @ 25°C

IV – REACTIVITY DATA

STABILITY	CONDITIONS TO AVOID
Stable	Avoid contact with open flame, electric arcs, or other hot surfaces which can cause thermal decomposition.

INCOMPATIBILITY (Materials to avoid)

Strong alkalies, oxidizers, and reactive metals (i.e., aluminum, potassium, sodium, etc.). Refer to Section VIII for additional information on aluminum.

HAZARDOUS DECOMPOSITION PRODUCTS

Hydrogen chloride, phosgene, chlorine.

HAZARDOUS POLYMERIZATION
Will not occur.

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V – FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	FLAMMABLE LIMITS IN AIR
None (TOC)	7.5 – 15.0% (vol.) @ 25°C

EXTINGUISHING AGENTS

Water, foam, dry chemical, carbon dioxide (CO_2)

UNUSUAL FIRE AND EXPLOSION HAZARDS Concentrated vapors can be ignited by high intensity ignition source. Firefighters should wear self-contained, positive-pressure breathing apparatus, due to thermal decomposition products, and avoid skin contact.

VI – TOXICITY AND FIRST AID

EXPOSURE LIMITS (When exposure to this product and other chemicals is concurrent, the TLV must be defined in the workplace.)

1,1,1 trichloroethane ACGIH: 350 ppm TWA (8 hr), 450 ppm STEL
OSHA: 350 ppm TWA (8 hr)
(Odor threshold approximately 100 ppm; causes olfactory fatigue)

Effects described in this section are believed not to occur if exposures are maintained at or below appropriate TLVs.
Because of the wide variation in individual susceptibility, TLVs may not be applicable to all persons and those with medical conditions listed below.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

Acute and chronic liver disease and rhythm disorders of the heart.

ACUTE TOXICITY Primary route(s) of exposure: ☒ Inhalation ☐ Skin Absorption ☐ Ingestion

Inhalation: Major potential route of exposure. Minimal effects observed below 1,000 ppm; dizziness, drowsiness, and throat irritation at levels above 1,000 ppm. Unconciousness and death possible at levels above 10,000 ppm. Blood pressure depression, cardiac sensitization, and ventricular arrhythmia can result from the exposure to near-anesthetic levels.

Skin: Prolonged or repeated skin contact can cause irritation, defatting of skin, and dermatitis. Absorption of liquid through intact skin possible, resulting in systemic effects, but unlikely route of significant exposure.

Eyes: Liquid can cause slight temporary irritation with slight temporary corneal injury. Vapors can irritate eyes.

Ingestion: Single dose toxicity is low to moderate. If vomiting occurs, 1,1,1 trichloroethane can be aspirated into the lungs, which can cause chemical pneumonia and systemic effects.

FIRST AID

Inhalation: Remove to fresh air. If breathing has stopped, administer artificial respiration. Call a physician.
Skin: Remove contaminated clothing and shoes. Wash exposed area with soap and water. Wash contaminated clothing before reuse.
Eyes: Flush eyes immediately with water for at least 15 minutes. If irritation persists, call a physician.
Ingestion: Do not induce vomiting. Contact physician or emergency medical facility immediately.

NOTE TO PHYSICIAN: Adrenalin should never be given to persons overexposed to 1,1,1 trichloroethane.

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PPG INDUSTRIES, INC. ONE PPG PLACE PITTSBURGH, PA 15272

* * * TRI-ETHANE(R) 366

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INDUSTRIAL HYGIENE

MSDS NUMBER: 0086
DATE: 10/05/88
EDITION: 011
TRADE NAME: TRI-ETHANE(R) 366
CHEMICAL NAME/SYNONYMS: 1,1,1-TRICHLOROETHANE, METHYLCHLOROFORM
CHEMICAL FAMILY: HALOGENATED HYDROCARBONS
FORMULA: CH3CCL3 CAS NUMBER: 00071 55 6
U.S. DOT SHIPPING NAME: 1,1,1-TRICHLOROETHANE
U.S. DOT HAZARD CLASS: ORM-A
SUBSIDIARY RISK: N/A
I.D. NUMBER: UN2831
REPORTABLE QUANTITY: 1000 LBS/454 KG
ONLY REGULATED WHEN SHIPPED IN BULK OR BY AIR.
* STABILIZED FOR VAPOR DEGREASING AND GENERAL SOLVENT USE.

SECTION 1 * PHYSICAL DATA

BOILING POINT @ 760 MM HG: 72-88 C
VAPOR DENSITY (AIR=1): 4.54
SPECIFIC GRAVITY (H20=1): 1.300-1.320 @ 25/25 C
PH OF SOLUTIONS: 6.0 TO 7.5
FREEZING/MELTING POINT: -45 C
SOLUBILITY (WEIGHT % IN WATER): NEGLIGIBLE
BULK DENSITY: 10.8-10.97 #/GAL @ 25 C
VOLUME % VOLATILE: 100
VAPOR PRESSURE: 135 MM HG @ 25 C
EVAPORATION RATE: (ETHYL ETHER=1): 0.35
HEAT OF SOLUTION: N/A
APPEARANCE AND ODOR:
CLEAR, COLORLESS LIQUID WITH ETHER-LIKE ODOR
NOTE: TESTED MIXTURE.

SECTION 2 * INGREDIENTS

MATERIAL	PERCENT
1,1,1-TRICHLOROETHANE (STABILIZED)	96
1,4-DIETHYLENE DIOXIDE (CAS #123-91-1), GLYCOL METHYLENE ETHER (CAS #646-06-0), SEC BUTANOL (CAS #78-92-2), OTHER STABILIZERS. (TESTED MIXTURE)	BALANCE

SECTION 3 * FIRE/EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED):
NONE

FLAMMABLE LIMITS IN AIR (% BY VOLUME)
LEL: 7%
UEL: 15%

EXTINGUISHING MEDIA:
WATER, DRY CHEMICALS OR CARBON DIOXIDE

SPECIAL FIRE FIGHTING PROCEDURES:
FIRE FIGHTERS SHOULD WEAR NIOSH/MSHA APPROVED,PRESSURE DEMAND, SELF-CONTAINED BREATHING APPARATUS FOR POSSIBLE EXPOSURE TO HYDROGEN CHLORIDE AND POSSIBLE TRACES OF PHOSGENE.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
VAPORS CONCENTRATED IN A CONFINED OR POORLY VENTILATED AREA CAN BE IGNITED UPON CONTACT WITH A HIGH ENERGY SPARK, FLAME, OR HIGH INTENSITY SOURCE OF HEAT. THIS CAN OCCUR AT CONCEN. RANGING BETWEEN 7-15% BY VOLUME. DECOMPOSITION OR BURNING CAN PRODUCE HYDROGEN CHLORIDE OR POSSIBLE TRACES OF PHOSGENE.

SECTION 4 * HEALTH HAZARD DATA

TOXICITY DATA:

LC50 INHALATION:	(RAT) 14,250 PPM/7 HOURS
LD50 DERMAL:	(RABBIT) > 15 G/KG
SKIN/EYE IRRITATION:	SEE SECTION 5
LD50 INGESTION:	(RAT) 10-12 G/KG
FISH,LC50 (LETHAL CONCENTRATION):	UNKNOWN

CLASSIFICATION: (POISON, IRRITANT, ETC.)

INHALATION:	SLIGHTLY TOXIC
SKIN:	NOT SIGNIFICANTLY TOXIC
SKIN/EYE:	IRRITATING
INGESTION:	NOT SIGNIFICANTLY TOXIC
AQUATIC:	UNKNOWN

SECTION 5 * EFFECTS OF OVEREXPOSURE

THIS SECTION COVERS EFFECTS OF OVEREXPOSURE FOR INHALATION, EYE/SKIN CONTACT, INGESTION AND OTHER TYPES OF OVEREXPOSURE INFORMATION IN THE ORDER OF THE MOST HAZARDOUS AND THE MOST LIKELY ROUTE OF OVEREXPOSURE.

IS CHEMICAL LISTED AS A CARCINOGEN OR POTENTIAL CARCINOGEN?
NTP - NO IARC - NO OSHA - NO

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE:
NONE KNOWN.

PERMISSIBLE EXPOSURE LIMITS:
OSHA: 350 PPM, 8-HOUR TWA (TIME-WEIGHTED AVERAGE); 29 CFR 1910.1000.
ACGIH: 350 PPM, 8-HOUR TWA (TIME-WEIGHTED AVERAGE);
450 PPM, STEL (SHORT-TERM EXPOSURE LIMIT).

ACUTE:

INHALATION: TRI-ETHANE(R) IS PRIMARILY A CENTRAL NERVOUS SYSTEM DEPRESSANT. INHALATION CAN CAUSE IRRITATION OF THE RESPIRATORY SYSTEM, DIZZINESS, NAUSEA, LIGHTHEADEDNESS, HEADACHE, LOSS OF COORDINATION AND EQUILIBRIUM, UNCONSCIOUSNESS, POSSIBLE CENTRAL NERVOUS SYSTEM DAMAGE AND EVEN DEATH IN CONFINED OR POORLY VENTILATED AREAS. FATALITIES FOLLOWING SEVERE ACUTE EXPOSURE TO VARIOUS CHLORINATED SOLVENTS HAVE BEEN ATTRIBUTED TO VENTRICULAR FIBRILLATION.

AEROSOL - PRELIMINARY RESULTS FROM STUDIES IN RATS INDICATE THAT THE ACUTE INHALATION TOXICITY OF "AEROSOLIZED" 1,1,1-TRICHLOROETHANE IS HIGHER THAN EXPECTED BASED ON THE REPORTED ACUTE INHALATION TOXICITY OF 1,1,1-TRICHLOROETHANE VAPOR. THE SIGNIFICANCE OF THESE FINDINGS TO HUMAN HEALTH IN PRODUCT USE SITUATIONS IS NOT CLEARLY UNDERSTOOD.

EYE/SKIN: LIQUID SPLASHED IN THE EYE CAN RESULT IN DISCOMFORT, PAIN AND IRRITATION. PROLONGED OR REPEATED CONTACT WITH LIQUID ON THE SKIN CAN CAUSE IRRITATION AND DERMATITIS. THE PROBLEM MAY BE ACCENTUATED BY LIQUID BECOMING TRAPPED AGAINST THE SKIN BY CONTAMINATED CLOTHING AND SHOES, AND SKIN ABSORPTION CAN OCCUR.

INGESTION: SWALLOWING OF THIS MATERIAL MAY RESULT IN IRRITATION OF THE MOUTH AND GI TRACT WITH OTHER EFFECTS AS LISTED ABOVE FOR INHALATION.

VOMITING AND SUBSEQUENT ASPIRATION INTO THE LUNGS MAY LEAD TO CHEMICAL PNEUMONIA AND PULMONARY EDEMA WHICH IS A POTENTIALLY FATAL CONDITION. LD50 INGESTION (RABBIT; GUINEA PIG) 5.6-9.5 G/KG.

CHRONIC:

TRI-ETHANE(R) HAS BEEN EXTENSIVELY STUDIED FOR CANCER POTENTIAL. THERE THERE IS NO DOCUMENTED EVIDENCE TO SUGGEST THAT TRI-ETHANE(R) CAUSES AN INCREASED CANCER INCIDENCE IN HUMANS OR ANIMALS. THE EPA'S SCIENCE ADVISORY BOARD CONCLUDED THAT THERE IS NO EVIDENCE TO SUGGEST CARCINOGENIC ACTIVITY FOR TRI-ETHANE(R).

REPRODUCTIVE:

IN DEVELOPMENTAL TOXICITY STUDIES, THERE WAS NO EVIDENCE FOR BIRTH DEFECTS IN RATS OR RABBITS AFTER INHALATION EXPOSURE TO PREGNANT ANIMALS. NO ADVERSE FINDINGS RELATIVE TO REPRODUCTIVE OR DEVELOPMENTAL TOXICITY WERE OBSERVED FOLLOWING DAILY SIX-HOUR EXPOSURES AT OR BELOW 3000 PPM IN RATS OR RABBITS.

---

* EMERGENCY AND FIRST AID PROCEDURES

INHALATION:

REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION, PREFERABLY MOUTH-TO-MOUTH. IF BREATHING IS DIFFICULT, GIVE OXYGEN. CALL A PHYSICIAN.

EYE OR SKIN CONTACT:

FLUSH EYES AND SKIN WITH PLENTY OF WATER (SOAP AND WATER FOR SKIN) FOR AT LEAST 15 MINUTES, WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. IF IRRITATION OCCURS, CONSULT A PHYSICIAN. THOROUGHLY CLEAN CONTAMINATED CLOTHING AND SHOES BEFORE REUSE OR DISCARD.

INGESTION:

IF CONSCIOUS, DRINK LARGE QUANTITIES OF WATER. DO NOT INDUCE VOMITING. TAKE IMMEDIATELY TO A HOSPITAL OR PHYSICIAN. IF UNCONSCIOUS, OR IN CONVULSIONS, TAKE IMMEDIATELY TO A HOSPITAL. DO NOT ATTEMPT TO GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

NOTES TO PHYSICIAN (INCLUDING ANTIDOTES):

NEVER ADMINISTER ADRENALINE FOLLOWING TRI-ETHANE(R) OVEREXPOSURE. INCREASED SENSITIVITY OF THE HEART TO ADRENALINE MAY BE CAUSED BY OVEREXPOSURE TO TRI-ETHANE(R).

SECTION 6 * REACTIVITY DATA

STABILITY: STABLE
CONDITIONS TO AVOID: OPEN FLAMES, HOT GLOWING SURFACES OR ELECTRIC ARCS.
HAZARDOUS POLYMERIZATION: WILL NOT OCCUR.
CONDITIONS TO AVOID: NONE
INCOMPATIBILITY (MATERIALS TO AVOID):
AVOID MIXING WITH CAUSTIC SODA, CAUSTIC POTASH, OR OXIDIZING MATERIALS. SHOCK SENSITIVE COMPOUNDS MAY BE FORMED.
HAZARDOUS DECOMPOSITION PRODUCTS:
HYDROGEN CHLORIDE AND POSSIBLE TRACES OF PHOSGENE.

SECTION 7 * SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS SPILLED OR RELEASED:
IMMEDIATELY EVACUATE THE AREA AND PROVIDE MAXIMUM VENTILATION. UNPROTECTED PERSONNEL SHOULD MOVE UPWIND OF SPILL. ONLY PERSONNEL EQUIPPED WITH PROPER RESPIRATORY AND SKIN/EYE PROTECTION (SEE SECTION 8) SHOULD BE PERMITTED IN AREA. DIKE AREA TO CONTAIN SPILL. TAKE PRECAUTIONS AS NECESSARY TO PREVENT CONTAMINATION OF GROUND AND SURFACE WATERS. RECOVER SPILLED MATERIAL ON ADSORBENTS, SUCH AS SAWDUST AND VERMICULATE, AND SWEEP INTO CLOSED CONTAINERS FOR DISPOSAL. AFTER ALL VISIBLE TRACES, INCLUDING IGNITABLE VAPORS, HAVE BEEN REMOVED, THOROUGHLY WET VACUUM THE AREA. DO NOT FLUSH TO SEWER. IF AREA OF SPILL IS POROUS, REMOVE AS MUCH CONTAMINATED EARTH AND GRAVEL, ETC. AS NECESSARY AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.
WASTE DISPOSAL METHOD:
CONTAMINATED SAWDUST, VERMICULITE, OR POROUS SURFACES MUST BE DISPOSED OF IN A PERMITTED HAZARDOUS WASTE MANAGEMENT FACILITY. RECOVERED LIQUIDS MAY BE REPROCESSED OR INCINERATED OR MUST BE TREATED IN A PERMITTED HAZARDOUS WASTE MANAGEMENT FACILITY. CARE MUST BE TAKEN WHEN USING OR DISPOSING OF CHEMICAL MATERIALS AND/OR THEIR CONTAINERS TO PREVENT ENVIRONMENTAL CONTAMINATION. IT IS YOUR DUTY TO DISPOSE OF THE CHEMICAL MATERIALS AND/OR THEIR CONTAINERS IN ACCORDANCE WITH THE CLEAN AIR ACT, THE CLEAN WATER ACT, THE RESOURCE CONSERVATION AND RECOVERY ACT, AS WELL AS ANY OTHER RELEVANT FEDERAL, STATE, OR LOCAL LAWS/REGULATIONS REGARDING DISPOSAL.

SECTION 8 * SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:

USE A HALF OR FULL FACEPIECE ORGANIC VAPOR CHEMICAL CARTRIDGE OR CANISTER RESPIRATOR WHEN CONCENTRATIONS EXCEED PERMISSIBLE LIMITS. USE SELF-CONTAINED BREATHING APPARATUS (SCBA) OR FULL FACEPIECE AIRLINE RESPIRATOR WITH AUXILIARY SCBA OPERATED IN THE PRESSURE-DEMAND MODE FOR EMERGENCIES AND FOR ALL WORK PERFORMED IN STORAGE VESSELS, POORLY VENTILATED ROOMS, AND OTHER CONFINED AREAS. RESPIRATORS MUST BE APPROVED BY NIOSH OR MSHA. THE RESPIRATOR USE LIMITATIONS MADE BY NIOSH/MSHA AND BY THE MANUFACTURER MUST BE OBSERVED. RESPIRATORY PROTECTION PROGRAMS MUST BE IN ACCORDANCE WITH 29 CFR 1910.134.

VENTILATION(TYPE):

USE LOCAL EXHAUST OR DILUTION VENTILATION AS APPROPRIATE TO CONTROL EXPOSURES TO BELOW PERMISSIBLE LIMITS.

EYE PROTECTION:

SPLASHPROOF GOGGLES

GLOVES:

VITRON(R), SILVER SHIELD(R), FOR LIMITED SERVICE ONLY: POLYVINYL ALCOHOL (DEGRADES IN WATER)

OTHER PROTECTIVE EQUIPMENT:

BOOTS, APRONS, OR CHEMICAL SUITS SHOULD BE USED WHEN NECESSARY TO PREVENT SKIN CONTACT. PERSONAL PROTECTIVE CLOTHING AND USE OF EQUIPMENT MUST BE IN ACCORDANCE WITH 29 CFR 1910.132 AND 29 CFR 1910.133.

SECTION 9 * SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN DURING HANDLING AND STORING:

* DO NOT USE IN POORLY VENTILATED OR CONFINED AREAS WITHOUT PROPER RESPIRATORY PROTECTION (SEE SECTION 8).
* TRI-ETHANE(R) VAPORS ARE HEAVIER THAN AIR AND WILL COLLECT IN LOW AREAS.
* KEEP CONTAINER CLOSED WHEN NOT IN USE.
* STORE ONLY IN CLOSED, PROPERLY LABELED CONTAINERS.
* LIQUID OXYGEN OR OTHER STRONG OXIDANTS MAY FORM EXPLOSIVE MIXTURES WITH TRI-ETHANE(R).
* THIS MATERIAL OR ITS VAPORS WHEN IN CONTACT WITH FLAMES, HOT GLOWING SURFACES, OR ELECTRIC ARCS CAN DECOMPOSE TO FORM HYDROGEN CHLORIDE AND POSSIBLE TRACES OF PHOSGENE.
* AVOID CONTAMINATION OF WATER SUPPLIES. HANDLING, STORAGE, AND USE PROCE-

DURES MUST BE CAREFULLY MONITORED TO AVOID SPILLS OR LEAKS. ANY SPILL OR LEAK HAS THE POTENTIAL TO CAUSE UNDERGROUND WATER CONTAMINATION WHICH MAY, IF SUFFICIENTLY SEVERE, RENDER A DRINKING WATER SOURCE UNFIT FOR HUMAN CONSUMPTION. CONTAMINATION THAT DOES OCCUR CANNOT BE EASILY CORRECTED.

* DO NOT STORE OR STACK ALUMINUM IN CONTACT WITH TRI-ETHANE(R) TO PREVENT POSSIBLE SOLVENT DECOMPOSITION (STACKING CORROSION).
* CAUTION SHOULD BE TAKEN NOT TO USE IN PRESSURIZED OR TOTALLY ENCLOSED SYSTEM OF ALUMINUM CONSTRUCTION. EXAMPLE: PAINT OR ADHESIVE SPRAY SYSTEM.
* A CHLORINATED SOLVENT USED AS A FLASHPOINT SUPPRESSANT MUST BE ADDED IN SUFFICIENT QUANTITY OR THE RESULTANT MIXTURE MAY HAVE A FLASHPOINT LOWER THAN THE FLAMMABLE COMPONENT.
* DO NOT USE CUTTING OR WELDING TORCHES ON EMPTY DRUMS THAT CONTAINED TRI-ETHANE(R) UNLESS PROPERLY PURGED AND CLEANED.

OTHER PRECAUTIONS:

* DO NOT BREATHE VAPORS. HIGH VAPOR CONCENTRATIONS CAN CAUSE DIZZINESS, UNCONSCIOUSNESS OR DEATH. LONG-TERM OVEREXPOSURE MAY CAUSE POSSIBLE CENTRAL NERVOUS SYSTEM DAMAGE.
* USE ONLY WITH ADEQUATE VENTILATION. VENTILATION MUST BE SUFFICIENT TO LIMIT EMPLOYEE EXPOSURE TO TRI-ETHANE(R) BELOW PERMISSIBLE EXPOSURE LIMITS. OBSERVANCE OF LOWER LIMITS (OUTLINED IN SECTION 5) IS ADVISABLE. EYE IRRITATION, DIZZINESS AND/OR DRUNKENNESS ARE SIGNS OF OVEREXPOSURE.
* AVOID CONTACT WITH EYES. WILL CAUSE IRRITATION AND PAIN.
* AVOID PROLONGED OR REPEATED CONTACT WITH SKIN. MAY CAUSE IRRITATION OR DERMATITIS.
* DO NOT SWALLOW. SWALLOWING MAY CAUSE INJURY OR DEATH.
* DO NOT EAT, DRINK OR SMOKE IN WORK AREA.

COMMENTS:

TSCA - 1,1,1-TRICHLOROETHANE IS ON THE TSCA INVENTORY UNDER CAS #71-55-6. TRI-ETHANE FORMULATIONS CONTAIN STABILIZERS THAT ARE LISTED ON THE TSCA INVENTORY.

SARA TITLE III - A) 311/312 CATEGORIES - ACUTE, B) LISTED IN SECTION 313 AS 1,1,1-TRICHLOROETHANE (METHYLCHLOROFORM), C) NOT LISTED AS AN "EXTREMELY HAZARDOUS SUBSTANCE" IN SECTION 302.

CERCLA - LISTED IN TABLE 302.4 OF 40 CFR PART 302 AS A HAZARDOUS SUBSTANCE WITH A REPORTABLE QUANTITY OF 1000 POUNDS. RELEASES TO AIR, LAND, OR WATER WHICH EXCEED THE RQ MUST BE REPORTED TO THE NATIONAL RESPONSE CENTER, 800-424-8802.

RCRA - WASTE 1,1,1-TRICHLOROETHANE AND CONTAMINATED SOILS/MATERIALS FROM SPILL CLEANUP ARE U226 HAZARDOUS WASTE AS PER 40 CFR 261.33 AND MUST BE

DISPOSED OF ACCORDINGLY UNDER RCRA. SEE 40 CFR 261.33(C) AND 261.7(B)(3) FOR CLEANING REQUIREMENTS FOR EMPTY CONTAINERS.

CALIFORNIA PROP. 65 - THIS PRODUCT CONTAINS A CHEMICAL KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

R. KENNETH LEE
MANAGER, PRODUCT SAFETY

PM 29056

PPG

PPG INDUSTRIES, INC. · ONE PPG PLACE PITTSBURGH, PA 15272

MSDS: 86 PRODUCT: TRI-ETHANE(R) 366

RECEIVED
NOV 30 1988
INDUSTRIAL HYGIENE

11/18/88

PRATT & WHITNEY AIRCRAFT GROUP

MIDDLETOWN , CT 06457

GENTLEMEN:

AS YOU KNOW, YOU ARE CURRENTLY PURCHASING THE ABOVE-MENTIONED PRODUCT FROM PPG. EVEN THOUGH THIS PRODUCT IS VERY USEFUL, YOU SHOULD BE AWARE OF THE HAZARDS, PROPER HANDLING, AND USE OF SUCH PRODUCTS. ACCORDINGLY, WE ARE ENCLOSING THE ABOVE MATERIAL SAFETY DATA SHEET SHOWING WARNINGS AND INFORMATIONAL DATA.

PPG URGES YOU, AND IT IS YOUR DUTY, TO PASS THE ENCLOSED WARNINGS AND INFORMATION ALONG TO YOUR EMPLOYEES, CUSTOMERS, HANDLERS, OR USERS OF THIS PRODUCT. THE SAME PRINCIPLE APPLIES TO ANY PRODUCT MADE BY YOU FROM PPG PRODUCTS.

EVEN THOUGH PPG IS FURNISHING THIS INFORMATION TO YOU, IT IS NOT NECESSARILY ALL-ENCOMPASSING; THEREFORE, IT IS RECOMMENDED THAT YOU SHOULD CONSULT WITH KNOWLEDGEABLE PEOPLE OF YOUR CHOICE IN ORDER TO DETERMINE WHETHER YOUR SAFETY PROGRAMS AND WARNINGS ARE ADEQUATE AND/OR IN COMPLIANCE WITH ANY APPLICABLE LAWS OR REGULATIONS.

VERY TRULY YOURS,

R. KENNETH LEE
MANAGER, PRODUCT SAFETY
ENVIRONMENTAL AFFAIRS
CHEMICALS

ENCLOSURE

RECEIVED
NOV 29 1988
SAFETY
MIDDLETOWN

FILE COPY

★ ★ ★ 24-HOUR EMERGENCY ASSISTANCE: (304) 843-1300 ★ ★ ★

FORM 6372 Rev. 3-88 **Material Safety Data Sheet**

* * * TRI-ETHANE(R) 366

RECEIVED
NOV 30 1988
INDUSTRIAL HYGIENE

MSDS NUMBER: 0086
DATE: 10/05/88
EDITION: 011
TRADE NAME: TRI-ETHANE(R) 366
CHEMICAL NAME/SYNONYMS: 1,1,1-TRICHLOROETHANE, METHYLCHLOROFORM
CHEMICAL FAMILY: HALOGENATED HYDROCARBONS
FORMULA: CH3CCL3 CAS NUMBER: 00071 55 6
U.S. DOT SHIPPING NAME: 1,1,1-TRICHLOROETHANE
U.S. DOT HAZARD CLASS: ORM-A
SUBSIDIARY RISK: N/A
I.D. NUMBER: UN2831
REPORTABLE QUANTITY: 1000 LBS/454 KG
ONLY REGULATED WHEN SHIPPED IN BULK OR BY AIR.
* STABILIZED FOR VAPOR DEGREASING AND GENERAL SOLVENT USE.

SECTION 1 * PHYSICAL DATA

BOILING POINT @ 760 MM HG: 72-88 C
VAPOR DENSITY (AIR=1): 4.54
SPECIFIC GRAVITY (H20=1): 1.300-1.320 @ 25/25 C
PH OF SOLUTIONS: 6.0 TO 7.5
FREEZING/MELTING POINT: -45 C
SOLUBILITY (WEIGHT % IN WATER): NEGLIGIBLE
BULK DENSITY: 10.8-10.97 #/GAL @ 25 C
VOLUME % VOLATILE: 100
VAPOR PRESSURE: 135 MM HG @ 25 C
EVAPORATION RATE: (ETHYL ETHER=1): 0.35
HEAT OF SOLUTION: N/A
APPEARANCE AND ODOR:
CLEAR, COLORLESS LIQUID WITH ETHER-LIKE ODOR
NOTE: TESTED MIXTURE.

SECTION 2 * INGREDIENTS

MATERIAL	PERCENT
1,1,1-TRICHLOROETHANE (STABILIZED)	96
1,4-DIETHYLENE DIOXIDE (CAS #123-91-1), GLYCOL METHYLENE ETHER (CAS #646-06-0), SEC BUTANOL (CAS #78-92-2), OTHER STABILIZERS. (TESTED MIXTURE)	BALANCE

SECTION 3 * FIRE/EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED):
NONE
FLAMMABLE LIMITS IN AIR (% BY VOLUME)
LEL: 7%
UEL: 15%
EXTINGUISHING MEDIA:
WATER, DRY CHEMICALS OR CARBON DIOXIDE

SPECIAL FIRE FIGHTING PROCEDURES:
FIRE FIGHTERS SHOULD WEAR NIOSH/MSHA APPROVED,PRESSURE DEMAND, SELF-CONTAINED BREATHING APPARATUS FOR POSSIBLE EXPOSURE TO HYDROGEN CHLORIDE AND POSSIBLE TRACES OF PHOSGENE.
UNUSUAL FIRE AND EXPLOSION HAZARDS:
VAPORS CONCENTRATED IN A CONFINED OR POORLY VENTILATED AREA CAN BE IGNITED UPON CONTACT WITH A HIGH ENERGY SPARK, FLAME, OR HIGH INTENSITY SOURCE OF HEAT. THIS CAN OCCUR AT CONCEN. RANGING BETWEEN 7-15% BY VOLUME. DECOMPOSITION OR BURNING CAN PRODUCE HYDROGEN CHLORIDE OR POSSIBLE TRACES OF PHOSGENE.

SECTION 4 * HEALTH HAZARD DATA

TOXICITY DATA:

LC50 INHALATION:	(RAT) 14,250 PPM/7 HOURS
LD50 DERMAL:	(RABBIT) > 15 G/KG
SKIN/EYE IRRITATION:	SEE SECTION 5
LD50 INGESTION:	(RAT) 10-12 G/KG
FISH,LC50 (LETHAL CONCENTRATION):	UNKNOWN

CLASSIFICATION: (POISON, IRRITANT, ETC.)

INHALATION:	SLIGHTLY TOXIC
SKIN:	NOT SIGNIFICANTLY TOXIC
SKIN/EYE:	IRRITATING
INGESTION:	NOT SIGNIFICANTLY TOXIC
AQUATIC:	UNKNOWN

SECTION 5 * EFFECTS OF OVEREXPOSURE

THIS SECTION COVERS EFFECTS OF OVEREXPOSURE FOR INHALATION, EYE/SKIN CONTACT, INGESTION AND OTHER TYPES OF OVEREXPOSURE INFORMATION IN THE ORDER OF THE MOST HAZARDOUS AND THE MOST LIKELY ROUTE OF OVEREXPOSURE.

IS CHEMICAL LISTED AS A CARCINOGEN OR POTENTIAL CARCINOGEN?
NTP - NO IARC - NO OSHA - NO

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE:
NONE KNOWN.

PERMISSIBLE EXPOSURE LIMITS:
OSHA: 350 PPM, 8-HOUR TWA (TIME-WEIGHTED AVERAGE); 29 CFR 1910.1000.
ACGIH: 350 PPM, 8-HOUR TWA (TIME-WEIGHTED AVERAGE);
450 PPM, STEL (SHORT-TERM EXPOSURE LIMIT).

ACUTE:

INHALATION: TRI-ETHANE(R) IS PRIMARILY A CENTRAL NERVOUS SYSTEM DEPRESSANT. INHALATION CAN CAUSE IRRITATION OF THE RESPIRATORY SYSTEM, DIZZINESS, NAUSEA, LIGHTHEADEDNESS, HEADACHE, LOSS OF COORDINATION AND EQUILIBRIUM, UNCONSCIOUSNESS, POSSIBLE CENTRAL NERVOUS SYSTEM DAMAGE AND EVEN DEATH IN CONFINED OR POORLY VENTILATED AREAS. FATALITIES FOLLOWING SEVERE ACUTE EXPOSURE TO VARIOUS CHLORINATED SOLVENTS HAVE BEEN ATTRIBUTED TO VENTRICULAR FIBRILLATION.

AEROSOL - PRELIMINARY RESULTS FROM STUDIES IN RATS INDICATE THAT THE ACUTE INHALATION TOXICITY OF "AEROSOLIZED" 1,1,1-TRICHLOROETHANE IS HIGHER THAN EXPECTED BASED ON THE REPORTED ACUTE INHALATION TOXICITY OF 1,1,1-TRICHLOROETHANE VAPOR. THE SIGNIFICANCE OF THESE FINDINGS TO HUMAN HEALTH IN PRODUCT USE SITUATIONS IS NOT CLEARLY UNDERSTOOD.

EYE/SKIN: LIQUID SPLASHED IN THE EYE CAN RESULT IN DISCOMFORT, PAIN AND IRRITATION. PROLONGED OR REPEATED CONTACT WITH LIQUID ON THE SKIN CAN CAUSE IRRITATION AND DERMATITIS. THE PROBLEM MAY BE ACCENTUATED BY LIQUID BECOMING TRAPPED AGAINST THE SKIN BY CONTAMINATED CLOTHING AND SHOES, AND SKIN ABSORPTION CAN OCCUR.

INGESTION: SWALLOWING OF THIS MATERIAL MAY RESULT IN IRRITATION OF THE MOUTH AND GI TRACT WITH OTHER EFFECTS AS LISTED ABOVE FOR INHALATION.

VOMITING AND SUBSEQUENT ASPIRATION INTO THE LUNGS MAY LEAD TO CHEMICAL PNEUMONIA AND PULMONARY EDEMA WHICH IS A POTENTIALLY FATAL CONDITION. LD50 INGESTION (RABBIT; GUINEA PIG) 5.6-9.5 G/KG.

CHRONIC:

TRI-ETHANE(R) HAS BEEN EXTENSIVELY STUDIED FOR CANCER POTENTIAL. THERE THERE IS NO DOCUMENTED EVIDENCE TO SUGGEST THAT TRI-ETHANE(R) CAUSES AN INCREASED CANCER INCIDENCE IN HUMANS OR ANIMALS. THE EPA'S SCIENCE ADVISORY BOARD CONCLUDED THAT THERE IS NO EVIDENCE TO SUGGEST CARCINOGENIC ACTIVITY FOR TRI-ETHANE(R).

REPRODUCTIVE:

IN DEVELOPMENTAL TOXICITY STUDIES, THERE WAS NO EVIDENCE FOR BIRTH DEFECTS IN RATS OR RABBITS AFTER INHALATION EXPOSURE TO PREGNANT ANIMALS. NO ADVERSE FINDINGS RELATIVE TO REPRODUCTIVE OR DEVELOPMENTAL TOXICITY WERE OBSERVED FOLLOWING DAILY SIX-HOUR EXPOSURES AT OR BELOW 3000 PPM IN RATS OR RABBITS.

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* EMERGENCY AND FIRST AID PROCEDURES

INHALATION:

REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION, PREFERABLY MOUTH-TO-MOUTH. IF BREATHING IS DIFFICULT, GIVE OXYGEN. CALL A PHYSICIAN.

EYE OR SKIN CONTACT:

FLUSH EYES AND SKIN WITH PLENTY OF WATER (SOAP AND WATER FOR SKIN) FOR AT LEAST 15 MINUTES, WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. IF IRRITATION OCCURS, CONSULT A PHYSICIAN. THOROUGHLY CLEAN CONTAMINATED CLOTHING AND SHOES BEFORE REUSE OR DISCARD.

INGESTION:

IF CONSCIOUS, DRINK LARGE QUANTITIES OF WATER. DO NOT INDUCE VOMITING. TAKE IMMEDIATELY TO A HOSPITAL OR PHYSICIAN. IF UNCONSCIOUS, OR IN CONVULSIONS, TAKE IMMEDIATELY TO A HOSPITAL. DO NOT ATTEMPT TO GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

NOTES TO PHYSICIAN (INCLUDING ANTIDOTES):

NEVER ADMINISTER ADRENALINE FOLLOWING TRI-ETHANE(R) OVEREXPOSURE. INCREASED SENSITIVITY OF THE HEART TO ADRENALINE MAY BE CAUSED BY OVEREXPOSURE TO TRI-ETHANE(R).

SECTION 6 * REACTIVITY DATA

STABILITY: STABLE
CONDITIONS TO AVOID: OPEN FLAMES, HOT GLOWING SURFACES OR ELECTRIC ARCS.
HAZARDOUS POLYMERIZATION: WILL NOT OCCUR.
CONDITIONS TO AVOID: NONE
INCOMPATIBILITY (MATERIALS TO AVOID):
AVOID MIXING WITH CAUSTIC SODA, CAUSTIC POTASH, OR OXIDIZING MATERIALS. SHOCK SENSITIVE COMPOUNDS MAY BE FORMED.
HAZARDOUS DECOMPOSITION PRODUCTS:
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VENTILATION(TYPE):
USE LOCAL EXHAUST OR DILUTION VENTILATION AS APPROPRIATE TO CONTROL EXPOSURES TO BELOW PERMISSIBLE LIMITS.

EYE PROTECTION:
SPLASHPROOF GOGGLES

GLOVES:
VITRON(R), SILVER SHIELD(R), FOR LIMITED SERVICE
ONLY: POLYVINYL ALCOHOL (DEGRADES IN WATER)

OTHER PROTECTIVE EQUIPMENT:
BOOTS, APRONS, OR CHEMICAL SUITS SHOULD BE USED WHEN NECESSARY TO PREVENT SKIN CONTACT. PERSONAL PROTECTIVE CLOTHING AND USE OF EQUIPMENT MUST BE IN ACCORDANCE WITH 29 CFR 1910.132 AND 29 CFR 1910.133.

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* TRI-ETHANE(R) VAPORS ARE HEAVIER THAN AIR AND WILL COLLECT IN LOW AREAS.
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* LIQUID OXYGEN OR OTHER STRONG OXIDANTS MAY FORM EXPLOSIVE MIXTURES WITH TRI-ETHANE(R).
* THIS MATERIAL OR ITS VAPORS WHEN IN CONTACT WITH FLAMES, HOT GLOWING SURFACES, OR ELECTRIC ARCS CAN DECOMPOSE TO FORM HYDROGEN CHLORIDE AND POSSIBLE TRACES OF PHOSGENE.
* AVOID CONTAMINATION OF WATER SUPPLIES. HANDLING, STORAGE, AND USE PROCE-

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* DO NOT STORE OR STACK ALUMINUM IN CONTACT WITH TRI-ETHANE(R) TO PREVENT POSSIBLE SOLVENT DECOMPOSITION (STACKING CORROSION).
* CAUTION SHOULD BE TAKEN NOT TO USE IN PRESSURIZED OR TOTALLY ENCLOSED SYSTEM OF ALUMINUM CONSTRUCTION. EXAMPLE: PAINT OR ADHESIVE SPRAY SYSTEM.
* A CHLORINATED SOLVENT USED AS A FLASHPOINT SUPPRESSANT MUST BE ADDED IN SUFFICIENT QUANTITY OR THE RESULTANT MIXTURE MAY HAVE A FLASHPOINT LOWER THAN THE FLAMMABLE COMPONENT.
* DO NOT USE CUTTING OR WELDING TORCHES ON EMPTY DRUMS THAT CONTAINED TRI-ETHANE(R) UNLESS PROPERLY PURGED AND CLEANED.

OTHER PRECAUTIONS:

* DO NOT BREATHE VAPORS. HIGH VAPOR CONCENTRATIONS CAN CAUSE DIZZINESS, UNCONSCIOUSNESS OR DEATH. LONG-TERM OVEREXPOSURE MAY CAUSE POSSIBLE CENTRAL NERVOUS SYSTEM DAMAGE.
* USE ONLY WITH ADEQUATE VENTILATION. VENTILATION MUST BE SUFFICIENT TO LIMIT EMPLOYEE EXPOSURE TO TRI-ETHANE(R) BELOW PERMISSIBLE EXPOSURE LIMITS. OBSERVANCE OF LOWER LIMITS (OUTLINED IN SECTION 5) IS ADVISABLE. EYE IRRITATION, DIZZINESS AND/OR DRUNKENNESS ARE SIGNS OF OVEREXPOSURE.
* AVOID CONTACT WITH EYES. WILL CAUSE IRRITATION AND PAIN.
* AVOID PROLONGED OR REPEATED CONTACT WITH SKIN. MAY CAUSE IRRITATION OR DERMATITIS.
* DO NOT SWALLOW. SWALLOWING MAY CAUSE INJURY OR DEATH.
* DO NOT EAT, DRINK OR SMOKE IN WORK AREA.

COMMENTS:

TSCA - 1,1,1-TRICHLOROETHANE IS ON THE TSCA INVENTORY UNDER CAS #71-55-6. TRI-ETHANE FORMULATIONS CONTAIN STABILIZERS THAT ARE LISTED ON THE TSCA INVENTORY.

SARA TITLE III - A) 311/312 CATEGORIES - ACUTE, B) LISTED IN SECTION 313 AS 1,1,1-TRICHLOROETHANE (METHYLCHLOROFORM), C) NOT LISTED AS AN "EXTREMELY HAZARDOUS SUBSTANCE" IN SECTION 302.

CERCLA - LISTED IN TABLE 302.4 OF 40 CFR PART 302 AS A HAZARDOUS SUBSTANCE WITH A REPORTABLE QUANTITY OF 1000 POUNDS. RELEASES TO AIR, LAND, OR WATER WHICH EXCEED THE RQ MUST BE REPORTED TO THE NATIONAL RESPONSE CENTER, 800-424-8802.

RCRA - WASTE 1,1,1-TRICHLOROETHANE AND CONTAMINATED SOILS/MATERIALS FROM SPILL CLEANUP ARE U226 HAZARDOUS WASTE AS PER 40 CFR 261.33 AND MUST BE

DISPOSED OF ACCORDINGLY UNDER RCRA. SEE 40 CFR 261.33(C) AND 261.7(B)(3) FOR CLEANING REQUIREMENTS FOR EMPTY CONTAINERS.

CALIFORNIA PROP. 65 - THIS PRODUCT CONTAINS A CHEMICAL KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

R. KENNETH LEE
MANAGER, PRODUCT SAFETY

72-62-7820-01 +NC

9056

MATERIAL SAFETY DATA SHEET

Ashland Chemical Company
DIVISION OF ASHLAND OIL, INC.
P. O. BOX 2219, COLUMBUS, OHIO 43216 • (614) 889-3333
24-HOUR EMERGENCY TELEPHONE (606) 324-1133

RECEIVED NOV 18 1985 INDUSTRIAL HYGIENE

Ashland

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THIS MSDS COMPLIES WITH 29 CFR 1910.1200 (THE HAZARD COMMUNICATION STANDARD)

****

PRODUCT NAME: TRICHLORETHAN 111 DEGRS COLD/V
CAS NUMBER: 71 55 6

PRATT AND WHITNEY
400 MAIN STREET
EAST HARTFORD CT 06108

ATTN: PLANT MGR./SAFETY DIR.

05 50 077 7228590-
DATA SHEET NO: 0001466-005
LATEST REVISION DATE: 10/85-85303
PRODUCT: 3968500
INVOICE: 884624
INVOICE DATE: 09/18/85
TO: PRATT AND WHITNEY
8801 MACON ROAD
COLUMBUS GA 31908

SECTION I-PRODUCT IDENTIFICATION

GENERAL OR GENERIC ID: CHLORINATED HYDROCARBON

HAZARD CLASSIFICATION: (14) ORM-A

SECTION II-HAZARDOUS COMPONENTS

INGREDIENT	% (BY WT)	PEL	TLV	NOTE
1,1,1-TRICHLOROETHANE	90-95	350	350 PPM	

SECTION III-PHYSICAL DATA

PROPERTY	REFINEMENT	MEASUREMENT
INITIAL BOILING POINT	FOR PRODUCT	161.60 - 190.40 DEG F (72.00 - 88.00 DEG C) @ 760.00 MMHG
VAPOR PRESSURE	FOR PRODUCT	100.00 MMHG @ 68.00 DEG F (20.00 DEG C)
VAPOR DENSITY	AIR = 1	4.8
SPECIFIC GRAVITY		1.300 - 1.324 @ 77.00 DEG F (25.00 DEG C)
PERCENT VOLATILES		100.00%
EVAPORATION RATE	(ETHYL ETHER = 1)	2.60
APPEARANCE		CLEAR, APHA COLOR 15 MAX
STATE		LIQUID
FORM		HOMOG SOLN

SECTION IV-FIRE AND EXPLOSION DATA

FLASH POINT NOT APPLICABLE

EXPLOSIVE LIMIT (PRODUCT) LOWER - 6.7%

EXTINGUISHING MEDIA: WATER FOG

HAZARDOUS DECOMPOSITION PRODUCTS: MAY FORM TOXIC MATERIALS , CARBON DIOXIDE AND CARBON MONOXIDE, HYDROGEN CHLORIDE, PHOSGENE, VARIOUS HYDROCARBONS, ETC.

SPECIAL FIREFIGHTING PROCEDURES: WATER MAY BE USED TO KEEP FIRE-EXPOSED CONTAINERS COOL UNTIL FIRE IS OUT.

WEAR SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE WHEN FIGHTING FIRES.

UNUSUAL FIRE & EXPLOSION HAZARDS: NEVER USE WELDING OR CUTTING TORCH ON OR NEAR DRUM (EVEN EMPTY) BECAUSE PRODUCT (EVEN JUST RESIDUE) CAN IGNITE EXPLOSIVELY.

NFPA CODES: HEALTH- 2 FLAMMABILITY- 1 REACTIVITY- 0

SECTION V-HEALTH HAZARD DATA

PERMISSIBLE EXPOSURE LEVEL 350 PPM

THRESHOLD LIMIT VALUE 350 PPM

EFFECTS OF OVEREXPOSURE: FOR PRODUCT

EYES - CAN CAUSE SEVERE IRRITATION, REDNESS, TEARING, BLURRED VISION.
SKIN - PROLONGED OR REPEATED CONTACT CAN CAUSE MODERATE IRRITATION, DEFATTING, DERMATITIS.
BREATHING - EXCESSIVE INHALATION OF VAPORS CAN CAUSE NASAL AND RESPIRATORY IRRITATION, DIZZINESS, WEAKNESS, FATIGUE, NAUSEA, HEADACHE, POSSIBLE UNCONSCIOUSNESS, AND EVEN ASPHYXIATION.
SWALLOWING - CAN CAUSE GASTROINTESTINAL IRRITATION, NAUSEA, VOMITING, AND DIARRHEA.

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72-62-7920-01

MATERIAL SAFETY DATA SHEET

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SECTION V-HEALTH HAZARD DATA (CONTINUED)

UTCIHL 9

FIRST AID:

IF ON SKIN: THOROUGHLY WASH EXPOSED AREA WITH SOAP AND WATER. REMOVE CONTAMINATED CLOTHING. LAUNDER CONTAMINATED CLOTHING BEFORE RE-USE.

IF IN EYES: FLUSH WITH LARGE AMOUNTS OF WATER, LIFTING UPPER AND LOWER LIDS OCCASIONALLY, GET MEDICAL ATTENTION.

IF SWALLOWED: DO NOT INDUCE VOMITING. CALL PHYSICIAN OR TRANSPORT TO AN EMERGENCY FACILITY.

IF BREATHED: IF AFFECTED, REMOVE INDIVIDUAL TO FRESH AIR. IF BREATHING IS DIFFICULT, ADMINISTER OXYGEN. IF BREATHING HAS STOPPED GIVE ARTIFICIAL RESPIRATION. KEEP PERSON WARM, QUIET AND GET MEDICAL ATTENTION. DO NOT GIVE STIMULANTS. EPINEPHRINE OR EPHEDRINE MAY ADVERSELY AFFECT THE HEART WITH FATAL RESULTS.

PRIMARY ROUTE(S) OF ENTRY:

INHALATION

SKIN CONTACT

SECTION VI-REACTIVITY DATA

HAZARDOUS POLYMERIZATION: CANNOT OCCUR

STABILITY: STABLE

INCOMPATIBILITY: AVOID CONTACT WITH:, WATER, REACTIVE METALS SUCH AS ALUMINUM AND MAGNESIUM, OPEN FLAME, WELDING ARCS, RESISTANCE HEATERS, ETC., WHICH CAN RESULT IN THERMAL DECOMPOSITION RELEASING HYDROGEN CHLORIDE AND SMALL AMOUNTS OF PHOSGENE AND CHLORINE., STRONG OXIDIZING AGENTS.

SECTION VII-SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:

SMALL SPILL: ABSORB LIQUID ON PAPER, VERMICULITE, FLOOR ABSORBENT, OR OTHER ABSORBENT MATERIAL AND TRANSFER TO HOOD.

LARGE SPILL: PERSONS NOT WEARING PROTECTIVE EQUIPMENT SHOULD BE EXCLUDED FROM AREA OF SPILL UNTIL CLEAN-UP HAS BEEN COMPLETED. STOP SPILL AT SOURCE. DIKE AREA OF SPILL TO PREVENT SPREADING. PUMP LIQUID TO SALVAGE TANK REMAINING LIQUID MAY BE TAKEN UP ON SAND, CLAY, EARTH, FLOOR ABSORBENT, OR OTHER ABSORBENT MATERIAL AND SHOVELED INTO CONTAINERS.

WASTE DISPOSAL METHOD:

SMALL SPILL: ALLOW VOLATILE PORTION TO EVAPORATE IN HOOD. ALLOW SUFFICIENT TIME FOR VAPORS TO COMPLETELY CLEAR HOOD DUCT WORK. DISPOSE OF REMAINING MATERIAL IN ACCORDANCE WITH APPLICABLE REGULATIONS.

LARGE SPILL: DESTROY BY LIQUID INCINERATION WITH OFF-GAS SCRUBBER. CONTAMINATED ABSORBENT MAY BE DEPOSITED IN A LANDFILL IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS.

SECTION VIII-PROTECTIVE EQUIPMENT TO BE USED

RESPIRATORY PROTECTION: IF TLV OF THE PRODUCT OR ANY COMPONENT IS EXCEEDED, A NIOSH/MSHA JOINTLY APPROVED AIR SUPPLIED RESPIRATOR IS ADVISED IN ABSENCE OF PROPER ENVIRONMENTAL CONTROL. OSHA REGULATIONS ALSO PERMIT OTHER NIOSH/MSHA RESPIRATORS UNDER SPECIFIED CONDITIONS. (SEE YOUR SAFETY EQUIPMENT SUPPLIER). ENGINEERING OR ADMINISTRATIVE CONTROLS SHOULD BE IMPLEMENTED TO REDUCE EXPOSURE.

VENTILATION: PROVIDE SUFFICIENT MECHANICAL (GENERAL AND/OR LOCAL EXHAUST) VENTILATION TO MAINTAIN EXPOSURE BELOW TLV(S).

PROTECTIVE GLOVES: WEAR RESISTANT GLOVES SUCH AS:, POLYVINYL ALCOHOL, POLYETHYLENE

EYE PROTECTION: CHEMICAL SPLASH GOGGLES IN COMPLIANCE WITH OSHA REGULATIONS ARE ADVISED; HOWEVER, OSHA REGULATIONS ALSO PERMIT OTHER TYPE SAFETY GLASSES. (CONSULT YOUR SAFETY EQUIPMENT SUPPLIER)

OTHER PROTECTIVE EQUIPMENT: TO PREVENT REPEATED OR PROLONGED SKIN CONTACT, WEAR IMPERVIOUS CLOTHING AND BOOTS.

SECTION IX-SPECIAL PRECAUTIONS OR OTHER COMMENTS

CONTAINERS OF THIS MATERIAL MAY BE HAZARDOUS WHEN EMPTIED SINCE EMPTIED CONTAINERS RETAIN PRODUCT RESIDUES (VAPOR, LIQUID, AND/OR SOLID), ALL HAZARD PRECAUTIONS GIVEN IN THE DATA SHEET MUST BE OBSERVED.

AVOID CONTACT WITH PLASTIC AND RUBBER I.E. EQUIPMENT, PROTECTIVE CLOTHING, AND CONTAINERS.

OVEREXPOSURE TO MATERIAL HAS APPARENTLY BEEN FOUND TO CAUSE THE FOLLOWING EFFECTS IN LABORATORY ANIMALS:, LIVER ABNORMALITIES, KIDNEY DAMAGE, LUNG DAMAGE

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PMC 905

SECTION IX-SPECIAL PRECAUTIONS OR OTHER COMMENTS (CONTINUED)

OVEREXPOSURE TO MATERIAL HAS BEEN SUGGESTED AS A CAUSE OF THE FOLLOWING EFFECTS IN HUMANS:, CARDIAC ABNORMALITY, LIVER ABNORMALITIES, KIDNEY DAMAGE, LUNG DAMAGE

THE INFORMATION ACCUMULATED HEREIN IS BELIEVED TO BE ACCURATE BUT IS NOT WARRANTED TO BE WHETHER ORIGINATING WITH ASHLAND OR NOT. RECIPIENTS ARE ADVISED TO CONFIRM IN ADVANCE OF NEED THAT THE INFORMATION IS CURRENT, APPLICABLE, AND SUITABLE TO THEIR CIRCUMSTANCES.

UTC:H:9

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UTCIHL 16 PMC 9056 DS 35A

Material Safety Data Sheet

PPG Industries, Inc.
One PPG Place
Pittsburgh, PA 15272

Approved by U S Dept of Labor as Essentially similar to Form OSHA-20

Date: November, 1985	Edition: Eighth
Chemical Name and Synonyms: 1,1,1-trichloroethane; methylchloroform CAS No. 71-55-6	Trade Name and Synonyms: TRI-ETHAN [redacted]
Chemical Family: Halogenated Hydrocarbons	Formula: CH_3CCl_3
DOT Shipping Name: See Comments, Page 2	DOT Hazard Class: See Comments, Page 2
Reportable Quantity: N/A I. D. Number: See Comments, Page 2	Subsidiary Risk: N/A

PMC 9056

SECTION 1 · PHYSICAL DATA

Boiling Point @ 760 mm Hg: 72°C Boiling Range 72°C-88°C	Vapor Density (Air=1): 4.54	Specific Gravity (H_2O=1): 1.300-1.320 @ 25/25°C	pH of Solutions: 6.0 to 7.5
Freezing/Melting Point: -45°C	Solubility (Weight % in Water): Negligible	Bulk Density: 10.80-10.97 lbs/gal @ 25°C	Volume % Volatile: 100
Vapor Pressure: 135mmHg @ 25°C	Evaporation Rate (ethyl ether=1): 0.35	Heat of Solution: Not Applicable	Appearance and Odor: Clear, colorless liquid with ether-like odor

SECTION 2 · INGREDIENTS

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	%
1,1,1-trichloroethane (Stabilized)	96
Diethylene ether (CAS No. 123-91-1)	
Glycol methylene ether (CAS No. 646-06-0)	
Sec butanol (CAS No. 78-92-2)	

NOTE: Hazard information is based upon the tested mixture and not individual ingredients.

SECTION 3 · FIRE AND EXPLOSION HAZARD DATA

Flash Point °F (Method Used) None when tested in accordance with DOT requirements	Flammable Limits in Air (% by Volume) LEL: 7% UEL: 15% (See Below)	Extinguishing Media: Water, dry chemicals or carbon dioxide

Special Fire Fighting Procedures: Fire fighters should wear NIOSH/MSHA-approved pressure-demand, self-contained breathing apparatus for possible exposure to hydrogen chloride and possible traces of phosgene.

Unusual Fire and Explosion Hazards: Vapors concentrated in a confined or poorly ventilated area can be ignited upon contact with a high energy spark, flame, or high intensity source of heat. This can occur at concentrations ranging between 7-15% by volume. Decomposition or burning can produce hydrogen chloride or possible traces of phosgene.

SECTION 4 · HEALTH HAZARD DATA

Toxicity Data		Classification (Poison, Irritant, Etc.)	
LC_{50} Inhalation	(rat) 8,000 ppm/7 hours	Inhalation:	Slightly Toxic
LD_{50} Dermal	(rabbit) >15 g/kg	Skin	Not Significantly Toxic
Skin/Eye Irritation	See Section 5	Skin/Eye:	Liquid mildly irritating to skin; eye irritant
LD_{50} Ingestion	(rat) 10-12 g/kg (rabbit; guinea pig) 5.6-9.5 g/kg	Ingestion:	Not Significantly Toxic
Fish, LC_{50} (Lethal Concentration)	Unknown	Aquatic:	Unknown

24-HOUR EMERGENCY ASSISTANCE: (304) 843-1300

SECTION 5 · EFFECTS OF OVEREXPOSURE

This section covers effects of overexposure for inhalation, eye/skin contact, ingestion and other types of overexposure information in the order of the most hazardous and the most likely route of overexposure.

Permissible Exposure Limits:

OSHA: 350 ppm, 8-hour TWA (time-weighted average); 29CFR 1910.1000

ACGIH: 350 ppm, 8-hour TWA (time-weighted average); 450 ppm, STEL, (15-minute short-term exposure limit).

ACUTE

Inhalation: Tri-Ethane® is primarily a central nervous system depressant. Inhalation can cause irritation of the respiratory system, dizziness, nausea, lightheadedness, headache, los of coordination and equilibrium, unconsciousness, possible central nervous system damage and even death in confined or poorly ventilated areas. Fatalities following severe acute exposure to various chlorinated solvents have been attributed to ventricular fibrillation.

Eye/Skin: Liquid splashed in the eye can result in discomfort, pain and irritation. Prolonged or repeated contact with liquid on the skin can cause irritation and dermatitis. The problem may be accentuated by liquid becoming trapped against the skin by contaminated clothing and shoes, and skin absorption can occur.

Ingestion: Swallowing of this material may result in irritation of the mouth and GI tract with other effects as listed above for Inhalation. Vomiting and subsequent aspiration into the lungs may lead to chemical pneumonia and pulmonary edema which is a potentially fatal condition.

CHRONIC

Tri-Ethane® has been extensively studied for cancer potential. There is no documented evidence to suggest that Tri-Ethane® causes an increased cancer incidence in humans or animals. The EPA's Science Advisory Board concluded that there is no evidence to suggest carcinogenic activity for Tri-Ethane®. 1,1,1-trichloroethane is not listed by IARC, NTP, or OSHA as a carcinogen.

References (continued)

5. Toxicity and Metabolisms of Industrial Solvents, Browning, 1965
6. Toxicology, the Basic Science of Poisons, Casarett and Doull, 1975
7. EPA Science Advisory Board, Subcommittee on Airborne Carcinogens, September, 1980
8. Encyclopedia of Chemical Technology, Volume 5, Third Edition, Kirk-Othmer, 1979
9. NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards, DHHS (NIOSH) Publication No. 81-123, January, 1981
10. NIOSH/OSHA Pocket Guide to Chemical Hazards, DHEW (NIOSH) Publication No. 78-210, September, 1978

COMMENTS: Only regulated when shipped by air. DOT Shipping Name is 1,1,1-trichloroethane DOT Hazard Class is ORM-A, and UN Number is UN2831.

EMERGENCY AND FIRST AID PROCEDURES:

Inhalation: Remove to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Call a physician.

Eye or Skin Contact: Flush eyes and skin with plenty of water (soap and water for skin) for at least 15 minutes, while removing contaminated clothing and shoes. If irritation occurs, consult a physician. Thoroughly clean contaminated clothing and shoes before reuse or discard.

Ingestion: If conscious, drink large quantities of water. DO NOT induce vomiting. Take immediately to a hospital or physician. If unconscious, or in convulsions, take immediately to a hospital. DO NOT attempt to give anything by mouth to an unconscious person.

Notes to Physician (Including Antidotes): NEVER administer adrenalin following Tri-Ethane® overexposure. Increased sensitivity of the heart to adrenalin may be caused by overexposure to Tri-Ethane®.

SECTION 6 - REACTIVITY DATA

Stability: Stable	**Conditions to Avoid:** Avoid open flames, hot glowing surfaces or electric arcs.
Hazardous Polymerization: Will not occur.	**Conditions to Avoid:** None

Incompatibility (Materials to Avoid): Avoid mixing with caustic soda, caustic potash, or oxidizing materials. Shock sensitive compounds may be formed.

Hazardous Decomposition Products: Hydrogen chloride and possible traces of phosgene.

SECTION 7 - SPILL OR LEAK PROCEDURES

Steps to be Taken If Material is Spilled or Released: Immediately evacuate the area and provide maximum ventilation. Unprotected personnel should move upwind of spill. Only personnel equipped with proper respiratory and skin/eye protection (See Section 8) should be permitted in area. Dike area to contain spill. Take precautions as necessary to prevent contamination of ground and surface waters. Recover spilled material on adsorbents, such as sawdust and vermiculite, and sweep into closed containers for disposal. After all visible traces, including ignitable vapors, have been removed, thoroughly wet vacuum the area. DO NOT flush to sewer. If area of spill is porous, remove as much contaminated earth and gravel, etc. as necessary and place in closed containers for disposal.

Waste Disposal Method:

Contaminated sawdust, vermiculite, or porous surfaces must be disposed of in a permitted hazardous waste management facility. Recovered liquids may be reprocessed or incinerated or must be treated in a permitted hazardous waste management facility. Care must be taken when using or disposing of chemical materials and/or their containers to prevent environmental contamination. It is your duty to dispose of the chemical materials and/or their containers in accordance with the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act, as well as any other relevant federal, state, or local laws/regulations regarding disposal.

RCRA - Hazardous Waste Number - U-226

PMC 9056

SECTION 8 · SPECIAL PROTECTION INFORMATION

Respiratory Protection: Use a half or full facepiece organic vapor chemical cartridge or canister respirator when concentrations exceed permissible limits. Use self-contained breathing apparatus (SCBA) or full facepiece airline respirator with auxiliary SCBA operated in the pressure-demand mode for emergencies and for all work performed in storage vessels, poorly ventilated rooms, and other confined areas. Respirators must be approved by NIOSH or MSHA. The respirator use limitations made by NIOSH/MSHA[9,10] and by the manufacturer must be observed. Respiratory protection programs must be in accordance with 29CFR 1910.134.

Ventilation (Type): Use local exhaust or dilution ventilation as appropriate to control exposures to below permissible limits.

Eye Protection: Splashproof goggles	**Gloves:** Viton®. For limited service only: Polyvinyl alcohol*, Nitrile, Butyl, Neoprene. *(degrades in water)

Other Protective Equipment: Boots, aprons, or chemical suits should be used when necessary to prevent skin contact. Personal protective clothing and use of equipment must be in accordance with 29CFR 1910.133 and 29CFR 1910.132.

SECTION 9 · SPECIAL PRECAUTIONS

Precautions to be Taken During Handling and Storing:

- Do not use in poorly ventilated or confined areas without proper respiratory protection (See Section 8).
- Tri-Ethane® vapors are heavier than air and will collect in low areas.
- Keep container closed when not in use.
- Store only in closed, properly labeled containers.
- Liquid oxygen or other strong oxidants may form explosive mixtures with Tri-Ethane®.
- This material or its vapors when in contact with flames, hot glowing surfaces, or electric arcs can decompose to form hydrogen chloride and possible traces of phosgene.
- AVOID CONTAMINATION OF WATER SUPPLIES. Handling, storage, and use procedures must be carefully monitored to avoid spills or leaks. Any spill or leak has the potential to cause underground water contamination which may, if sufficiently severe, render a drinking water source unfit for human consumption. Contamination that does occur cannot be easil corrected.
- Do not store or stack aluminum in contact with Tri-Ethane® to prevent possible solvent decomposition (stacking corrosion).
- Caution should be taken not to use in pressurized or totally enclosed system of aluminum construction. Example: paint or adhesive spray system.
- A chlorinated solvent used as a flashpoint suppressant must be added in sufficient quantity or the resultant mixture may have a flashpoint lower than the flammable compone
- Do not use cutting or welding torches on empty drums that contained Tri-Ethane® unless properly purged and cleaned.

Other Precautions:

- Do not breathe vapors. High vapor concentrations can cause dizziness, unconsciousness, possible central nervous system damage or death.
- Use only with adequate ventilation. Ventilation must be sufficient to limit employee exposure to Tri-Ethane® below permissible exposure limits. Observance of lower limits (outlined in Section 5) is advisable.
- Avoid contact with eyes. Will cause irritation and pain.
- Avoid prolonged or repeated contact with skin. May cause irritation or dermatitis.
- Do not swallow. Swallowing may cause injury or death.
- Do not eat, drink, or smoke in work areas.

References:

1. NIOSH Registry of Toxic Effects of Chemical Substances, 1975
2. Industrial Hygiene and Toxicology, Volume II, Second Edition, F. A. Patty, 1963
3. Dangerous Properties of Industrial Materials, Fourth Edition, N. I. Sax, 1975
4. Industrial Toxicology, Hamilton and Hardy, 1974

(References continued on page 2)

Form Approved
Budget Bureau No. 44-R1387
Approval Expires April 30, 1971

MTC IHL

U.S. DEPARTMENT OF LABOR

WAGE AND LABOR STANDARDS ADMINISTRATION
Bureau of Labor Standards

PMC 9036

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G. E. PARSONS

MATERIAL SAFETY DATA SHEET

Supplier: Axton-Cross 617-
Holliston, Mass. 429-6766

SECTION I

add. info in file

MANUFACTURER'S NAME: PPG Industries, Inc.	EMERGENCY TELEPHONE NO.: (318) 882-1200
ADDRESS (Number, Street, City, State, and ZIP Code): No. 1 Gateway Center, Pittsburgh, Pa. 15222	
CHEMICAL NAME AND SYNONYMS: * 1,1,1-trichloroethane, methylchloroform	TRADE NAME AND SYNONYMS: TRI-ETHANE, AXOTHENE
CHEMICAL FAMILY: Chlorinated Hydrocarbons	FORMULA: CH_3CCl_3

SECTION II HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS	100	350	FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
* Stabilized (according to label) (old MSDS: 1,1,1 trichloroethane)		
letter, R.L. Finocchio: 3-3-78, does not contain 1,4 dioxane		

SECTION III PHYSICAL DATA

BOILING POINT (°F.)	165.4	SPECIFIC GRAVITY (H_2O = 1)	1.31
VAPOR PRESSURE (mm Hg.)	120	PERCENT VOLATILE BY VOLUME (%)	100
VAPOR DENSITY (AIR = 1)	4.54	EVAPORATION RATE (ether = 1)	0.35
SOLUBILITY IN WATER	Negligible		
APPEARANCE AND ODOR	Colorless appearance, ethereal odor		

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used): None (Tag, open or closed)	FLAMMABLE LIMITS	Lel	Uel
EXTINGUISHING MEDIA			
SPECIAL FIRE FIGHTING PROCEDURES			
UNUSUAL FIRE AND EXPLOSION HAZARDS: Vapors can be ignited only by high intensity source of ignition. Combustion forms HCl and possible traces of phosgene.			

COPY TO LOCAL I.A.M.

C.A.S.R. No. 71-55-6 B738-5839 MAY 20 '82 1746

SEP 9 '82 07 - PMC 9056

SECTION V. HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE: 350 ppm

EFFECTS OF OVEREXPOSURE: Loss of co-ordination and equilibrium to actual unconsciousness, and even death, in unventilated areas (such as tanks).

EMERGENCY AND FIRST AID PROCEDURES: Move to fresh air, use artificial respiration if breathing has stopped. Administer oxygen after breathing has been restored. (Never administer adrenalin!) Call physician (he should not administer adrenalin).

SECTION VI REACTIVITY DATA

STABILITY			CONDITIONS TO AVOID
	UNSTABLE		
	STABLE	X	

INCOMPATABILITY (Materials to avoid): Avoid mixing with caustic soda and caustic potash.

HAZARDOUS DECOMPOSITION PRODUCTS: HCl and possible traces of phosgene.

HAZARDOUS POLYMERIZATION			CONDITIONS TO AVOID
	MAY OCCUR		
	WILL NOT OCCUR	X	

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Adequate ventilation must be provided. Workmen should be provided with fresh air mask or sent to fresh air.

WASTE DISPOSAL METHOD: Forced ventilation or evaporation.

SECTION VIII SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type): Fresh air masks

VENTILATION			
	LOCAL EXHAUST: Sufficient to maintain TLV		SPECIAL
	MECHANICAL (General)		OTHER

PROTECTIVE GLOVES: Neoprene or Viton

EYE PROTECTION: Glasses or goggles

OTHER PROTECTIVE EQUIPMENT: Neoprene apron

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

OTHER PRECAUTIONS

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ADDENDUM TO MATERIAL SAFETY DATA SHEET

ON TRI-ETHANE® 1,1,1-TRICHLOROETHANE (December, 1977)

SECTION IV -- FIRE AND EXPLOSION HAZARD DATA

Flash Point - None when tested in accordance with standard accepted laboratory techniques; however, 1,1,1-trichloroethane vapors concentrated in a confined or poorly ventilated area can be ignited upon contact with a spark, flame or high-intensity source of heat. This can occur at concentrations ranging between 8 percent and 15 percent by volume.

SECTION V -- HEALTH HAZARD DATA

Acute Toxicity Values[1] - Oral LD_{50} (rat): 10 - 12 gm/kg.
Oral LD_{50} (rabbit, guinea pig): 5.6 - 9.5 gm/kg
Inhalation LC_{50} (rat): 8,000 ppm/7 hours

Effects of Overexposure

Acute: Primarily a central nervous system depressant. Inhalation can cause irritation of the respiratory system, dizziness, nausea, lightheadedness, headache, loss of coordination and equilibrium, unconsciousness, and even death in confined or poorly ventilated areas. Depression of the circulatory system has been reported as a result of overexposure to methyl chloroform. Ventricular arrhythmia may be induced after sensitization to epinephrine.

Eye contact can result in discomfort, pain and irritation. Prolonged or repeated contact with the skin can cause irritation and dermatitis.

Chronic: Torkelson, et. al. (1959) reported that female guinea pigs had slight inflammation of lungs and fatty changes in liver at chronic exposure concentrations of 2,000 ppm, although no evidence can presently be found to confirm any chronic exposure hazard to humans.

Emergency and First Aid Procedures

Inhalation Overexposure: Remove to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Call a physician.

Note to Physician: Avoid use of adrenalin in any case where a person has been overcome by 1,1,1-trichloroethane.

Eye Contact: Flush with plenty of water for at least fifteen minutes. If irritation occurs, consult a physician.

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Skin Contact: Wash thoroughly with plenty of soap and water. If irritation occurs, consult a physician.

Swallowing: If conscious, drink a quart of water then induce vomiting by placing a finger far back in the throat. Call a physician. If vomiting cannot be induced, take immediately to a hospital or physician. If unconscious, or in convulsions, take immediately to a hospital or physician. DO NOT induce vomiting or give anything by mouth.

SECTION VIII -- SPECIAL PROTECTION INFORMATION

Respiratory Protection -- NIOSH/MESA approved organic vapor respirator for concentrations below 1000 ppm. For 1000 ppm and above, use air-supplied respiratory protection. Consult 29 CFR 1910.134 for details.

SECTION IX -- SPECIAL PRECAUTIONS

Precautions to be Taken in Handling and Storing

- -- Do not use in poorly ventilated or confined spaces.
- -- Keep containers tightly closed when not in use.
- -- Do not store in open, unlabeled or mislabled containers.
- -- Do not store degreaser clean-out sludge in tightly sealed containers.
- -- Sludge containing finely divided aluminum residues should be stored out of doors away from combustible materials.
- -- Liquid oxygen or other strong oxidizers may form explosive mixtures with 1,1,1-trichloroethane when mixed in confined areas.
- -- Under certain conditions, decomposition may occur followed by release of hydrogen chloride vapors when 1,1,1-trichloroethane is blended with other organic materials such as toluene. Before performing any such blending operations, consult with PPG on potential hazards involved.

Other Precautions

- -- Avoid prolonged or repeated breathing of vapor.
- -- Use only with ventilation sufficient to limit employee exposure below OSHA permissible exposure limit.
- -- Avoid contact with eyes.
- -- Avoid prolonged or repeated contact with skin.
- -- Do not take internally.

REFERENCES

(1) NIOSH Registry of Toxic Effects of Chemical Substances, 1975.

(2) Industrial Hygiene and Toxicology, Volume II, Second Edition, F. A. Patty, 1963.

(3) Dangerous Properties of Industrial Materials, Fourth Edition, N. I. Sax, 1975.

(4) Industrial Toxicology, Hamilton and Hardy, 1974.

(5) Toxicity and Metabolisms of Industrial Solvents, Browning, 1965.

(6) Toxicology, the Basic Science of Poisons, Casarett and Doull, 1975.

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Material Safety Data Sheet

MSD 8208.20

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INDUSTRIAL HYGIENE

DETREX CHEMICAL INDUSTRIES, INC.
P.O. BOX 501.
DETROIT, MICHIGAN 48232

Approved by U.S. Dept. of Labor as "Essentially similar" to Form OSHA-20

UTCIHL (8)

Date: August, 1982	Edition: First
Chemical Name and Synonyms: 1,1,1-trichloroethane; methylchloroform CAS No. 71-55-6	Trade Name and Synonyms: PERM-ETHANE ® DG
Chemical Family: Halogenated Hydrocarbons	Formula: CH_3CCl_3
DOT Shipping Name: 1,1,1-trichloroethane	DOT Hazard Class: ORM-A I. D. Number: UN 2831

SECTION 1 · PHYSICAL DATA

Boiling Point @ 760 mm Hg:	Vapor Density (Air=1):	Specific Gravity (H_2O=1):	pH of Solutions:
165.4°F	4.54	1.300-1.320 @ 25°/25°C	6.0 to 7.5
Freezing/Melting Point:	**Solubility (Weight % in Water):**	**Bulk Density:**	**Volume % Volatile:**
-49°F -45°C	Negligible	10.80-10.97 lbs/gal @25°C	Essentially 100
Vapor Pressure:	**Evaporation Rate**	**Heat of Solution:**	**Appearance and Odor:**
@25°C = 135mmHg	(ethyl ether = 1):0.35	Not Applicable	Clear, colorless liquid - ether-like odor.

SECTION 2 · HAZARDOUS INGREDIENTS

	%	Hazard Data
1,1,1-trichloroethane (Stabilized)	100	See Sections 4 & 5

SECTION 3 · FIRE AND EXPLOSION HAZARD DATA

Flash Point °F (Method Used)	Flammable Limits in Air (% by Volume)	Extinguishing Media:
None when tested in accordance with DOT requirements.	LEL: 7% UEL: 15% See Below	water, dry chemical or carbon dioxide

Special Fire Fighting Procedures: Fire fighters should wear a NIOSH/MSHA-approved pressure-demand, self-contained breathing apparatus for possible exposure to hydrogen chloride and possibly traces of phosgene. Use water only in degreasers when aluminum reaction occurs.

Unusual Fire and Explosion Hazards: Vapors concentrated in a confined or poorly ventilated area can be ignited upon contact with a spark, flame, or high intensity source of heat. This can occur at concentrations ranging between 7-15% by volume. Decomposition or burning can produce hydrogen chloride or possibly traces of phosgene. Also see Detrex warning letter Form SoL 8208.21 attached.

SECTION 4 · HEALTH HAZARD DATA

Toxicity Data	Classification (Poison, Irritant, Etc.)
LC_{50} Inhalation (rat) 8,000 ppm/7 hours	Inhalation: Toxic
LD_{50} Dermal (rabbit) 15g/kg (2)	Skin/Eye: Liquid mildly irritating to skin; eye irritant
LD_{50} Ingestion (rat) 10-12g/kg (See Section 5)	Ingestion: Not significantly toxic
Fish, LC_{50} (Lethal Concentration) Not Determined	Aquatic:

Human Exposure Information/Data:

24-HOUR EMERGENCY ASSISTANCE: (313) 358-5800

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SECTION 5 · EFFECTS OF OVEREXPOSURE

This section covers effects of overexposure for inhalation, eye/skin contact, ingestion and other types of overexposure information in the order of the most hazardous and the most likely route of overexposure.

Permissible Exposure Limits (TLV):

350 ppm - 8-hour time-weighted average (TWA) - OSHA 29CFR 1910.1000 (May 28, 1975).

Acute

Primarily a central nervous system depressant. Inhalation can cause irritation of the respiratory system, dizziness, nausea, lightheadedness, headache, loss of coordination and equilibrium, unconsciousness and, if exposed to high concentrations in confined or poorly ventilated areas, even death. Depression of the circulatory system has been reported as a result of overexposure to 1,1,1-trichloroethane. The heart may be sensitized by overexposure and ventricular arrhythmia may be induced by epinephrine administration.

Liquid splashed in the eyes can result in disconfort, pain and irritation. Prolonged or repeated contact with liquid on the skin can cause irritation and dermatitis. The problem may be accentuated by liquid becoming trapped against the skin by contaminated clothing and shoes. Skin absorption can occur.

Chronic

Prolonged exposure above the OSHA permissible exposure limits may result in liver and kidney damage. 1,1,1-trichloroethane has been extensively studied for cancer both in the U.S. and Europe by government, industry and academia. There is no documented evidence that 1,1,1-trichloroethane causes an increased cancer incidence in humans.

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EMERGENCY AND FIRST AID PROCEDURES:

Inhalation: Remove to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Call a physician.

Eye or Skin Contact: Flush eyes and skin with plenty of water (soap and water for skin) for at least 15 minutes, while removing contaminated clothing and shoes. If irritation occurs, consult a physician.

Ingestion: If conscious, drink large quantities of water, DO NOT induce vomiting. Take immediately to a hospital or physician. If unconscious, or in convulsions, take immediately to a hospital. DO NOT give anything by mouth to an unconscious person.

Notes to Physician (Including Antidotes): NEVER administer adrenalin following 1,1,1-trichloroethane overexposure. Increased sensitivity of the heart to adrenalin may be caused by overexposure to 1,1,1-trichloroethane.

SECTION 6 · REACTIVITY DATA

Stability: Stable	**Conditions to Avoid:** Avoid open flames, hot glowing surfaces or electric arcs.
Hazardous Polymerization: Will not occur.	**Conditions to Avoid:** None

Incompatibility (Materials to Avoid):
Avoid contamination with caustic soda, caustic potash or oxidizing materials. Shock sensitive explosives may be formed. Avoid contact with aluminum, magnesium, zinc and alloys thereof under high pressures. See Detrex warning letter Form SoL 8208.21 attached.

Hazardous Decomposition Products: Hydrogen chloride and possibly traces of phosgene.

SECTION 7 · SPILL OR LEAK PROCEDURES (See Detrex Forms SoL 8208.14 and SoL 8208.15 attached)

Steps to be Taken if Material is Spilled or Released: Immediately evacuate the area and provide maximum ventilation. Unprotected personnel should move upwind of spill. Only personnel equipped with proper respiratory and skin/eye protection should be permitted in area. Dike area to contain spill. Take precautions as necessary to prevent contamination of ground and surface waters. Recover or absorb spilled material on sawdust or vermiculite and sweep into closed containers for disposal. After all visible traces have been removed, thoroughly wet vacuum the area. DO NOT flush to sewer. If area of spill is porous, remove as much contaminated earth and gravel, etc., as necessary and place in closed containers for disposal. (See Below)

Waste Disposal Method: Contaminated sawdust, vermiculite or porous surface must be disposed of in a permitted hazardous waste management facility. Recovered liquids may be re-processed or incinerated or must be treated in a permitted hazardous waste management facility. Care must be taken when using or disposing of chemical materials and/or their containers to prevent environmental contamination. It is your duty to dispose of the chemical materials and/or their containers in accordance with the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act as well as any other relevant federal, state or local laws/regulations regarding disposal.

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SECTION 8 · SPECIAL PROTECTION INFORMATION

Respiratory Protection: For emergencies or working in confined areas, wear self-contained breathing apparatus or supplied air respiratory protection (use the "buddy system" and wear a safety harness with a lifeline). In other circumstances involving potential overexposure, use NIOSH/MSHA-approved organic vapor respirator. (Observe limitations directed by manufacturer.) Respiratory protection program must be in accordance with 29CFR 1910.134.

Ventilation (Type): Dilution (General) or Local Exhaust - Sufficient to maintain workplace concentration below permissible exposure limits.

Eye Protection:	Gloves:
Splashproof Goggles	polyethylene, neoprene or polyvinyl alcohol

Other Protective Equipment: Safety shower and eye-wash fountain in immediate area. Personnel protective clothing and use of equipment must be in accordance with 29CFR 1910.133 and 29CFR 1910.132.

SECTION 9 · SPECIAL PRECAUTIONS

Precautions to be Taken During Handling and Storing:

- Do not use in poorly ventilated or confined areas.
- 1,1,1-trichloroethane vapors are heavier than air and will collect in low areas.
- Keep container closed when not in use.
- Do not store in open, unlabeled or mislabeled containers.
- Liquid oxygen or other strong oxidants may form explosive mixtures with 1,1,1-trichloroethane.
- This material or its vapors when in contact with flames, hot glowing surfaces or electric arcs can decompose to form hydrogen chloride gas and traces of phosgene.
- AVOID CONTAMINATION OF WATER SUPPLIES: Handling, storage, and use procedures must be carefully monitored to avoid spills or leaks. Any spill or leak has the potential to cause underground water contamination which may, if sufficiently severe, render a drinking water source unfit for human consumption. Contamination that does occur cannot be easily corrected.
- A chlorinated solvent used as a flashpoint suppressant must be added in sufficient quantity or the resultant mixture may have a flashpoint lower than the flammable component.
- Caution should be taken not to use in pressurized or totally enclosed system of light metal construction such as aluminum, magnesium, zinc or alloys thereof. Example, paint or adhesive spray system. (See Detrex Form SoL 8208.21 attached.)

Other Precautions:

- AVOID PROLONGED OR REPEATED BREATHING OF VAPORS. High vapor concentrations can cause dizziness, unconsciousness or death. Long-term overexposure may cause liver/kidney injury.
- USE ONLY WITH ADEQUATE VENTILATION. Ventilation must be sufficient to limit employee exposure to 1,1,1-trichloroethane below OSHA permissible limits (8-hour TWA 350 ppm). Observance of lower limits (outlined in Section 4) is advisable.
- AVOID CONTACT WITH EYES. Will cause irritation and pain.
- AVOID PROLONGED OR REPEATED CONTACT WITH SKIN. May cause irritation or dermatitis.
- DO NOT TAKE INTERNALLY. Swallowing may cause injury or death.
- DO NOT EAT, DRINK, OR SMOKE IN WORK AREAS.

References:

1. NIOSH Registry of Toxic Effects of Chemical Substances, 1978
2. Industrial Hygiene and Toxicology, Volume II, Second Edition, F.A. Patty, 1963
3. Dangerous Properties of Industrial Materials, Fifth Edition, N.I. Sax, 1979
4. Industrial Toxicology, Hamilton and Hardy, 1974
5. Toxicity and Metabolisms of Industry Solvents, Browning, 1965
6. Toxicology, the Basic Science of Poisons, Casarett and Doull, 1980
7. Federal Register, 45FR Hazardous Waste Management Systems Part III, Identification and Listing of Hazardous Wastes, Page 33084, May 19, 1980
8. EPA Science Advisory Board, Subcommittee on Airborne Carcinogens, September, 1980

Comments: As this solvent (1,1,1-trichloroethane) is used to clean and/or degrease a wide variety of metal and plastic parts, it should always be used in conjunction with properly designed and fully controlled degreasing equipment that is in compliance with the U.S. Environmental Protection Agency, OAQPS Guidelines, "Control of Volatile Organic Emissions from Solvent Metal Cleaning", and/or all other applicable federal, state and local regulatory guidelines.

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MATERIAL SAFETY DATA SHEET PAGE: 1

DOW CHEMICAL U.S.A. MIDLAND MICHIGAN 48640 EMERGENCY PHONE: 517-636-4400

EFFECTIVE DATE: 10 JAN 78 DATE PRINTED: 14 FEB 78 PRODUCT CODE: 16822

PRODUCT NAME: CHLOROTHENE (R) VG MSD: 0110

INGREDIENTS (TYPICAL VALUES-NOT SPECIFICATIONS)	%
1,1,1-TRICHLOROETHANE (MINIMUM)	94.5

SECTION 1 PHYSICAL DATA

BOILING POINT: 165F (74C) : SOL. IN WATER: 0.07G/100G @ 25C
VAP PRESS: 100 MMHG @ 20C : SP. GRAVITY: 1.321 @ 25/25C
VAP DENSITY (AIR=1): 4.55 : % VOLATILE BY VOL: 100 (ESSEN.)
APPEARANCE AND ODOR: COLORLESS LIQUID.

SECTION 2 FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: NONE : FLAMMABLE LIMITS (STP IN AIR)
METHOD USED: T.O.C.,T.C.C.,C.O.C. : LFL: 8.0 @ 25C UFL: 10.5 @ 25C
EXTINGUISHING MEDIA: WATER FOG.
SPECIAL FIRE FIGHTING EQUIPMENT AND HAZARDS: SELF - CONTAINED RESPIRATORY EQUIPMENT. NOT CONSIDERED A FLAMMABLE LIQUID HAZARD UNDER NORMAL INDUSTRIAL USE CONDITIONS.

SECTION 3 REACTIVITY DATA

STABILITY: STABLE. AVOID OPEN FLAMES, WELDING ARCS OR OTHER HIGH TEMPERATURE SOURCES WHICH INDUCE THERMAL DECOMPOSITION.
INCOMPATIBILITY: WATER - SLOW HYDROLYSIS PRODUCES CORROSIVE ACID.
HAZARDOUS DECOMPOSITION PRODUCTS: HYDROGEN CHLORIDE AND VERY SMALL AMOUNTS OF PHOSGENE AND CHLORINE.
HAZARDOUS POLYMERIZATION: WILL NOT OCCUR.

SECTION 4 SPILL, LEAK, AND DISPOSAL PROCEDURES

ACTION TO TAKE FOR SPILLS (USE APPROPRIATE SAFETY EQUIPMENT): SMALL LEAKS: MOP UP, WIPE UP OR SOAK IMMEDIATELY. REMOVE TO OUT OF DOORS. LARGE SPILLS: EVACUATE AREA. CONTAIN LIQUID; TRANSFER TO CLOSED METAL CONTAINERS. KEEP OUT OF WATER SUPPLIES.
DISPOSAL METHOD: SEND SOLVENT TO RECLAIMER. IN SOME CASES IT CAN BE TRANSPORTED TO AN AREA WHERE IT CAN BE PLACED ON THE GROUND AND

(CONTINUED ON PAGE 2)
(R) INDICATES A REGISTERED OR TRADEMARK NAME OF THE DOW CHEMICAL COMPANY

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SECTION 4 SPILL, LEAK, AND DISPOSAL PROCEDURES (CONTINUED)

DISPOSAL METHOD: (CONTINUED)
ALLOWED TO EVAPORATE SAFELY. REFER TO CHEMICAL SAFETY DATA SHEET SD-90, MANUFACTURING CHEMISTS ASSOCIATION, 1825 CONNECTICUT AVENUE, WASHINGTON, D. C. 20009.

SECTION 5 HEALTH HAZARD DATA

INGESTION: VERY LOW TOXICITY. LD50 (LABORATORY ANIMALS) RANGES FROM 8 TO 14.0 G/KG.
EYE CONTACT: MILD IRRITATION, BUT ESSENTIALLY NO CORNEAL INJURY.
SKIN CONTACT: SHORT CONTACT - NO IRRITATION. PROLONGED OR FREQUENT EXPOSURE - MINOR IRRITATIONS. IF CONFINED TO THE SKIN - UP TO MODERATE IRRITATION, EVEN A BURN.
SKIN ABSORPTION: VERY LOW. LD50 (RABBITS) - 24 HOUR EXPOSURE - GREATER THAN 1.5 G/KG.
INHALATION: TLV: 350 PPM (1974).
EFFECTS OF OVEREXPOSURE: ANESTHETIC EFFECTS - MAY OCCUR IN THE RANGE OF 500 TO 1000 PPM.

SECTION 6 FIRST AID--NOTE TO PHYSICIAN

FIRST AID PROCEDURES: CAUTION - NEVER GIVE FLUIDS OR INDUCE VOMITING IF PATIENT IS UNCONSCIOUS OR HAVING CONVULSIONS.
EYES: FLUSH EYES WITH PLENTY OF WATER, GET MEDICAL ATTENTION IF IRRITATION OR INJURY DEVELOPS.
SKIN: FLUSH SKIN WITH PLENTY OF WATER, GET MEDICAL ATTENTION IF IRRITATION OR INJURY DEVELOPS.
INHALATION: IF BREATHING STOPS, GIVE ARTIFICIAL RESPIRATION. GET MEDICAL HELP. REMOVE TO FRESH AIR; KEEP WARM AND QUIET UNTIL RECOVERED.
INGESTION: INDUCE VOMITING. CALL A PHYSICIAN IMMEDIATELY. NO SPECIFIC ANTIDOTE KNOWN. TREAT SYMPTOMATICALLY. CAUTION: WITH SOME SOLVENTS, DRINKING ALCOHOL SHORTLY BEFORE, DURING OR AFTER EXPOSURE MAY CAUSE UNDESIRABLE EFFECTS.
NOTE TO PHYSICIAN: OVEREXPOSURE TO MANY OF THE CHLORINATED SOLVENTS, ESPECIALLY IF ACCOMPANIED BY ANOXIA, MAY TEMPORARILY INCREASE CARDIAC IRRITABILITY. MAINTAIN ADEQUATE OXYGENATION UNTIL RECOVERY. AVOID SYMPATOMIMETIC AMINES, SUCH AS EPINEPHRINE, WHICH MAY PRECIPITATE ARRHYTHMIAS.

SECTION 7 SPECIAL HANDLING INFORMATION

VENTILATION: LIMIT CONCENTRATION IN AIR TO TLV.
RESPIRATORY PROTECTION: BELOW 350 PPM - NONE. RESPIRATORY PROTECTION REQUIRED IN THE ABSENCE OF ENVIRONMENTAL CONTROL. FOR LEVELS UP TO 2%

(CONTINUED ON PAGE 3)
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DOW CHEMICAL U.S.A. MIDLAND MICHIGAN 48640 EMERGENCY PHONE: 517-636-4400
PRODUCT CODE: 16822
PRODUCT (CONT'D): CHLOROTHENE (R) VG MSD: 0110

SECTION 7 SPECIAL HANDLING INFORMATION (CONTINUED)

RESPIRATORY PROTECTION: (CONTINUED)
FOR 1/2 HOUR OR LESS, A SUITABLE FULL - FACE MASK WITH ORGANIC CANISTER SHOULD BE USED. ABOVE 2 PERCENT AND FOR EMERGENCIES, USE A SELF - CONTAINED BREATHING APPARATUS.

PROTECTIVE CLOTHING: NO SPECIAL PROTECTIVE CLOTHING NEEDED.

EYE PROTECTION: SAFETY GLASSES WITHOUT SIDE SHIELDS. EYE - WASH STATIONS AND SAFETY SHOWERS SHOULD BE READILY AVAILABLE.

SECTION 8 SPECIAL PRECAUTIONS AND ADDITIONAL INFORMATION

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: HANDLE WITH REASONABLE CARE. AVOID BREATHING VAPORS. STORE IN A COOL DRY PLACE. VAPORS OF THIS PRODUCT ARE HEAVIER THAN AIR AND WILL COLLECT IN LOW AREAS SUCH AS PITS, DEGREASERS, STORAGE TANKS, AND OTHER CONFINED AREAS. DO NOT ENTER THESE AREAS WHERE VAPORS OF THIS PRODUCT ARE SUSPECTED UNLESS SPECIAL BREATHING APPARATUS IS USED AND AN OBSERVER IS PRESENT FOR ASSISTANCE.

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ADDITIONAL INFORMATION, IF ANY: ---- MAY 20 '82 1746

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THE INFORMATION HEREIN IS GIVEN IN GOOD FAITH, BUT NO WARRANTY, EXPRESS OR IMPLIED, IS MADE.

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JAN 3 G. E. PARSONS

Vulcan CHEMICALS

Division of Vulcan Materials Company

MATERIAL SAFETY DATA SHEET

(ESSENTIALLY SIMILAR TO FORM OSHA-20)

SEE IMPORTANT NOTICE ON BOTTOM OF OTHER SIDE

24 Hour Emergency Phone (316) 524-5751

I - PRODUCT IDENTIFICATION

MANUFACTURER'S NAME AND ADDRESS Vulcan Materials Company, Chemicals Division, P. O. Box 7689, Birmingham, AL 35253-0689	
CHEMICAL NAME 1,1,1-Trichloroethane, Methyl Chloroform	CHEMICAL FORMULA CH_3CCl_3
TRADE NAME AND SYNONYMS Solvent 111®	CHEMICAL FAMILY Chlorinated Hydrocarbon
CAS REGISTRY NO. 71-55-6	DOT IDENTIFICATION NO. UN 2831

II - HAZARDOUS INGREDIENTS

MATERIAL OR COMPONENT	% (wt)	PEL (Units)
1,1,1 Trichloroethane (stabilized)	100	350ppm

III - PHYSICAL DATA

BOILING POINT (°F.)	162-190°F	SPECIFIC GRAVITY (H_2O=1)	1.3
VAPOR PRESSURE (mm Hg.) @20°C	100	PERCENT, VOLATILE BY VOLUME (%)	100
VAPOR DENSITY (AIR=1)	4.6	EVAPORATION RATE (ether=1)	0.4
SOLUBILITY IN WATER	0.07g/100g @ 25°C	APPEARANCE AND ODOR	Colorless clear liquid; mildly sweet odor.

IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used) None (TCC)	FLAMMABLE LIMITS in air @ 25°C	Lower 7.5% (vol)	Upper 15.0% (vol)

EXTINGUISHING MEDIA

Foam, Dry Chemical, Carbon dioxide

SPECIAL FIRE FIGHTING PROCEDURES

Self-contained breathing apparatus should be used in areas where 1,1,1-trichloroethane is stored.

UNUSUAL FIRE AND EXPLOSION HAZARDS Concentrated vapors can be ignited by high intensity heat source. Decomposition produces hydrogen chloride.

V - REACTIVITY DATA

STABILITY			CONDITIONS TO AVOID
	UNSTABLE		
	STABLE	X	Contact with open flame, hot surfaces or electric arcs

INCOMPATABILITY (Materials to avoid)

Strong alkalies, oxidizing materials

HAZARDOUS DECOMPOSITION PRODUCTS

Hydrogen chloride, phosgene (small amounts)

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID

Southington Maintenance Center

VI - HEALTH HAZARD DATA

PMC 9056

OSHA PERMISSIBLE EXPOSURE LIMIT

350 ppm 8 hour TWA. (29 CFR part 1910.1000)

ACGIH: 350 ppm 8 hour TLV; 450 ppm 15 min STEL.

EFFECTS OF OVEREXPOSURE

INHALATION:
Major route of exposure - low systemic toxicity; acute exposures in the 1000 ppm range cause narcosis. Overexposure can cause dizziness, drunkenness and drowsiness, unconsciousness and even death at extreme doses.

SKIN CONTACT/ABSORPTION:
Prolonged or repeated skin contact can cause dermatitis through defatting of skin. Absorption through skin is not a significant route of exposure - mildly irritating on contact.

INGESTION:
Unlikely route of exposure, ingestion of small quantities is not likely to be toxic.

EYES:
Mild irritation, but no corneal injury likely. May cause conjunctivitis.

EMERGENCY AND FIRST AID PROCEDURES

EYES AND SKIN
Remove contaminated clothing and flush exposed areas with water for 5 to 15 minutes.

INHALATION
Remove to fresh air. If breathing has stopped, administer respiration or oxygen if available.

INGESTION
Do not induce vomiting. Call physician and obtain medical attention.

VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Evacuate the area, ventilate, avoid breathing vapors, contain spill. Clean up area (wear protective clothing) by mopping or with absorbent material, transfer to closed container.

WASTE DISPOSAL METHOD Recovered liquids may be sent to a licensed reclaimer or incinerated. Contaminated absorbent material must be disposed of in a permitted waste management facility. Consult federal, state or local disposal authorities for approved procedures.

VIII - SPECIAL PROTECTION INFORMATION

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY	None required when used with adequate ventilation.
EYE	Chemical safety goggles. Contact lenses should not be worn.
SKIN	Neoprene, viton, polyvinyl alcohol coated gloves or equivalent.
OTHER	Protective headgear & apron when splashing is a problem.

VENTILATION REQUIREMENTS
Sufficient to maintain below PEL.

IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING Avoid contact with skin & avoid breathing vapors. Pipe vents outdoors. Store in cool, dry, ventilated area. Vapors are heavier than air and will collect in low areas.

OTHER PRECAUTIONS
Prevent moist air from entering storage. No smoking in presence of vapors.
Contact with aluminum parts in a pressurizable fluid system may cause violent reactions.
Consult equipment supplier for further information.

DATE April 1983

VMC 3239

NOTICE: Vulcan Chemicals believes that the information contained on this Material Safety Data Sheet is accurate. The suggested procedures are based on experience as of the date of publication. They are not necessarily all-inclusive nor fully adequate in every circumstance. Also, the suggestions should not be confused with nor followed in violation of applicable laws, regulations, rules or insurance requirements.
NO WARRANTY, EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS OR OTHERWISE IS MADE.

Form 3239-560

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MATERIAL SAFETY DATA SHEET

NOV 9 1987

DATE 2-1-86

INDUSTRIAL HYGIENE

SECTION I

Manufacturer's Name: TOLBER DIV/PYRAMID PLASTICS, INC.	Emergency Telephone No: (501) 777-3251
Address (Number, Street, City, State and ZIP Code): 220 W. 5th St., Hope, Ark. 71801	
Chemical Name and Synonyms: Petroleum Wax	Trade Name: #C-562 MICCROWAX
DOT Classification: Not Hazardous	

SECTION II INGREDIENTS

Chemical Name	% Wt.	CAS Registry No.	TLV
Aliphatic Hydrocarbon Wax	100	All chemical substances manufactured for #C-562 Miccrowax by the Tolber Div. have been reported for the chemical substances inventory pursuant to Secs. 8 (a) and 8 (b) of the Toxic substances Control Act (Public Laws 94-469)	

SECTION III PHYSICAL DATA

Melting Point (°F.)	170°F	Specific Gravity (H_2O = 1)	.85
Vapor Pressure (mm. Hg)	-----	Percent Volatile By Volume (%)	0
Vapor Density (Air = 1)	-----	Evaporation Rate (Butyl Acetate = 1)	NA
Solubility in Water	NA	pH =	NA

Appearance and Odor: Dark Brown Solid. Petroleum odor

SECTION IV FIRE AND EXPLOSION HAZARD DATA

Flash Point (Method Used)	500°F	Flammable Limit	Lel	Uel

Extinguishing Media: CO_2

Special Fire Fighting Procedures: None

Unusual Fire and Explosion Hazards: None

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SECTION V HEALTH HAZARD DATA

Threshold Limit Value NA

Effects of Overexposure NA

Emergency and First Aid Procedures NA

Toxicity Information NA

SECTION VI REACTIVITY DATA

Stability	Unstable		Conditions to Avoid
	Stable	XX	

Incompatability (Materials to Avoid)

Hazardous Decomposition Products Carbon Monoxide

Hazardous Polymerization	May Occur		Conditions to Avoid
	Will Not Occur	XX	

SECTION VII SPILL OR LEAK PROCEDURES

Steps to Be Taken in Case Material is Released or Spilled Wipe up after cools

Waste Disposal Method In accordance with state, local and federal regulations for aliphatic hydrocarbon wax.

SECTION VIII SPECIAL PROTECTION INFORMATION

Respiratory Protection (Specify Type) NA

Ventilation	Local Exhaust	Special

Protective Gloves	None	Eye Protection	None

Other Protective Equipment None

SECTION IX SPECIAL PRECAUTIONS

Precautions to be taken in Handling and Storing None

Other Precautions

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UTC IHL

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

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MATERIAL SAFETY DATA SHEET

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Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

MANUFACTURER'S NAME: M. Argueso & Co., Inc.	EMERGENCY TELEPHONE NO.: (914) 698-8500
ADDRESS (Number, Street, City, State, and ZIP Code): 441 Waverly Avenue, Mamaroneck, N.Y. 10543	
CHEMICAL NAME AND SYNONYMS: Hydrocarbon	TRADE NAME AND SYNONYMS: Cerita Masking Wax 361-C
CHEMICAL FAMILY: Wax	FORMULA:

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
Telecon 5/22/80 not halogenated		

SECTION III - PHYSICAL DATA

BOILING POINT (°F.)	Above - 700°F.	SPECIFIC GRAVITY (H_2O=1)	0.927
VAPOR PRESSURE (mm Hg.)		PERCENT, VOLATILE BY VOLUME (%)	
VAPOR DENSITY (AIR=1)		EVAPORATION RATE (_____ =1)	
SOLUBILITY IN WATER	Insoluble		
APPEARANCE AND ODOR	Solid material, No odor		

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used): 530°F. Coc, ASTM D-92	FLAMMABLE LIMITS	Lel	Uel
EXTINGUISHING MEDIA: Water, CO_2, Foam, and Dry Chemical			
SPECIAL FIRE FIGHTING PROCEDURES: None			
UNUSUAL FIRE AND EXPLOSION HAZARDS			

(Continued on reverse side)

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SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE: No Known Effects

EFFECTS OF OVEREXPOSURE:

EMERGENCY AND FIRST AID PROCEDURES: A burn from molten wax should be treated as a thermal burn.

SECTION VI - REACTIVITY DATA

STABILITY			CONDITIONS TO AVOID
	UNSTABLE	No	
	STABLE	Yes	

INCOMPATABILITY *(Materials to avoid)*

HAZARDOUS DECOMPOSITION PRODUCTS

HAZARDOUS POLYMERIZATION			CONDITIONS TO AVOID
	MAY OCCUR		
	WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Sweep or scrape up material

WASTE DISPOSAL METHOD: Burn in approved incinerator or an open pit. (controlled)

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION *(Specify type)*: None required

VENTILATION			
	LOCAL EXHAUST	Adequate	SPECIAL: None
	MECHANICAL *(General)*		OTHER

PROTECTIVE GLOVES: Not required

EYE PROTECTION: Nothing special

OTHER PROTECTIVE EQUIPMENT

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

OTHER PRECAUTIONS

GPO 930-540

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Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

MANUFACTURER'S NAME: Frank B. Ross Co., Inc.	EMERGENCY TELEPHONE NO.: 201-433-4512
ADDRESS (Number, Street, City, State, and ZIP Code): 6 Ash Street Jersey City, N.J. 07304	
CHEMICAL NAME AND SYNONYMS: Microcrystalline Wax	TRADE NAME AND SYNONYMS: Ross PMC 9952-1 Masking Wax
CHEMICAL FAMILY: Petroleum	FORMULA: PMC9551 64-0504

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
Non Hazardous		
Not halogenated per D. Ayerlee, Telecon 5/22/80		

SECTION III - PHYSICAL DATA

BOILING POINT (°F.) Melting Point	165/175°F	SPECIFIC GRAVITY (H_2O=1)	0.930
VAPOR PRESSURE (mm Hg.)	---	PERCENT, VOLATILE BY VOLUME (%)	
VAPOR DENSITY (AIR=1)		EVAPORATION RATE (_____ =1)	
SOLUBILITY IN WATER	Insoluble		
APPEARANCE AND ODOR	Black Solid		

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used) 500° F Min. C.O.C.	FLAMMABLE LIMITS	LEL	UEL
EXTINGUISHING MEDIA: Foam no water			
SPECIAL FIRE FIGHTING PROCEDURES			
UNUSUAL FIRE AND EXPLOSION HAZARDS			

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(Continued on reverse side)

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SECTION V - HEALTH HAZARD DA

THRESHOLD LIMIT VALUE

EFFECTS OF OVEREXPOSURE

EMERGENCY AND FIRST AID PROCEDURES

Non Hazardous

SECTION VI - PEACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE		

INCOMPATABILITY *(Materials to avoid)*

HAZARDOUS DECOMPOSITION PRODUCTS

Non Hazardous

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR		

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Non Hazardous

WASTE DISPOSAL METHOD

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION *(Specify type)*

VENTILATION	LOCAL EXHAUST	SPECIAL
	MECHANICAL *(General)*	OTHER

PROTECTIVE GLOVES	EYE PROTECTION

OTHER PROTECTIVE EQUIPMENT

Non Hazardous

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

OTHER PRECAUTIONS

Non Hazardous

GPO 920-540

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Form OSHA-20
Rev. May 72

Form Approved
Budget Bureau No. 44-R130
Approval Expires April 30, 1969

Form No. LSB-005-4
May 1969

UTC
Tolber Div.
220 West 5th St.
Hope, Arkansas 71801

U.S. DEPARTMENT OF LABOR

PMC 9551

WAGE AND LABOR STANDARDS ADMINISTRATION
Bureau of Labor Standards

50-0367

MATERIAL SAFETY DATA SHEET

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SECTION I

MANUFACTURER'S NAME: MICHIGAN CHEMICAL CO.	EMERGENCY TELEPHONE NO.: (313) 921-3711
ADDRESS (Number, Street, City, State, and ZIP Code): 8415 GRINNELL, DETROIT, MICH. 48213	
CHEMICAL NAME AND SYNONYMS: PETROLEUM BASE HYDROCARBON-ALIPHATIC	TRADE NAME AND SYNONYMS: MICROWAX C-502
CHEMICAL FAMILY: PETROLEUM WAX	FORMULA: NOT A HAZARDOUS MATERIAL

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

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
ODORLESS, TASTELESS, NON-TOXIC		
COULD BE FDA QUALIFIED		
Not halogenated		

BOILING POINT (°F.) MELTING 170°F		SPECIFIC GRAVITY (H_2O=1)	.85
VAPOR PRESSURE (mm Hg.)		PERCENT VOLATILE BY VOLUME (%)	—
VAPOR DENSITY (AIR=1)		EVAPORATION RATE (_____=1)	—
SOLUBILITY IN WATER NO			
APPEARANCE AND ODOR BROWN ODORLESS			

FLASH POINT (Method used) 500°F	FLAMMABLE LIMITS	Lel	Uel
EXTINGUISHING MEDIA			
SPECIAL FIRE FIGHTING PROCEDURES NONE			
UNUSUAL FIRE AND EXPLOSION HAZARDS NONE			

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SECTION V: HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE: NA

EFFECTS OF OVEREXPOSURE: NA

EMERGENCY AND FIRST AID PROCEDURES: NA

SECTION VI: REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE		

INCOMPATABILITY (Materials to avoid)

HAZARDOUS DECOMPOSITION PRODUCTS

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID IMMERSION IN HOT WAX
	WILL NOT OCCUR	X	

SECTION VII: SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: WIPE UP AFTER COOLS

WASTE DISPOSAL METHOD

SECTION VIII: SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type): NONE

VENTILATION	LOCAL EXHAUST	SPECIAL
NONE	MECHANICAL (General)	OTHER

PROTECTIVE GLOVES	EYE PROTECTION

OTHER PROTECTIVE EQUIPMENT: NONE

SECTION IX: SPECIAL INFORMATION

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: NONE

Can material be stored outside? YES

OTHER PRECAUTIONS

Is material freezable? NO

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MATERIAL SAFETY DATA SHEET

PENNWALT CORPORATION
METAL PREP DEPARTMENT
2375 STATE ROAD
CORNWELLS HEIGHTS, PA. 19020

EMERGENCY PHONE NUMBERS
BUSINESS HRS: 215-245-3128
OTHER HOURS:
CHEMTREC: 800-424-9300

PRODUCT IDENTIFICATION

PRODUCT NAME: CAS NO.: NA-MIXTURE
CLEANER K7
SYNONYMS:
ALKALINE CLEANER
CHEMICAL NAME:
NA-MIXTURE
MOLECULAR FORMULA:
NA-MIXTURE
CHEMICAL FAMILY: STRONG ALKALI

INGREDIENTS-----HAZARD CLASSIFICATIONS

COMPONENTS-HAZARDOUS	CAS NO.	%	COMMENTS
SODIUM METASILICATE	06834-92-0		TWA 10 mg/M3 (NUISANCE DUST) LD50 1280 mg/kg (ORAL-RAT)
SODIUM HYDROXIDE	01310-73-2	80.0	TWA 2 mg/kg (C) PEL 2 mg/M3 EPA has classified aqueous solutions of this material as a SARA 313 reportable chemical.

SHIPPING INFORMATION

CAUSTIC SODA, DRY, MIXTURE; CORROSIVE MATERIAL; UN 1823

PHYSICAL PROPERTIES

BOILING POINT/RANGE: NA
MELTING POINT: NE
FREEZING POINT: NA
MOLECULAR WEIGHT: NA-MIXTURE
SPECIFIC GRAVITY(H2O=1): NA
VAPOR PRESSURE(MM HG): NA
VAPOR DENSITY(AIR=1): NA
SOLUBILITY IN H2O: SOLUBLE
% VOLATILES BY VOLUME: NA
APPEARANCE AND ODOR:
WHITE, FREE-FLOWING GRANULES

pH (5 % soln) - >12.0

FIRE AND EXPLOSION DATA

FLASH POINT: NA
FLAMMABLE LIMITS: LOWER: NA UPPER: NA
AUTOIGNITION TEMP.: NA

NA - NOT APPLICABLE NE - NOT ESTABLISHED
(R) - INDICATES REGISTERED TRADEMARK OF PENNWALT CORPORATION

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203-2211

September 11, 1989

APPROVAL

Mr. John G. Whitehead, Plant Manager
UTC Pratt & Whitney Aircraft
400 Main Street
East Hartford, Connecticut 06108

RE: Approval of partial closure plan for incinerator at Pratt & Whitney Aircraft, East Hartford, Connecticut CTD 990672081

Dear Mr. Whitehead:

The partial closure plan dated May 2, 1988 as amended July 7, 1989 and August 17, 1989 that was prepared for Pratt & Whitney Aircraft, 400 Main Street, East Hartford, Connecticut has been reviewed by the Connecticut Department of Environmental Protection (DEP) and the U.S. Environmental Protection Agency (EPA) Region I.

The DEP and EPA have determined that these plans comply with the closure requirements pursuant to Section 22a-449(c)-29 of the regulations of Connecticut State Agencies and with Title 40 Part 265 Subparts G and O of the Code of Federal Regulations. Both agencies hereby approve the plan as submitted provided the following conditions are met:

1. Pratt and Whitney Aircraft shall contact DEP/EPA for review of the following closure plan events at least 14 days prior to their implementation:

   a. Prior to sampling for hazardous constituents.

2. The background decontamination standard must be the lowest value obtained of the two samples taken.

All work shall be subject to the review of the DEP and the EPA. They shall decide all questions as to interpretations of approved plans and specifications.

FACILITIES & SERVICES
RECEIVED
SEP 15 1989
R. C. WEISS

Mr. John C. Whitehead
UTC Pratt & Whitney Aircraft
Approval

September 11, 1989

The Regional Administrator of the EPA and the Commissioner of the DEP may authorize changes to the approved closure plan upon written request pursuant to 40 CFR 265.112(c).

This approval does not relieve the facility of the obligation to obtain any other authorization as may be required by other provisions of the Connecticut General Statues, Regulations of Connecticut State Agencies, Code of Federal Regulations, or Federal Statutes.

Sincerely,

Stephen W. Hitchcock, Director
Hazardous Material Management Unit
Connecticut Department of
Environmental Protection

Merrill S. Hohman, Director
Waste Management Division
Region I
U. S. Environmental
Protection Agency

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RECEIVED JAN 30 199 SAFETY ENGINEER

MATERIAL SAFETY DATA SHEET

PENNWALT CORPORATION
METAL PREP DEPARTMENT
2375 STATE ROAD
CORNWELLS HEIGHTS, PA. 19020

EMERGENCY PHONE NUMBERS
BUSINESS HRS: 215-245-3128
OTHER HOURS:
CHEMTREC: 800-424-9300

PRODUCT IDENTIFICATION

PRODUCT NAME: CAS NO.: NA-MIXTURE
CLEANER K7
SYNONYMS:
ALKALINE CLEANER
CHEMICAL NAME:
NA-MIXTURE
MOLECULAR FORMULA:
NA-MIXTURE
CHEMICAL FAMILY: STRONG ALKALI

INGREDIENTS-----HAZARD CLASSIFICATIONS

COMPONENTS-HAZARDOUS	CAS NO.	%	COMMENTS
SODIUM METASILICATE	06834-92-0		TWA 10 mg/M3 (NUISANCE DUST) LD50 1280 mg/kg (ORAL-RAT)
SODIUM HYDROXIDE	01310-73-2	80.0	TWA 2 mg/kg (C) PEL 2 mg/M3 EPA has classified aqueous solutions of this material as a SARA 313 reportable chemical.

SHIPPING INFORMATION

CAUSTIC SODA, DRY, MIXTURE; CORROSIVE MATERIAL; UN 1823

PHYSICAL PROPERTIES

BOILING POINT/RANGE: NA
MELTING POINT: NE
FREEZING POINT: NA
MOLECULAR WEIGHT: NA-MIXTURE
SPECIFIC GRAVITY(H2O=1): NA
VAPOR PRESSURE(MM HG): NA
VAPOR DENSITY(AIR=1): NA
SOLUBILITY IN H2O: SOLUBLE
% VOLATILES BY VOLUME: NA
APPEARANCE AND ODOR:
WHITE, FREE-FLOWING GRANULES

pH (5 % soln) - >12.0

FIRE AND EXPLOSION DATA

FLASH POINT: NA
FLAMMABLE LIMITS: LOWER: NA UPPER: NA
AUTOIGNITION TEMP.: NA

NA - NOT APPLICABLE NE - NOT ESTABLISHED
(R) - INDICATES REGISTERED TRADEMARK OF PENNWALT CORPORATION

EXTINGUISHING MEDIA:
WATER-SPRAY WATER-FOG

SPECIAL FIRE FIGHTING PROCEDURES:
Wear Self Contained Breathing Apparatus. Cool fire exposed containers with water.

UNUSUAL FIRE AND EXPLOSION HAZARDS: NA

****

REACTIVITY DATA

STABILITY: CONDITIONS CONTRIBUTING TO INSTABILITY: NA
STABLE

Hazard Rating (NFPA 704M): EXTREME 4 HIGH 3 MODERATE 2
SLIGHT 1 LEAST 0

HEALTH	(BLUE)	3
FLAMMABILITY	(RED)	0
REACTIVITY	(YELLOW)	0

INCOMPATIBILITY-AVOID CONTACT WITH:
STRONG ACIDS

HAZARDOUS DECOMPOSITION THERMAL AND OTHER: NA

CONDITIONS TO AVOID:

This product liberates a great deal of heat when added to water. To avoid rapid temperature rise, violent spattering or explosive eruptions, *ALWAYS* ADD PRODUCT TO WATER. *NEVER* ADD WATER TO PRODUCT.

THE FOLLOWING MIXING PROCEDURE SHOULD BE USED:

1. Heat water to 80 - 100 DEG F before adding product.
2. Add small amounts of product slowly and evenly while constantly mixing solution. Never increase concentration of product in solution by more than five percent with any single addition. Water temperature should not exceed 160 DEG F during addition.

****

TOXICITY

ROUTE	ANIMAL	DATA
ORAL	ACUTE - SODIUM HYDROXIDE LD50-	340 mg/kg (ORAL-RAT)
DERMAL	ACUTE - SODIUM HYDROXIDE LD50-	1350 mg/kg (ORAL-RAT)

TOXIC EFFECTS

EYE EFFECTS: CORROSIVE
Causes rapid tissue destruction, permanent damage and possible blindness.

SKIN EFFECTS: CORROSIVE

NA - NOT APPLICABLE NE - NOT ESTABLISHED
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Solids or dust will cause skin irritation. Prolonged exposure will cause irreversible scarring.

OTHER TOXIC EFFECTS:
This product does not contain any components listed by IARC, NTP or OSHA as carcinogens.

TARGET ORGAN TOXIN:
Ingestion may cause severe burns of the mouth and throat. Prolonged exposure to skin will cause irreversible scarring.
Dust inhalation can cause burns to the mucous membranes.

TOXICITY COMMENTS:
Individuals with breathing difficulty may find exposure to this product increases that difficulty. Such individuals should pay special attention to the recommended exposure limits for hazardous ingredients.

****

HEALTH HAZARD INFORMATION

PERMISSIBLE EXPOSURE LIMITS
Since this product is a mixture, there is no exposure limit established for it. Hazardous components and their associated permissible exposure limits are listed in the section titled 'INGREDIENTS-----HAZARD CLASSIFICATIONS'.

EMERGENCY FIRST AID

INGESTION

DO NOT INDUCE VOMITING	GIVE PLENTY OF WATER	GET MEDICAL ATTENTION

DO NOT INDUCE VOMITING. GIVE PLENTY OF WATER OR MILK. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. GET IMMEDIATE MEDICAL ATTENTION.
NOTE TO PHYSICIAN: PROBABLE MUCOSAL DAMAGE MAY CONTRAINDICATE THE USE OF GASTRIC LAVAGE. MEASURES AGAINST CIRCULATORY SHOCK, RESPIRATORY DEPRESSION AND CONVULSION MAY BE NEEDED

DERMAL

WASH WITH SOAP AND WATER	GET MEDICAL ATTENTION	CONTAMINATED CLOTHING REMOVE & LAUNDER	CONTAMINATED SHOES - DESTROY

EYE CONTACT

FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES	GET MEDICAL ATTENTION

IMMEDIATELY AND CONSTANTLY FLUSH EYES (HOLDING EYELIDS OPEN) WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES OR UNTIL MEDICAL TREATMENT IS RECEIVED. WHILE FLUSHING, REMOVE CONTAMINATED CLOTHING AND SHOES AND DESTROY. GET EMERGENCY MEDICAL ATTENTION

NA - NOT APPLICABLE NE - NOT ESTABLISHED
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INHALATION
REMOVE TO FRESH AIR — IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION

****

SPECIAL PROTECTION INFORMATION

VENTILATION REQUIREMENTS:
LOCAL EXHAUST — USE WITH ADEQUATE VENTILATION

Maintain ventilation sufficient to reduce the level of hazardous ingredient(s) below the stated concentration level(s).

EYE: FACE SHIELD GOGGLES

Contact lenses should NEVER be worn when working with this or any chemical.

HAND (GLOVE TYPE): ANY NON-PERMEABLE TO PRODUCT

RESPIRATOR TYPE: CARTRIDGE

FILTERS DUST

Respiratory protection should be worn if the level of airborne contamination exceeds the level(s) listed above. Air quality should always be improved first by engineering solutions (such as better ventilation), and then by using respiratory protection if the engineering solution is unsuccessful.

OTHER PROTECTIVE EQUIPMENT:
RUBBER BOOTS APRON

****

SPECIAL HANDLING AND STORAGE CONDITIONS

WASH THOROUGHLY AFTER HANDLING — DO NOT GET IN EYES, ON SKIN OR CLOTHING — DO NOT BREATHE DUST,VAPOR,MIST,GAS

KEEP CONTAINER CLOSED

****

SPILL MANAGEMENT

FLUSH WITH WATER — SWEEP OR SCOOP UP AND REMOVE

Flush residue,with water,to chemical waste treatment.

****

DISPOSAL PROCEDURES

Dissolve slowly in water. Carefully neutralize with dilute acid and flush to chemical waste drain.

CONSULT FEDERAL, STATE, OR LOCAL AUTHORITIES FOR PROPER DISPOSAL PROCEDURES

NA - NOT APPLICABLE NE - NOT ESTABLISHED
(R) - INDICATES REGISTERED TRADEMARK OF PENNWALT CORPORATION

PMC 1256

****

MSDS PREPARED BY H.D.McLaughlin Jr.

****

THE ABOVE INFORMAION IS ACCURATE TO THE BEST OF OUR KNOWLEDGE. HOWEVER, SINCE DATA, SAFETY STANDARDS, AND GOVERNMENT REGULATIONS ARE SUBJECT TO CHANGE AND THE CONDITIONS OF HANDLING AND USE, OR MISUSE ARE BEYOND OUR CONTROL, PENNWALT MAKES NO WARRANTY, EITHER EXPRESS OR IMPLIED, WITH RESPECT TO THE COMPLETENESS OR CONTINUING ACCURACY OF THE INFORMATION CONTAINED HEREIN AND DISCLAIMS ALL LIABILITY FOR RELIANCE THEREON. USER SHOULD SATISFY HIMSELF THAT HE HAS ALL CURRENT DATA RELEVANT TO HIS PARTICULAR USE.

NA - NOT APPLICABLE NE - NOT ESTABLISHED
(R) - INDICATES REGISTERED TRADEMARK OF PENNWALT CORPORATION

UTC
I.H. Lab

U.S. DEPARTMENT OF LABOR
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MATERIAL SAFETY DATA SHEET

PMC 1256

Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

Phone: 756-5521

rec'd 4-24-79

SECTION I

MANUFACTURER'S NAME	EMERGENCY TELEPHONE NO.
HUBBARD HALL CHEMICAL CO.	203-756-5521

ADDRESS (Number, Street, City, State, and ZIP Code)
563 South Leonard Street, Waterbury, Connecticut 06714

CHEMICAL NAME AND SYNONYMS	TRADE NAME AND SYNONYMS
	HHCleaner 200-P.W.A.

CHEMICAL FAMILY	FORMULA
Mixture of alkaline salt & surfactants.	Old Name: Ahcoloid #200 Cleaner

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS		NA	BASE METAL		NA
CATALYST		NA	ALLOYS		NA
VEHICLE		NA	METALLIC COATINGS		NA
SOLVENTS		NA	FILLER METAL PLUS COATING OR CORE FLUX		NA
ADDITIVES		NA	OTHERS		
OTHERS		NA			

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
Caustic Soda (excess of)	50	2MG/M^3 (Du

SECTION III - PHYSICAL DATA

BOILING POINT (°F.)	N. A.	SPECIFIC GRAVITY (H_2O=1)	
VAPOR PRESSURE (mm Hg.)	N. A.	PERCENT, VOLATILE BY VOLUME (%)	N. A.
VAPOR DENSITY (AIR=1)	N. A.	EVAPORATION RATE (---=1)	N. A.
SOLUBILITY IN WATER	Appreciable		
APPEARANCE AND ODOR	White or off - white granular		

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	FLAMMABLE LIMITS	Lel	Uel
N. A.	N.A.		

EXTINGUISHING MEDIA
Not Flammable

SPECIAL FIRE FIGHTING PROCEDURES

UNUSUAL FIRE AND EXPLOSION HAZARDS
Will release flammable Hydrogen gas when in contact with aluminum, tin, zinc and their alloys. can react violently with some organic chemicals including chlorinated hydrocarbons

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(Continued on reverse side)

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9'82 07 - PMC 1256

HH Cleaner 200

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE Value for sodium hydroxide is 2 mg/M3 (ACGIH-1970)

EFFECTS OF OVEREXPOSURE Skin: May cause severe burns. Eyes: Rapidly causes severe damage to eyes. Ingestion will damage tissues and can cause death. Dust inhalation may damage respiratory tract.

EMERGENCY AND FIRST AID PROCEDURES Speed in removal of caustic is of primary importance. Skin: Flush with large amounts of water up to 1 or 2 hours. Eyes: Irrigate immediately with copious amounts of water for at least 15 min. Ingestion: Drink large amounts of water to dilute the chemical. Get physician's treatment at once for eye skin burns and if ingested or inhaled

SECTION VI - REACTIVITY DATA

STABILITY			CONDITIONS TO AVOID
	UNSTABLE		
	STABLE	x	

INCOMPATABILITY (Materials to avoid) Aluminum, zinc, tin, organic chemicals including chlorinated hydrocarbons such as trichloroethylene.

HAZARDOUS DECOMPOSITION PRODUCTS NA

HAZARDOUS POLYMERIZATION			CONDITIONS TO AVOID
	MAY OCCUR		
	WILL NOT OCCUR	x	

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED Sweep up carefully and remove. Dissolve and flush away remainder. Dilute acid, preferably acetic acid, may be used to neutralize final caustic traces.

WASTE DISPOSAL METHOD If disposal regulations permit discharge of neutral solution dissolve in water, cool neutralize carefully with dilute acid such as acetic. Then flush to sewer with lots of water. Disposal by a contractor may otherwise be needed.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type) Filter or dust type respirators.

VENTILATION	LOCAL EXHAUST	SPECIAL
	As necessary to eliminate dust.	
	MECHANICAL (General) Good ventilation is essential	OTHER Safety showers in work area.

PROTECTIVE GLOVES	EYE PROTECTION
Rubber, neoprene or vinyl	Chemical Safety Goggles

OTHER PROTECTIVE EQUIPMENT Face shields, hard hats, rubber aprons, boots or shoes and rubber clothing as necessary to prevent skin contact

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING Do not mix with hot water. Add a cleaner slowly and carefully to cold water with stirring, as heat is evolved. Heat is also evolved in neutralizing.

OTHER PRECAUTIONS

COPY TO LOCAL I.A.M.

MAY 18 '82 1746

COPY TO LOCAL I.A.M.

MAY 18 '82 1746

PMC 1256

SEP 9 '82 07

PRODUCT BULLETIN

HH CLEANER 200 PWA - Old Name: Alkaloid

HH Cleaner 200 PWA is an extra heavy duty anodic alkaline electrocleaner for steel, copper and copper plated steel.

HH Cleaner 200 PWA has been formulated so that it may also serve as a soak electrocleaner in shops and plants where the cycle is limited to a few steps.

HH Cleaner 200 PWA may serve as a general purpose soak electrocleaner for the removal of such soils as: stamping oils, water soluble fabrication compounds, polishing and grinding compounds and cutting and drawing lubricants.

Furthermore, because of its unique formulation, HH Cleaner 200 PWA should be considered for applications where smutted steel is encountered.

The advantages of HH Cleaner 200 PWA are:

1. High Conductivity.
2. Free rinsing - will perform equally well in hard water areas.
3. Non dusting - free flowing powder.
4. May serve as soak-electrocleaner.

Operating Conditions

Concentrations: 8 to 32 oz/gal. (60 to 240 gms/l)

Temperatures: 140° - 205° F. (60° - 91° C.)

Current Densities: 60 to 100 amps/ft^2 (6 to 10 amps/dm^2)

Equipment: Mild steel tanks, anodes and coils.

Ventilation: Required when used as an electrocleaner.

Control

Titration Procedure

factor (oz/gal.) 0.33

factor (gms/l) 2.46

Use 10 ml sample, N/2 HCL, 3 drops phenolphthalein indicator.

Concentration 200 PWA =mls N/2 HCL x factor

(OVER)

COPY TO LOCAL I.A.M.

MAY 18 '82 1740 PMC 1256

Test Kit Procedure (Kocour test kit)

factor (oz/gal.) 0.42

factor (gms/l) 3.16

Conc. 200 PWA = drops N-94 solution x factor

Waste Disposal

Neutralize solutions of cleaner 200 PWA to a pH between 6 to 8 with a mineral acid. Use caution when adding the acid since neutralization generates heat. Discharge the neutralized solution to a sewer or settling lagoon.

In order to be completely informed on the latest disposal regulations for your area, please contact the local authorities.

Caution

HH Cleaner 200 PWA is a highly alkaline product, thus should be handled accordingly. Avoid skin and eye contact. Wear protective clothing, gloves and goggles. Flush exposed areas immediately with clean cold water. In case of injury contact a doctor immediately.

Standard packages - 400# drum

Warranty:

This product is guaranteed as to quality upon shipment from our plant. If the recommendations are followed, desired results will be obtained. Since the use of our products is beyond our control, no guarantee expressed or implied is made as to the effects of such use, or the results to be obtained.

Replaces sheet dated 11/10/76 5/22/78

PMC 1256-1

PENNWALT CORPORATION

MATERIAL SAFETY DATA SHEET

"ESSENTIALLY SIMILAR" TO OSHA FORM 20

FORM 4040 (Rev. 8-81)

RECEIVED
MAY 27 1986
SAFETY
MIDDLETOWN

ADDRESS: Pennwalt Corporation
900 First Avenue
King of Prussia, PA 19406

Emergency Phone Number(s)
Business: (215) 337-6634
Other:

CAS No.(s): See below

Chemical Family: Strong Alkali

PRODUCT IDENTIFICATION

Pennwalt Product Name: K-7

Pennwalt Code No: 9B01

Chemical Name and Molecular Formula: UTCIHL 10

RECEIVED
MAY 27 1986
INDUSTRIAL HYGIENE

Synonyms:

HAZARDOUS INGREDIENTS

MATERIALS OR COMPONENTS	% w/w	HAZARD DATA (TLV, LD50, LC50, etc.)
Sodium Hydroxide (1310-73-2)	<80.0	TWA 2 mg/m^3 (C)
Sodium Silicate (6834-92-0)	<20.0	TWA 10 mg/m^7 (nuisance particulate)

SHIPPING INFORMATION

Caustic Soda, Dry, Mixture; Corrosive Material; UN 1823

PHYSICAL PROPERTIES

Boiling Point/Range: °C NA °F

Melting Point: ND °C °F

Freezing Point: NA °C °F

Molecular Weight (Calculated): Mixture

Specific Gravity (H_2O=1): NA @ / °C

Vapor Pressure (mm Hg): NA @ °C °F

Vapor Density (Air=1): NA

Solubility in H_2O: Soluble

% Volatiles by Volume: NA

Evaporation Rate: NA ☐ Ether = 1 ☐ Water = 1 ☐ Butylacetate = 1

Appearance and Odor: White free flowing granules

Other: –

FIRE AND EXPLOSION DATA

Flash Point: None °C °F

Test Method:

Flammable Limits: NA Lower % Upper %

Autoignition Temperature/Fire Point: NA °C °F

EXTINGUISHING MEDIA
☒ Water-spray ☒ Water-fog ☒ Water stream ☐ CO_2 ☐ Dry chemical ☐ Alcohol foam ☐ Foam ☐ Earth or sand

SPECIAL FIRE FIGHTING PROCEDURES
☐ Do not enter building ☐ Allow fire to burn ☐ Water may cause frothing ☐ Do not use water NA

UNUSUAL FIRE AND EXPLOSION HAZARDS
☐ Dust explosion hazard ☐ Sensitive to shock ☐ Contamination ☐ Temperature ☐ Other (specify): NA

REACTIVITY DATA

STABILITY
☒ Stable ☐ Unstable

CONDITIONS CONTRIBUTING TO INSTABILITY
☐ Thermal decomposition ☐ Photo degradation ☐ Polymerization ☐ Contamination

INCOMPATIBILITY - Avoid contact with
☒ Strong acids ☐ Strong alkalis ☐ Strong oxidizers ☐ Other (specify):

HAZARDOUS DECOMPOSITION PRODUCTS - THERMAL AND OTHER (list)
Thermal - Oxides of Carbon

CONDITIONS TO AVOID
☐ Heat ☐ Open flames ☐ Sparks ☐ Ignition sources ☐ Other (specify):

SPILL OR LEAK

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
☐ Flush with water ☐ Absorb with sand or inert material ☐ Neutralize ☒ Sweep or scoop up and remove ☐ Keep upwind. Evacuate enclosed spaces. ☐ Prevent spread or spill
☐ Dispose of immediately ☒ Other (specify): Flush to chemical waste treatment

WASTE DISPOSAL METHOD - *Consult federal, state, or local authorities for proper disposal procedures.*

CONTINUED ON REVERSE SIDE ▶

NA — Not Applicable.

Before using product, read and follow directions and precautions on product label and bulletins.

PMC 1256-1

TOXICITY

Oral (acute): NE

Dermal (acute): NE

Eye: NE

Inhalation (acute): NE

Chronic, Subchronic, etc.: NE

HEALTH HAZARD INFORMATION

Effects of Exposure

PERMISSIBLE EXPOSURE LIMIT (Specify if TLV/TWA or Ceiling (c)): ACGIH 19___ OSHA 19___ Other:

IRRITATION: NA
- [ ] Skin [ ] Severe [ ] Moderate
- [ ] Eye [ ] Severe [ ] Moderate [ ] Mild (transient)

CORROSIVITY
- [X] Skin [X] 4 hrs. (DOT) [ ] 24 hrs. (CPSC)
- [X] Eye [X] May cause blindness

SENSITIZATION: [ ] Skin NA [ ] Respiratory [ ] Allergen

INHALATION EFFECTS: [ ] Narcotic effect NA [ ] Cyanosis [ ] Asphyxiant

LUNG EFFECTS (Specify): NA

OTHER (Specify): [ ] Repeated contact - skin defatter [ ] Other (Specify): NA

Emergency First Aid

INGESTION: [ ] Induce vomiting [X] Do NOT induce vomiting [X] Give plenty of water [X] Get medical attention [ ] Other (specify):

DERMAL: [X] Flush with soap and water [X] Get medical attention [ ] Contaminated clothing - remove & launder [ ] Contaminated shoes - destroy [ ] Other (specify):

EYE CONTACT: [X] Flush with plenty of water for at least 15 minutes [X] Get medical attention [X] Other (specify): Hold eyelids open while flushing

INHALATION: [X] Remove to fresh air [ ] If not breathing, give artificial respiration [ ] Give oxygen [ ] Get medical attention [ ] Other (specify):

SPECIAL PROTECTION INFORMATION

VENTILATION REQUIREMENTS — *Always maintain exposure below permissible exposure limits*
- [ ] Consult an industrial hygienist or environmental health specialist
- [X] Local exhaust
- [ ] Use with adequate ventilation
- [ ] Check for air contaminant and oxygen deficiency
- [ ] Other (specify):

Sufficient to maintain level below the specified hazardous ingredient concentration limit.

EYE
- [X] Face shield
- [ ] Safety glasses
- [X] Goggles

HAND (GLOVE TYPE)
- [X] Butyl rubber
- [ ] Polyvinyl alcohol
- [ ] Other (specify):
- [ ] Polyvinyl chloride
- [X] Neoprene
- [X] Natural rubber
- [ ] Poly-ethylene

RESPIRATOR TYPE - *Use only NIOSH approved equipment*
- [ ] Self-contained
- [ ] Supplied air
- [ ] Can or cartridge gas or vapor
- [X] Filter - dust, fume, mist
- [ ] Other (specify):

OTHER PROTECTIVE EQUIPMENT
- [X] Rubber boots
- [X] Apron
- [ ] Other (specify):

SPECIAL PRECAUTIONS

PRECAUTIONARY LABELING
- [X] Wash thoroughly after handling
- [X] Do not get in eyes, on skin or clothing
- [X] Do not breathe dust, vapor, mist, gas
- [ ] Keep container closed
- [ ] Keep away from heat, sparks, and open flames
- [ ] Store in tightly closed containers
- [ ] Do not store near combustibles
- [ ] Keep from contact with clothing and other combustible materials
- [ ] Empty container may contain hazardous residues
- [ ] Use explosion proof equipment
- [ ] Other (specify):

Other handling and storage conditions: Minimum contact with this and all chemicals is recommended as a good general policy to follow.

Prepared by	Date	Address	Phone
Hugh D. McLaughlin, Jr.	10/85	900 First Avenue, King of Prussia, PA 19406	(215) 337-6634

PLEASE NOTE ▶ "The above information is accurate to the best of our knowledge. However, since data, safety standards, and government regulations are subject to change and the conditions of handling and use, or misuse are beyond our control, Pennwalt MAKES NO WARRANTY, EITHER EXPRESS OR IMPLIED, WITH RESPECT TO THE COMPLETENESS OR CONTINUING ACCURACY OF THE INFORMATION CONTAINED HEREIN AND DISCLAIMS ALL LIABILITY FOR RELIANCE THEREON. User should satisfy himself that he has all current data relevant to his particular use.

25?

PENNWALT CORPORATION MSDS PRODUCT CODE: 05057. 1
DATE: 5/25/88 PAGE: 1

PMC 1256

MATERIAL SAFETY DATA SHEET

PENNWALT CORPORATION
METAL PREP DEPARTMENT
2375 STATE ROAD
CORNWELLS HEIGHTS, PA. 19020

EMERGENCY PHONE NUMBERS
BUSINESS HRS: 215-245-3128
OTHER HOURS:
CHEMTREC: 800-424-9300

****

PRODUCT IDENTIFICATION

PRODUCT NAME: CAS NO.: NA-MIXTURE
CLEANER K7
SYNONYMS:
ALKALINE CLEANER
CHEMICAL NAME:
NA-MIXTURE
MOLECULAR FORMULA:
NA-MIXTURE
CHEMICAL FAMILY: STRONG ALKALI

RECEIVED
JUN 13 1988
INDUSTRIAL HYGIENE

****

INGREDIENTS-----HAZARD CLASSIFICATIONS

COMPONENTS	CAS NO.	%	COMMENTS
SODIUM HYDROXIDE	01310-73-2		TWA 2 mg/kg (C) PEL 2 mg/M3
SODIUM METASILICATE	06834-92-0		TWA 10 mg/M3 (NUISANCE DUST) LD50 1280 mg/kg (ORAL-RAT)

Hazard Rating (NFPA 704M)

EXTREME	4	MODERATE	2
HIGH	3	SLIGHT	1
		LEAST	0

HEALTH	(BLUE)	3
FLAMMABILITY	(RED)	0
REACTIVITY	(YELLOW)	0

****

SHIPPING INFORMATION

CAUSTIC SODA, DRY, MIXTURE; CORROSIVE MATERIAL; UN 1823

****

PHYSICAL PROPERTIES

BOILING POINT/RANGE:	MELTING POINT:	FREEZING POINT:
NA	NE	NA
MOLECULAR WEIGHT:	SPECIFIC GRAVITY(H2O=1):	VAPOR PRESSURE(MM HG):
NA-MIXTURE	NA	NA
VAPOR DENSITY(AIR=1):	SOLUBILITY IN H2O:	% VOLATILES BY VOLUME:
NA	SOLUBLE	NA

APPEARANCE AND ODOR:
WHITE, FREE-FLOWING GRANULES

pH (5 % soln) - >12.0

****

NA - NOT APPLICABLE NE - NOT ESTABLISHED
(R) - INDICATES REGISTERED TRADEMARK OF PENNWALT CORPORATION

PMC 1256

FIRE AND EXPLOSION DATA

FLASH POINT: NA
FLAMMABLE LIMITS: LOWER: NA UPPER: NA
AUTOIGNITION TEMP.: NA

EXTINGUISHING MEDIA:
WATER-SPRAY
WATER-FOG

SPECIAL FIRE FIGHTING PROCEDURES:
Wear Self Contained Breathing Apparatus. Cool fire exposed containers with water.

UNUSUAL FIRE AND EXPLOSION HAZARDS: NA

****

REACTIVITY DATA

STABILITY: STABLE
CONDITIONS CONTRIBUTING TO INSTABILITY: NA

INCOMPATIBILITY-AVOID CONTACT WITH:
STRONG ACIDS

HAZARDOUS DECOMPOSITION THERMAL AND OTHER: NA

CONDITIONS TO AVOID:

This product liberates a great deal of heat when added to water. To avoid rapid temperature rise, violent spattering or explosive eruptions, *ALWAYS* ADD PRODUCT TO WATER. *NEVER* ADD WATER TO PRODUCT.

THE FOLLOWING MIXING PROCEDURE SHOULD BE USED:

1. Heat water to 80 - 100 DEG F before adding product.
2. Add small amounts of product slowly and evenly while constantly mixing solution. Never increase concentration of product in solution by more than five percent with any single addition. Water temperature should not exceed 160 DEG F during addition.

****

TOXICITY

ROUTE	ANIMAL	DATA
ORAL	ACUTE - SODIUM HYDROXIDE LD50-	340 mg/kg (ORAL-RAT)
DERMAL	ACUTE - SODIUM HYDROXIDE LD50-	1350 mg/kg (ORAL-RAT)

TOXIC EFFECTS

EYE EFFECTS: CORROSIVE
Causes rapid tissue destruction, permanent damage and possible blindness.

SKIN EFFECTS: CORROSIVE
Solids or dust will cause skin irritation. Prolonged exposure will cause irreversible scarring.

NA - NOT APPLICABLE NE - NOT ESTABLISHED
(R) - INDICATES REGISTERED TRADEMARK OF PENNWALT CORPORATION

PMC 1454

OTHER TOXIC EFFECTS:
This product does not contain any components listed by IARC, NTP or OSHA as carcinogens.

TARGET ORGAN TOXIN:
Ingestion may cause severe burns of the mouth and throat. Prolonged exposure to skin will cause irreversible scarring.
Dust inhalation can cause burns to the mucous membranes.

TOXICITY COMMENTS:
WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

****

HEALTH HAZARD INFORMATION

PERMISSIBLE EXPOSURE LIMITS
Since this product is a mixture, there is no exposure limit established for it. Hazardous components and their associated permissible exposure limits are listed in the section titled 'INGREDIENTS-----HAZARD CLASSIFICATIONS'.

EMERGENCY FIRST AID

INGESTION

DO NOT INDUCE VOMITING	GIVE PLENTY OF WATER	GET MEDICAL ATTENTION

DO NOT INDUCE VOMITING. GIVE PLENTY OF WATER OR MILK. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. GET IMMEDIATE MEDICAL ATTENTION.
NOTE TO PHYSICIAN: PROBABLE MUCOSAL DAMAGE MAY CONTRAINDICATE THE USE OF GASTRIC LAVAGE. MEASURES AGAINST CIRCULATORY SHOCK, RESPIRATORY DEPRESSION AND CONVULSION MAY BE NEEDED

DERMAL

WASH WITH SOAP AND WATER	GET MEDICAL ATTENTION	CONTAMINATED CLOTHING REMOVE & LAUNDER	CONTAMINATED SHOES - DESTROY

EYE CONTACT

FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES	GET MEDICAL ATTENTION

IMMEDIATELY AND CONSTANTLY FLUSH EYES (HOLDING EYELIDS OPEN) WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES OR UNTIL MEDICAL TREATMENT IS RECEIVED. WHILE FLUSHING, REMOVE CONTAMINATED CLOTHING AND SHOES AND DESTROY. GET EMERGENCY MEDICAL ATTENTION

INHALATION

REMOVE TO FRESH AIR	IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION

****

SPECIAL PROTECTION INFORMATION

VENTILATION REQUIREMENTS:
LOCAL EXHAUST USE WITH ADEQUATE VENTILATION

NA - NOT APPLICABLE NE - NOT ESTABLISHED
(R) - INDICATES REGISTERED TRADEMARK OF PENNWALT CORPORATION

Maintain ventilation sufficient to reduce the level of hazardous ingredient(s) below the stated concentration level(s).

EYE: FACE SHIELD GOGGLES
Contact lenses should NEVER be worn when working with this or any chemical.

HAND (GLOVE TYPE): ANY NON-PERMEABLE TO PRODUCT

RESPIRATOR TYPE: CARTRIDGE

FILTERS DUST
Respiratory protection should be worn if the level of airborne contamination exceeds the level(s) listed above. Air quality should always be improved first by engineering solutions (such as better ventilation), and then by using respiratory protection if the engineering solution is unsuccessful.

OTHER PROTECTIVE EQUIPMENT:
RUBBER BOOTS APRON

****

SPECIAL HANDLING AND STORAGE CONDITIONS

WASH THOROUGHLY AFTER HANDLING
DO NOT GET IN EYES, ON SKIN OR CLOTHING
DO NOT BREATHE DUST,VAPOR,MIST,GAS

KEEP CONTAINER CLOSED

****

SPILL MANAGEMENT

FLUSH WITH WATER
SWEEP OR SCOOP UP AND REMOVE

Flush residue,with water,to chemical waste treatment.

****

DISPOSAL PROCEDURES

Dissolve slowly in water. Carefully neutralize with dilute acid and flush to chemical waste drain.

CONSULT FEDERAL, STATE, OR LOCAL AUTHORITIES FOR PROPER DISPOSAL PROCEDURES

****

MSDS PREPARED BY H.D.McLaughlin Jr.

****

NA - NOT APPLICABLE NE - NOT ESTABLISHED
(R) - INDICATES REGISTERED TRADEMARK OF PENNWALT CORPORATION

PMC 1456

: ABOVE INFORMATION IS ACCURATE TO THE BEST OF OUR KNOWLEDGE. HOWEVER, NCE DATA, SAFETY STANDARDS, AND GOVERNMENT REGULATIONS ARE SUBJECT TO ANGE AND THE CONDITIONS OF HANDLING AND USE, OR MISUSE ARE BEYOND OUR CONTROL, PENNWALT MAKES NO WARRANTY, EITHER EXPRESS OR IMPLIED, WITH RESPECT TO THE COMPLETENESS OR CONTINUING ACCURACY OF THE INFORMATION CONTAINED HEREIN AND DISCLAIMS ALL LIABILITY FOR RELIANCE THEREON. USER SHOULD SATISFY HIMSELF THAT HE HAS ALL CURRENT DATA RELEVANT TO HIS PARTICULAR USE.

NA - NOT APPLICABLE NE - NOT ESTABLISHED
(R) - INDICATES REGISTERED TRADEMARK OF PENNWALT CORPORATION

PMC 1262-

ENTHONE INCORPORATED

RECEIVED DEC 10 1987 INDUSTRIAL HYGIENE

MATERIAL SAFETY DATA SHEET

ENDOX® 214

P.O. BOX 1900
NEW HAVEN, CT 06508

EMERGENCY PHONE NUMBERS			
PLANTS	203-934-8611	(8:30am-5pm	EST)
	312-598-3210	(8:30am-5pm	CST)
MFSA	313-644-5626	(24 hours)	
CHEMTREC	800-424-9300	(Transportation)	

PRODUCT CODE#: 2711
DATE ISSUED: 8/24/87
SUPERCEDES: 3/87
PREPARER: F.R. Hirtler FRH

II. HAZARDOUS INGREDIENTS

COMPONENT	COMMON NAME	CAS NO.	OSHA-PEL	ACGIH-TLV	%
Sodium hydroxide *Ceiling value	Caustic soda	1310-73-2	2mg/m3	2mg/m3*	>40
Sodium cyanide +As CN		143-33-9	5mg/m3+	5mg/m3+	>30

III. PHYSICAL PROPERTIES

SPECIFIC GRAVITY (WATER =1)	NI	BOILING POINT, °F	NA
EVAP.RATE (BUTYL ACETATE=1)	NA	MELTING POINT, °F	NI
VAPOR PRESSURE, mmHg	NA	SOLUBILITY IN WATER	essentially complete
VAPOR DENSITY (AIR=1)	NA	APPEARANCE	white powder
pH (AS IS)	NA	ODOR	caustic, cyanide

IV. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT, °F	None	FLAMMABLE LIMITS (AIR)	NA	LEL	NA	UEL

EXTINGUISHING MEDIA

[ ] Not Combustible [X] Water fog or spray [ ] Carbon Dioxide [ ] Dry Chemical [ ] Alcohol Foam [X] Foam [ ] Sand or Earth

SPECIAL FIRE FIGHTING PROCEDURES

Wear self-contained breathing apparatus (SCBA) and complete personal protective equipment when potential for exposure to vapors or products of combustion exists.

UNUSUAL FIRE AND EXPLOSION HAZARDS

In the presence of water, material may react with amphoteric metals (such as aluminum, zinc, or tin) generating hydrogen gas which will burn or explode if ignited.
Excessive heat may generate highly toxic and flammable hydrogen cyanide. Sodium cyanide dissolves readily in water; run off should be contained in order to avoid environmental or safety problems.

PMC 1262

V. HEALTH HAZARD DATA

EFFECTS OF ACUTE EXPOSURE:

INHALATION: Inhalation of dust may be fatal and can cause severe burns to upper respiratory tract.

INGESTION: May be fatal. Causes burns to mouth, throat, esophagus and stomach.

SKIN: Absorption through skin may be fatal. May cause irritation, rash.

EYES: Causes severe burns with damage to eyes and possible blindness.

EFFECTS OF CHRONIC EXPOSURE:

Eye and skin irritation, rash, blurring of vision, nausea, weakness and vomiting.

CARCINOGEN: Not listed by NTP, IARC, OSHA

REFERENCE:

EMERGENCY AND FIRST AID PROCEDURES

INHALATION: Remove victim to fresh air. If victim is unconscious and not breathing, resuscitate and administer antidote as prescribed by your company First Aid procedure. If conscious, administer oxygen and if necessary antidote as prescribed by your company first aid procedure (see pg. 4 section IX). Keep victim quiet and warm. Seek immediate medical attention.

INGESTION: Never give anything by mouth to an unconscious person. Give victim suitable antidotes while administering oxygen. Follow company procedures concerning administration of antidotes, or water, and inducing vomiting. Seek immediate medical attention.

SKIN: Wash skin to remove cyanide while removing all contaminated clothing, including shoes. Do not delay. Skin absorption can occur from cyanide dust, solutions, or HCN vapor. Seek immediate medical attention.

EYES: Immediately flush eyes with plenty of water for at least 15 minutes holding lids apart to ensure flushing of entire surface. Washing eyes within several seconds of exposure is essential to minimize damage. Seek immediate medical attention.

PMC 1262

VI. PRECAUTIONS FOR SAFE HANDLING AND USE

SPILL PROCEDURES:

Do not inhale dust. Avoid contact with skin, eyes and clothing. Wear protective equipment. Sweep or shovel into clean container and cover. Flush spill area with dilute solution of sodium or calcium hypochlorite. Dispose of according to Local, State and Federal regulations.

STORAGE AND HANDLING PRECAUTIONS:

Store in a cool, dry place. Keep away from acids and organic compounds. Loosen cover cautiously when opening.

ADDITIONAL INFORMATION:

Wash thoroughly after handling. Decontaminate clothing before disposal.

VII. CONTROL MEASURES

VENTILATION: Local exhaust recommended.

RESPIRATOR: Use NIOSH approved respirator when air concentration is greater than the TLV or PEL. Self-contained breathing apparatus is preferred.

EYE PROTECTION: [ ] Safety glasses [X] Chemical safety goggles [X] Face shield

PROTECTIVE GLOVES: [X] Neoprene [ ] Natural rubber Other: Butyl rubber

OTHER PROTECTIVE CLOTHING OR EQUIPMENT:

Chemically resistant coveralls, hat and shoes or boots. Emergency eye-wash fountain and safety shower as well as cyanide antidotes should be available (see pg. 4 section IX)

WORK/HYGENIC PRACTICES:

Do not consume, handle or store food, beverages or tobacco in areas where this product is present. Emergency eye wash and safety shower should be available. Wash thoroughly after handling.

ADDITIONAL INFORMATION:

For waste disposal of operating solutions consult Enthone Waste Disposal Procedures. For major spills consult Enthone for disposal assistance. Dispose of in accordance with Local, State, and Federal regulations.

CAS = Chemical Abstract Service
NI = No relevant information available
NA = Not applicable
Trade Secret = Claimed as allowed under 29 CFR 1910.1200

PEL = OSHA Permissible Exposure Limit
TLV = ACGIH Threshold Limit Value
NTP = National Toxicology Program
IARC = Int'l Agency for Research on Cancer

VIII. REACTIVITY DATA

X	Stable	CONDITIONS TO AVOID: Moisture, heat
	Unstable	

INCOMPATABILITY (Materials to avoid): Oxidizing agents, acids, acid salts.

HAZARDOUS DECOMPOSITION PRODUCTS: Toxic and flammable hydrogen cyanide, also oxides of carbon.

HAZARDOUS POLYMERIZATION		May occur	CONDITIONS TO AVOID: NA
	X	Will not occur	

IX. ADDITIONAL INFORMATION

It is highly recommended that procedures be established by your company's physician, concerning First Aid and Medical Treatment to be used in case of cyanide poisoning. Such procedure may include the administration of antidotes such as Amyl Nitrite, Sodium Thiosulfate, Sodium Nitrite, Methylene Blue and the like by qualified personnel.

This Material Safety Data Sheet may be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Enthone, Inc. furnishes the data contained herein in good faith at customer's request without liability or legal responsibility for same whatsoever, and no warranty or guarantee, express or implied, is made with respect to such data; nor does Enthone, Inc. grant permission, recommendation, or inducement to infringe any patent whether owned by Enthone or others. The data is offered solely for your information and consideration. Since conditions of use are beyond Enthone's control, user assumes all responsibility and risk.

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

Form Approved
OMB No. 44-R1387

UTCIHL 10

MATERIAL SAFETY DATA SHEET

RECEIVED
JUL 24 1986
INDUSTRIAL HYGIENE

PMC 1262

SECTION I

MANUFACTURER'S NAME: ENTHONE, INC.	EMERGENCY TELEPHONE NO.: (203) 934-8611
ADDRESS (Number, Street, City, State, and ZIP Code): P. O. Box 1900, New Haven, CT 06508	
CHEMICAL NAME AND SYNONYMS: N/A	TRADE NAME AND SYNONYMS: Endox 214
CHEMICAL FAMILY: N/A	FORMULA: N/A

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
Sodium Hydroxide	< 50	2 mg/M^3
Sodium Cyanide	< 40	5 mg/M^3
Balance of materials are non-hazardous		

SECTION III - PHYSICAL DATA

BOILING POINT (°F.)		SPECIFIC GRAVITY (H_2O=1)	
VAPOR PRESSURE (mm Hg.)		PERCENT, VOLATILE BY VOLUME (%)	
VAPOR DENSITY (AIR=1)		EVAPORATION RATE (_____ =1)	
SOLUBILITY IN WATER	very soluble		

APPEARANCE AND ODOR: White powder with odor of caustic and cyanide

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used): None	FLAMMABLE LIMITS	Lel	Uel

EXTINGUISHING MEDIA: Not flammable

SPECIAL FIRE FIGHTING PROCEDURES: Avoid using water on the product. The use of water will generate large quantities of the heat by reaction with the sodium hydroxide & may cause spattering. Use of water will dissolve the sodium cyanide & may thus spread the cyanide into sewers or drains where acid conditions may cause the liberation of highly toxic HCN.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Contact of the product with water may cause liberation of small amounts of toxic HCN which will be destroyed in a flaming fire. Heat may release volatile HCN which is very poisonous. Contact of the product with acids, acid salts, or acidic rinses liberates highly toxic and flammable HCN gas. In water solution, product may react with metals to generate hydrogen gas which is flammable.

Form OSHA-20
Rev. May 72

(Continued on reverse side)

PMC 1262

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE: N/A

EFFECTS OF OVEREXPOSURE: May be fatal if swallowed or if dust or mist from solution is inhaled. Inhalation of highly toxic hydrocyanic acid, generated by contact of the product with acid, may be fatal. Product may cause severe skin and eye burns.

EMERGENCY AND FIRST AID PROCEDURES: Always have on hand cyanide antidote kits and Amyl Nitrite. External - Flush skin or eyes with plenty of cool water for 15 mins. while removing contaminated clothing and shoes; for eyes also get immediate medical attention. Inhalation - Remove patient to fresh air. Have patient lie down and keep warm. If breathing has stopped apply artificial respiration. Administer amyl nitrite by inhalation for ¼-½ of every minute. Apply oxygen if available. Summon an ambulance to take patient to hospital. Cyanide Antidote Kit should accompany patient in ambulance.

SECTION VI - REACTIVITY DATA

STABILITY			CONDITIONS TO AVOID
	UNSTABLE		
	STABLE Shelf life 1 yr.		

INCOMPATABILITY (Materials to avoid): Moisture, oxidizers, acids, (very important)

HAZARDOUS DECOMPOSITION PRODUCTS: In a fire - toxic HCN, cyanogen, CO, CO_2, carboxylic acids

HAZARDOUS POLYMERIZATION			CONDITIONS TO AVOID
	MAY OCCUR		
	WILL NOT OCCUR	x	Unless subjected to high heat or contact with acids

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Stay upwind. Keep acid away from area. Do not breathe gas, dust or mist from product or solutions. Avoid contact with skin, eyes & clothing. Keep product dry if at all possible. Contain spill! Prevent material from getting into waters or into sewers. If spilled into waters or sewers, notify proper authorities immediately. If in solution prevent contact with metals as hydrogen may be generated.

WASTE DISPOSAL METHOD: For spills and leaks: If material is in dry state shovel up into steel containers, sweep up all powder, dam area & treat residual with sodium hypochlorite to destroy remaining cyanide. If material is in solution, contain spill & absorb on sand, gravel. Shovel up into steel containers. Take solids to chemical waste treatment facility for chlorination to destroy cyanide.

For Waste Disposal of Operating Solution, Consult Enthone Operating Instructions.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type): Type for caustic mist

VENTILATION		
	LOCAL EXHAUST: Yes, for operating solution Endox 214	SPECIAL
	MECHANICAL (General)	OTHER

PROTECTIVE GLOVES	EYE PROTECTION
Yes, rubber	Yes, goggles

OTHER PROTECTIVE EQUIPMENT: Apron

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Keep dry; store indoors at max. of 120°F.; avoid contact with moisture, oxidizers, acids.

OTHER PRECAUTIONS: Avoid dust inhalation. Wear gloves, apron, goggles at all times when handling. Avoid all contact with acids or acidic materials as such contact will release poisonous gas. Avoid contact of the powder with oxidizing agents as violent reaction may occur.

ISSUED: 12/83 (retyped)
SPSDS: 12/78

PMC 1525

DU PONT

MATERIAL SAFETY DATA SHEET

RECEIVED
MAR - 8 1989
INDUSTRIAL HYGIENE & SAFETY

IDENTIFICATION

NAME
Sodium Cyanide

GRADE
CYANOBRIK*; CYANOGRAN*; Compounders Grade

SYNONYMS
Cyanide of Sodium; Prussiate of Soda

CAS NAME
Sodium Cyanide

I.D. NOS./CODES
NIOSH Registry No. VZ7525000

MANUFACTURER/DISTRIBUTOR
E. I. du Pont de Nemours & Co. (Inc.)

ADDRESS
Wilmington, DE 19898

CHEMICAL FAMILY
Alkali Metal Cyanide

FORMULA
NaCN

CAS REGISTRY NO.
143-33-9

TSCA INVENTORY STATUS
Reported/Included

PRODUCT INFORMATION PHONE
(800) 441-9442

MEDICAL EMERGENCY PHONE
(800) 441-3637

TRANSPORTATION EMERGENCY PHONE
Du Pont Cyanide HOTLINE
(For emergencies only)
(901) 357-1546
CHEMTREC (800) 424-9300

*Reg. U. S. Pat. & Tm. Off., Du Pont Company. CYANOBRIK(R) and CYANOGRAN(R) Sodium Cyanide are made only by Du Pont.

The data in this Material Safety Data Sheet relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process.

F & PM21505

PHYSICAL DATA

BOILING POINT, 760 mmHg
1496°C (2725°F)

MELTING POINT
564°C (1047°F)

SPECIFIC GRAVITY
1.6

VAPOR PRESSURE
Negligible

VAPOR DENSITY
Not volatile

SOLUBILITY IN WATER
37% at 20°C (68°F)

pH INFORMATION
11.3 to 11.7 (Typical for 5 to 25% solutions with no pH adjustment)

EVAPORATION RATE (BUTYL ACETATE = 1)
Not applicable

FORM
Solid

APPEARANCE
Granular or Briquettes

COLOR
White

ODOR
None (but can have slight ammonia and/or HCN odor if damp)

HAZARDOUS COMPONENTS

MATERIAL(S)	CAS NO.	APPROXIMATE %
Sodium Cyanide	143-33-9	100

HAZARDOUS REACTIVITY

INSTABILITY
Very stable when dry.

INCOMPATIBILITY
Large amounts of highly toxic, flammable hydrogen cyanide (HCN) gas will be evolved from contact with acids. Reacts violently with strong oxidizing agents. Water or weak alkaline solution can produce dangerous amounts of HCN in confined areas.

DECOMPOSITION
Moisture will cause slow decomposition, releasing poisonous HCN and ammonia gas.

POLYMERIZATION
Will not occur.

PM21505

FIRE AND EXPLOSION DATA

FLASH POINT
Will not burn.

FLAMMABLE LIMITS IN AIR, % BY VOL.
LOWER Not applicable.
UPPER Not applicable.

AUTOIGNITION TEMPERATURE
Not applicable.

FIRE AND EXPLOSION HAZARDS
Will not burn. Sodium cyanide will not be destroyed in an ordinary fire involving combustible materials such as paper or wood.

EXTINGUISHING MEDIA
Use water on fires near sodium cyanide, but minimize amount of water if containers are opened or burned (see "Incompatibility", above). DO NOT use carbon dioxide (CO_2) which reacts with sodium cyanide to produce hydrogen cyanide if moisture is present.

SPECIAL FIRE FIGHTING INSTRUCTIONS
Sodium cyanide dissolves readily in water; therefore, cyanide solution runoff may occur if containers are opened or burned. Runoff should be contained to avoid environmental or safety problems. Contained cyanide solution can be detoxified with hypochlorite.

HEALTH HAZARD INFORMATION

PRINCIPAL HEALTH HAZARDS (Including Significant Routes, Effects, Symptoms of Over-Exposure, and Medical Conditions Aggravated by Exposure)

May be fatal if inhaled, swallowed, or absorbed through skin. Contact with acids or weak alkalis liberates poisonous gas. Causes eye burns and may irritate skin.

Oral LD_{50}: 15 mg/kg in rats

Toxic effects described in animals from exposure by inhalation, ingestion, or skin contact include asphyxia, dyspnea, ataxia, tremors, coma, and lethality by disrupting oxidative metabolism. Tests in bacterial and mammalian cell cultures demonstrate no mutagenic activity. Tests in some animals indicate that the compound may affect the fetus, that is, it may be a developmental toxin.

Human health effects of overexposure by inhalation, ingestion, or skin or eye contact may initially include: skin irritation with discomfort or rash, eye irritation or burns with discomfort, tearing, or blurring of vision, and possible permanent eye damage; and nonspecific discomfort such as nausea, headache, dizziness, vomiting, and weakness. Higher exposures may lead to these effects: rapid respiration; lowered blood pressure; unconsciousness; convulsions; and fatality. Evidence suggests that significant skin permeation can occur. Individuals with preexisting diseases of the central nervous system may have increased susceptibility to the toxicity of excessive exposures.

PMC 1505

CARCINOGENICITY

Not listed as a carcinogen by IARC, NTP, OSHA, ACGIH, or Du Pont.

EXPOSURE LIMITS [PEL (OSHA), TLV (ACGIH), AEL (DU PONT), ETC.]

The OSHA 8-hour Time Weighted Average (TWA) and ACGIH TLV(R)-TWA are 5 mg/m^3, as CN. Both carry a "skin" notation indicating that cyanide may penetrate the skin (especially if the skin is broken). Control of vapor, dust, and mist inhalation alone may not be sufficient to prevent absorption of an excessive dose.

SAFETY PRECAUTIONS

Do not breath dust, mist, or HCN gas. Do not get in eyes. Avoid contact with skin and clothing. Do not carry foodstuffs, beverages, or tobacco where contamination with cyanide is possible. Wash thoroughly after handling. Wash contaminated clothing before reuse.

FIRST AID AND MEDICAL TREATMENT

Actions to be taken in case of cyanide exposure should be planned and practiced before beginning work with cyanides. In most cases, cyanide poisoning causes a deceptively healthy pink to red skin color; however, if a physical injury or lack of oxygen is involved, the skin color may be bluish.

Treatment for cyanide poisoning can be provided in two ways, "First Aid" and "Medical Treatment." Both require immediate action to prevent further harm or death. First aid using amyl nitrite and oxygen is generally given by a layman before medical help arrives.

Medical treatment involves intravenous injections and must be administered by qualified medical personnel. Even if a doctor or nurse is present, the need for fast treatment dictates using first aid treatment with amyl nitrite and oxygen while medical treatment materials for intravenous injection are being prepared. Experience shows that first aid given promptly is usually the only treatment needed.

Medical treatment is given if the victim does not respond to first aid. It provides a larger quantity of antidote including sodium thiosulfate to chemically destroy cyanide in the body. However, even under optimum conditions, amyl nitrite can be administered faster and should be used even if medical treatment follows. Do not overreact. Fast treatment is needed, but a conscious person usually does not need treatment beyond oxygen.

Amyl nitrite and medical treatment kits for cyanide poisoning are available, with doctor's prescription, from pharmacies.

A. First Aid—Directions for Giving Amyl Nitrite Antidote and Oxygen

1. Conscious: For inhalation and/or absorption if the victim is alert, oxygen may be all that is needed. But if he is not fully conscious or shows signs of poisoning, follow paragraph A-2 below. For swallowing, see paragraph C. "First Aid—Swallowing Cyanide."

2. Unconscious But Breathing: Break an amyl nitrite ampule in a cloth and hold lightly under the victim's nose for 15 seconds, then take away for 15 seconds. Repeat 5-6 times. If necessary, use a fresh ampule every 3 minutes until the victim regains consciousness (usually 1-4 ampules). Give oxygen to aid recovery. Where more severe poisoning has occurred, consider holding the amyl nitrite under the nose continuously for the first ampule or more.

PMC150

3. Not Breathing:
   a. Give artificial respiration, preferably with an oxygen resuscitator. Give amyl nitrite antidote by placing a broken ampule inside the resuscitator face piece, being careful that the ampule does not enter the victim's mouth and cause choking.
   b. If using manual artificial respiration, give amyl nitrite antidote as in paragraph A-2 above except keep the first amyl nitrite ampule under the nose with replacement every 3 minutes.

4. Amyl Nitrite Notes:
   a. Amyl nitrite is highly volatile and flammable; do not smoke or use around source of ignition.
   b. If treating poison victim in a windy or drafty area, provide something—a rag, shirt, wall, drum, cupped hand, etc.—to prevent the amyl nitrite vapors from being blown away. Keep the ampule upwind from the nose. The objective is to get amyl nitrite into the victim's lungs.
   c. Rescuers should avoid amyl nitrite inhalation so they won't become dizzy and lose competence.
   d. Lay the victim down for treatment to maintain a good blood supply to the victim's head. Since amyl nitrite dilates the blood vessels and lowers blood pressure, lying down will help prevent unconsciousness.
   e. Do not overuse; excessive use might put the victim in shock. This has not occurred in practice at Du Pont plants and we are not aware of any death or serious aftereffects from treatment with amyl nitrite. (See paragraph E, "Medical Treatment.")

B. First Aid—Inhalation of Cyanide—Carry victim to fresh air. Lay victim down. Administer amyl nitrite antidote and oxygen (Paragraph A). Keep patient quiet and warm. Even with inhalation poisoning, thoroughly check clothing and skin to assure no cyanide is present. If cyanide is found on clothing or skin, proceed as in Paragraph D2. Call a physician.

C. First Aid—Swallowing Cyanide

1. Conscious: Immediately give patient one pint of 1% sodium thiosulfate solution (or plain water) by mouth and induce vomiting with finger in throat. Repeat until vomit fluid is clear. Never give anything by mouth to an unconscious person. Call a physician.

2. Unconscious: Follow first aid procedure as in paragraphs A-2 and A-3 (and/or medical treatment in paragraph E) and call a physician. If the victim revives, then proceed with paragraph C-1.

D. First Aid—Skin or Eye Contact (Skin Absorption)

1. Eye Contact: Immediately flush eyes with plenty of water, remove contaminated clothing, and keep victim quiet and warm. Call a physician.

2. Skin Contact: Wash skin to remove the cyanide while removing all contaminated clothing, including shoes. Do not delay. Skin absorption can occur from cyanide dust, solutions, or HCN vapor. Absorption is slower than inhalation, usually measured in minutes compared to seconds for inhalation.

Follow First Aid procedures in Paragraph A if treatment is needed, but even severe skin contact usually will not require treatment if 1) no inhalation or swallowing has occurred and 2) the cyanide is promptly washed from the skin and contaminated clothing and shoes are removed. If skin contact is prolonged, HCN poisoning may occur with nausea, unconsciousness, and then death possible if the source of cyanide intake is not removed and treatment provided. Even after washing the skin, the victim should be watched for at least 1 to 2 hours because absorbed cyanide can continue to work into the bloodstream. Wash clothing before reuse and destroy contaminated shoes.

E. Medical Treatment

Medical treatment is normally provided by a physician, but might be provided by a professionally trained "qualified medical person" where a need exists and where state and local laws permit.

While preparing for sodium nitrite and sodium thiosulfate injections, use amyl nitrite and oxygen as outlined in paragraph A. When ready and if the victim is not responding to first aid, first inject the solution of sodium nitrite (10 mL of a 3% solution) intravenously at the rate of 2.5 mL/minute, then immediately inject the sodium thiosulfate (50 mL of a 25% solution) at the same rate, taking care to avoid extravasation.

This is a fairly lengthy treatment (24 minutes) since a total of 10 + 50, or 60 mL is injected at a rate of 2.5 mL/minute. Consideration should be given to the size and condition of the victim as treatment is proceeding. The above sodium nitrite injection is about one-third of a lethal dose, so care should be taken to avoid excessive use. It is not essential that full quantities be given, just because treatment was started. Injections can be stopped at any point if recovery is evident.

Watch patient continuously for 24-48 hours if cyanide exposure was severe. If there is any return of symptoms during this period, repeat this treatment using one-half the amounts of sodium nitrite and sodium thiosulfate solutions. Caution should be used to avoid overuse of medical treatment chemicals as the prescribed dose is about 1/3 the lethal dose for an average individual.

If signs of excessive methemoglobinemia develop (i.e., blue skin and mucous membranes, vomiting, shock and coma), 1% methylene blue solution should be given intravenously. A total dose of 1 to 2 mg/kg of body weight should be administered over a period of five to ten minutes and should be repeated in one hour if necessary. In addition, oxygen inhalation will be helpful. Transfusion of whole fresh blood may be considered if there has been mechanical injury with external or internal bleeding and simultaneous cyanide exposure.

Du Pont's experience in treating cyanide poison cases is that first aid procedures using amyl nitrite and oxygen were effective and the only treatment needed in most cases. Medical treatment, using intravenous injections, was used in a few cases. Both procedures have been successful.

PMC 1505

PROTECTION INFORMATION

GENERALLY APPLICABLE CONTROL MEASURES

Good general ventilation should be provided to keep dust, mist, and HCN gas below exposure limits.

PERSONAL PROTECTIVE EQUIPMENT

Recommended Minimum Protection—chemical splash goggles and rubber gloves (butyl or neoprene preferred).

Have available and use as appropriate: face shields; rubber suits, aprons, and boots; disposable toxic dust and mist respirators; self-contained breathing air supply (in case of emergency); HCN detector; first aid and medical treatment supplies,* including oxygen resuscitators.

*See Du Pont Sodium Cyanide Storage and Handling Bulletin for list of supplies.

DISPOSAL INFORMATION

AQUATIC TOXICITY

The compound is highly toxic (96-hour LC_{50} = 0.5 - 1 mg/L).

SPILL, LEAK OR RELEASE

Sweep up and shovel into a covered container or plastic bag, pending transfer, to secure the spill. Cover and keep spillage dry. Flush spill area with a dilute solution of sodium or calcium hypochlorite. Comply with Federal, State, and local regulations on reporting releases.

WASTE DISPOSAL

Comply with Federal, State, and local regulations. Do not flush cyanide into sewers which may contain an acid. Detoxify with sodium hypochlorite, or hydrogen peroxide; flush to waste water treatment system; or call a licensed disposal contractor.

PMR 1505

SHIPPING INFORMATION

DOT(172.101)

PROPER SHIPPING NAME
Sodium Cyanide, Solid

HAZARD CLASS
Poison B

UN NO.
1689

DOT LABEL(S)
Poison

REPORTABLE QUANTITY
10 lb/4.54 kg

DOT/IMO (172.102)

PROPER SHIPPING NAME
Sodium Cyanide

HAZARD CLASS
Poison B, 6.1

UN NO.
1689

SHIPPING CONTAINERS
CYANO-DOL(R) railcars and trucks; hopper railcars; Flo-Bins(R) (3000 lb. net); 2000 lb. bag in a box; 100 kilo, 100 lb., and 200 lb. steel drums

STORAGE CONDITIONS
Store in properly labeled containers in dry, ventilated, secured areas. Keep containers closed and contents dry. Do not store with acids or acid salts, containers with water or weak alkalis, or oxidizing agents. Do not handle or store food, beverages, or tobacco in cyanide areas. Do not store near combustibles or flammables because of cyanide solution runoff from water used for fire fighting.

ADDITIONAL INFORMATION AND REFERENCES

NPCA – HMIS RATINGS		NFPA RATINGS	
Health (Acute)	3	Health	3
Flammability	0	Flammability	0
Reactivity	1	Reactivity	0
Personal Protection	-	Unusual Hazards	-

Personal Protection rating to be supplied by user depending on use conditions.

For further information, see Du Pont Sodium Cyanide Storage and Handling Bulletin.

DATE OF LATEST REVISION/REVIEW: 12/87

PERSON RESPONSIBLE FOR MSDS:
J. C. Watts
Du Pont Co.
C&P Dept., Chestnut Run-709
Wilmington, DE 19898
(302) 999-4946

103800

DU PONT

UTC IH Lab

Form Approved
Budget Bureau No. 44-R1387
Approval Expires April 30, 1971

Form No. LSA-005-4
May 1969

PMC 1505

U.S. DEPARTMENT OF LABOR

WAGE AND LABOR STANDARDS ADMINISTRATION
Bureau of Labor Standards

Supplier
Phillip. Bros. Chemicals Inc.
Middletown, Conn 06457

RECEIVED
OCT 31 1980
G. E. PARSONS

MATERIAL SAFETY DATA SHEET

SECTION I

MANUFACTURER'S NAME: Copper Pigment & Chemical Inc.	EMERGENCY TELEPHONE NO.: (201) 6364300
ADDRESS (Number, Street, City, State, and ZIP Code): Arbor Street, Sewaren, N.J. 07077	
CHEMICAL NAME AND SYNONYMS: Sodium Cyanide	TRADE NAME AND SYNONYMS:
CHEMICAL FAMILY:	FORMULA: NaCN

SECTION II HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
In contact with acids it liberates poisonous & flamable hydrocyanic acid gas. Not to stored near nitrates-nitrite mixtures or peroxides.		

SECTION III PHYSICAL DATA

BOILING POINT (°F.)	1500°g	SPECIFIC GRAVITY (H_2O=1)	
VAPOR PRESSURE (mm Hg.)		PERCENT VOLATILE BY VOLUME (%)	
VAPOR DENSITY (AIR=1)		EVAPORATION RATE (_____=1)	
SOLUBILITY IN WATER	Very soluble		

APPEARANCE AND ODOR: White powder or Crystals, when damp odor of HCN

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	FLAMMABLE LIMITS	Lel	Uel

EXTINGUISHING MEDIA

SPECIAL FIRE FIGHTING PROCEDURES: Sodium cyanide will not burn or support combustion. If exposed to water as thru perforations in steel containers of sodium cyanide will dissolve & small amounts of HCN gas may form by hydrolysis.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Do not use carbon dioxide type extinguishers.

COPY TO LOCAL T.A.M.

MAY 18 '82 1746

UTC IH Lab ✓ PMC 1505

SECTION V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE 180-200 milligrams is considered the minimum lethal dose

EFFECTS OF OVEREXPOSURE Large doses patient becomes unconscious within a few seconds. Smaller doses dizziness, confusion, headache & vomiting.

EMERGENCY AND FIRST AID PROCEDURES Carry patient to fresh air have him lie down-remove contaninated clothing-keep patient warm. Start treatment immeadiately using Cyanide first aid kit. Call physician.

SECTION VI REACTIVITY DATA

STABILITY			CONDITIONS TO AVOID
	UNSTABLE		
	STABLE	X	

INCOMPATABILITY (Materials to avoid) All acids.

HAZARDOUS DECOMPOSITION PRODUCTS

HAZARDOUS POLYMERIZATION			CONDITIONS TO AVOID
	MAY OCCUR		
	WILL NOT OCCUR	X	

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED Sweep up solids and dispose in proper fashion.

WASTE DISPOSAL METHOD Cyanide waste is treated with sodium hypochlorite at a PH 8.5 to 10.0. Dispose in accordance with local, state and federal regulations.

SECTION VIII SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type) Dust respirators approved by Bureau of Mines for dus

VENTILATION			
	LOCAL EXHAUST X		SPECIAL
	MECHANICAL (General) X		OTHER

PROTECTIVE GLOVES Rubber

EYE PROTECTION Metal safety spectacles with dide shields

OTHER PROTECTIVE EQUIPMENT

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING Do not store near acids, nitrate-nitrite mixtures. Store in dry area.

OTHER PRECAUTIONS Do not get in eyes, on skin or clothing.

COPY TO LOCAL I.A.M.

MAY 18 '82 1746

DU PONT

MATERIAL SAFETY DATA SHEET

RECEIVED
APR 7 1986
INDUSTRIAL HYGIENE

PMC 1505

IDENTIFICATION

NAME
Sodium Cyanide

GRADE
Cyanobrik*; Cyanogran*;
Compounders Grade

SYNONYMS
Cyanide of Sodium; Prussiate of Soda

CAS NAME Sodium Cyanide

I.D. NOS./CODES
NIOSH Registry No. VZ7525000

MANUFACTURER/DISTRIBUTOR
E. I. du Pont de Nemours & Co. (Inc.)

ADDRESS Wilmington, DE 19898

CHEMICAL FAMILY
Alkali Metal Cyanide

FORMULA NaCN

CAS REGISTRY NO. 143-33-9

PRODUCT INFORMATION PHONE
(800) 441-9442

MEDICAL EMERGENCY PHONE
(800) 441-3637

PHYSICAL DATA

BOILING POINT, 760 mmHg
1496°C (2725°F)

SPECIFIC GRAVITY 1.6

VAPOR DENSITY
Not volatile

pH INFORMATION 11.3 to 11.7
(Typical for 5 to 25% solutions with no pH adjustment)

FORM Solid

COLOR White

MELTING POINT
564°C (1047°F)

VAPOR PRESSURE Negligible

SOLUBILITY IN H_2O
37% at 20°C (68°F)

EVAPORATION RATE (BUTYL ACETATE=1)
Not applicable

APPEARANCE Granular or Briquettes

ODOR None (but can have slight ammonia and/or HCN odor if damp)

*Reg. U.S. Pat. & Tm Off., Du Pont Company. Cyanobrik® and Cyanogran® Sodium Cyanide are made only by Du Pont.

E-79954 Date: 10/85

The data in this Material Safety Data Sheet relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process.

HAZARDOUS COMPONENTS

MATERIAL(S)	APPROXIMATE %
Sodium Cyanide	100

HAZARDOUS REACTIVITY

INSTABILITY
Very stable when dry.

INCOMPATIBILITY
Large amounts of highly toxic, flammable hydrogen cyanide (HCN) gas will be evolved from contact with acids. Reacts violently with strong oxidizing agents. Water or weak alkaline solution can produce dangerous amounts of HCN in confined areas.

DECOMPOSITION
Moisture will cause slow decomposition, releasing poisonous HCN and ammonia gas.

POLYMERIZATION
Will not occur.

FIRE AND EXPLOSION DATA

FLASH POINT Will not burn.

AUTOIGNITION TEMPERATURE
Not applicable.

FLAMMABLE LIMITS IN AIR, % BY VOL.
LOWER Not applicable.
UPPER Not applicable.

FIRE AND EXPLOSION HAZARDS
Will not burn. Sodium cyanide will not be destroyed in an ordinary fire involving combustible materials such as paper or wood.

EXTINGUISHING MEDIA
Water on fires near sodium cyanide, but minimize amount of water if containers are opened or burned (see "Incompatibility", above) DO NOT use carbon dioxide (CO_2) which reacts with sodium cyanide to produce hydrogen cyanide if moisture is present.

SPECIAL FIRE FIGHTING INSTRUCTIONS
Sodium cyanide dissolves readily in water, therefore cyanide solution runoff may occur if containers are opened or burned. Runoff should be contained to avoid environmental or safety problems. Contained cyanide solution can be detoxified with hypochlorite.

PMC 1505

HEALTH HAZARD INFORMATION

PRINCIPAL HEALTH HAZARDS (Including Significant Routes, Effects, Symptoms of Over-Exposure, and Medical Conditions Aggravated by Exposure)

May be fatal if inhaled, swallowed, or absorbed through skin. Contact with acids or weak alkalis liberates poisonous gas. Causes eye burns and may irritate skin.

Oral LD50: 6 mg/kg in rats

Toxic effects described in animals from exposure include asphyxia, dyspnea, ataxia, tremors, coma, and lethality by disrupting oxidative metabolism. Tests in bacterial and mammalian cell cultures demonstrate no mutagenic activity. Tests in some animals indicate that the compound may affect the fetus, that is, it may be a developmental toxin.

Human health effects of overexposure may initially include: skin irritation with discomfort or rash, eye irritation or burns with discomfort, tearing, or blurring of vision, and possible permanent eye damage; and nonspecific discomfort such as nausea, headache, dizziness, vomiting, and weakness. Higher exposures may lead to these effects: rapid respiration; lowered blood pressure; unconsciousness; convulsions; and fatality. Evidence suggests that significant skin permeation can occur. Individuals with preexisting diseases of the central nervous system may have increased susceptibility to the toxicity of excessive exposures.

CARCINOGENICITY

Not listed as a carcinogen by IARC, NTP, OSHA, ACGIH, or Du Pont.

EXPOSURE LIMITS (PEL (OSHA), TLV (ACGIH), AEL (DU PONT), ETC.)

The OSHA 8-hour Time Weighted Average (TWA) and ACGIH TLV®-TWA are 5 mg/m^3, as CN. Both carry a "skin" notation indicating that cyanide may penetrate the skin (especially if the skin is broken). Control of vapor, dust, and mist inhalation alone may not be sufficient to prevent absorption of an excessive dose.

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Do not breathe dust, mist, or HCN gas. Do not get in eyes. Avoid contact with skin and clothing. Do not carry foodstuffs, beverages, or tobacco where contamination with cyanide is possible. Wash thoroughly after handling. Wash contaminated clothing before reuse.

FIRST AID AND MEDICAL TREATMENT

Actions to be taken in case of cyanide exposure should be planned and practiced before beginning work with cyanides. In most cases, cyanide poisoning causes a deceptively healthy pink to red skin color; however, if a physical injury or lack of oxygen is involved, the skin color may be bluish.

Treatment for cyanide poisoning can be provided in two ways, "First Aid" and "Medical Treatment". Both require immediate action to prevent further harm or death. First aid using amyl nitrite and oxygen is generally given by a layman before medical help arrives. Medical treatment involves

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intravenous injections and must be administered by qualified medical personnel. Even if a doctor or nurse is present, the need for fast treatment dictates using first aid treatment with amyl nitrite and oxygen while medical treatment materials for intravenous injection are being prepared. Experience shows that first aid given promptly is usually the only treatment needed.

Medical treatment is given if the victim does not respond to first aid. It provides a larger quantity of antidote including sodium thiosulfate to chemically destroy cyanide in the body. However, even under optimum conditions, amyl nitrite can be administered faster and should be used even if medical treatment follows. Do not overreact. Fast treatment is needed, but a conscious person usually does not need treatment beyond oxygen. Amyl nitrite and medical treatment kits for cyanide poisoning are available, with doctor's prescription, from pharmacies.

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A. First Aid - Directions for Giving Amyl Nitrite Antidote and Oxygen

1. Conscious:- For inhalation and/or absorption if the victim is alert, oxygen may be all that is needed. But if he is not fully conscious or shows signs of poisoning, follow paragraph A-2 below. For swallowing, see below paragraph C, "First Aid - Swallowing Cyanide".

2. Unconscious But Breathing: Break up amyl nitrite ampule in a cloth and hold lightly under the victim's nose for 15 seconds, then take away for 15 seconds. Repeat 5-6 times. If necessary, use a fresh ampule every 3 minutes until the victim regains consciousness (usually 1-4 ampules). Give oxygen to aid recovery. Where more severe poisoning has occurred, consider holding the amyl nitrite under the nose continuously for the first ampule or more.

3. Not Breathing:
   a. Give artificial respiration, preferably with an oxygen resuscitator. Give amyl nitrite antidote by placing a broken ampule inside the resuscitator face piece, being careful that the ampule does not enter the victim's mouth and cause choking.
   b. If using manual artificial respiration, give amyl nitrite antidote as in paragraph A-2 above except keep the first amyl nitrite ampule under the nose with replacement every 3 minutes.

4. Amyl Nitrite Notes:
   a. Amyl nitrite is highly volatile and flammable; do not smoke or use around source of ignition.
   b. If treating poison victim in a windy or drafty area, provide something - a rag, shirt, wall, drum, cupped hand, etc. - to prevent the amyl nitrite vapors from being blown away. Keep the ampule upwind from the nose. The objective is to get amyl nitrite into the victim's lungs.
   c. Rescuers should avoid amyl nitrite inhalation so they won't become dizzy and lose competence.
   d. Lay the victim down for treatment to maintain a good blood supply to the victim's head. Since amyl nitrite dilutes the blood vessels and lowers blood pressure, lying down will help prevent unconsciousness.

e. Do not overuse; excessive use might put the victim in shock. This has not occurred in practice at Du Pont plants and we are not aware of any death or serious after effects from treatment with amyl nitrite. (See paragraph E, "Medical Treatment".)

B. First Aid - Inhalation of Cyanide - Carry the victim to fresh air. Lay victim down. Administer amyl nitrite antidote and oxygen (Paragraph A). Check for and remove contaminated clothing. Keep patient quiet and warm. Call a physician.

C. First Aid - Swallowing Cyanide

1. Conscious: Immediately give patient one pint of 1% sodium thiosulfate solution (or plain water) by mouth and induce vomiting with finger in throat. Repeat until vomit fluid is clear. Never give anything by mouth to an unconscious person. Call a physician.

2. Unconscious: Follow first aid procedure as in paragraphs A-2 and A-3 (and/or medical treatment in paragraph E) and call a physician. If the victim revives, then proceed with paragraph C-1.

D. First Aid - Skin or Eye Contact (Skin Absorption)

1. Eye Contact: Immediately flush eyes with plenty of water, remove contaminated clothing, and keep victim quiet and warm. Call a physician.

2. Skin Contact: Wash skin to remove the cyanide while removing all contaminated clothing, including shoes. Do not delay. Skin absorption can occur from cyanide dust, solutions, or HCN vapor. Absorption is slower than inhalation, usually measured in minutes compared to seconds for inhalation.

Follow First Aid procedures in Paragraph A if treatment is needed, but even severe skin contact usually will not require treatment if 1) no inhalation or swallowing has occurred and 2) the cyanide is promptly washed from the skin and contaminated clothing and shoes are removed. If skin contact is prolonged, HCN poisoning may occur with nausea, unconsciousness, and then death possible if the source of cyanide intake is not removed and treatment provided. Even after washing the skin, the victim should be watched for at least 1 to 2 hours because absorbed cyanide can continue to work into the bloodstream. Wash clothing before reuse and destroy contaminated shoes.

E. Medical Treatment

Medical treatment is normally provided by a physician, but might be provided by a professionally trained "qualified medical person" where a need exists and where state and local laws permit.

While preparing for sodium nitrite and sodium thiosulfate injections, use amyl nitrite and oxygen as outlined in paragraph A. When ready and if the victim is not responding to first aid, first inject the solution

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of sodium nitrite (10 mL of a 3% solution) intravenously at the rate of 2.5 mL/minute, then immediately inject the sodium thiosulfate (50 mL of a 25% solution) at the same rate, taking care to avoid extravasation.

This is a fairly lengthy treatment (24 minutes) since a total of 10 + 50, or 60 mL is injected at a rate of 2.5 mL/minute. Consideration should be given to the size and condition of the victim as treatment is proceeding. The above sodium nitrite injection is about one third of a lethal dose, so care should be taken to avoid excessive use. It is not essential that full quantities be given, just because treatment was started. Injections can be stopped at any point if recovery is evident.

Watch patient continuously for 24-48 hours if cyanide exposure was severe. If there is any return of symptoms during this period, repeat this treatment using one-half the amounts of sodium nitrite and sodium thiosulfate solutions. Caution should be used to avoid overuse of medical treatment chemicals as the prescribed dose is about 1/3 the lethal dose for an average individual.

If signs of excessive methemoglobinemia develop (i.e., blue skin and mucous membranes, vomiting, shock and coma), 1% methylene blue solution should be given intravenously. A total dose of 1 to 2 mg/kg of body weight should be administered over a period of five to ten minutes and should be repeated in one hour if necessary. In addition, oxygen inhalation will be helpful. Transfusion of whole fresh blood may be considered if there has been mechanical injury with external or internal bleeding and simultaneous cyanide exposure.

Du Pont's experience in treating cyanide poison cases is that first aid procedures using amyl nitrite and oxygen were effective and the only treatment needed in most cases. Medical treatment, using intravenous injections, was used in a few cases. Both procedures have been successful.

PROTECTION INFORMATION

GENERALLY APPLICABLE CONTROL MEASURES

Good general ventilation should be provided to keep dust, mist, and HCN gas below exposure limits.

PERSONAL PROTECTIVE EQUIPMENT

Recommended Minimum Protection - chemical splash goggles and rubber gloves (butyl or neoprene preferred).

Have available and use as appropriate: face shields; rubber suits, aprons, and boots; disposable toxic dust and mist respirators; self-contained breathing air supply (in case of emergency); HCN detector; first aid and medical treatment supplies*, including oxygen resuscitators.

*See Du Pont Sodium Cyanide Storage and Handling Bulletin for list of supplies.

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DISPOSAL INFORMATION

AQUATIC TOXICITY
The compound is highly toxic (96-hour LC50 = 0.5 - 1 mg/L).

SPILL, LEAK OR RELEASE
Sweep up and shovel into a covered container or plastic bag, pending transfer, to secure the spill. Cover and keep spillage dry. Flush spill area with a dilute solution of sodium or calcium hypochlorite. Comply with Federal, State, and local regulations on reporting releases.

WASTE DISPOSAL
Comply with Federal, State, and local regulations. Do not flush cyanide into sewers which may contain an acid. Detoxify with sodium hypochlorite, or hydrogen peroxide; flush to waste water treatment system; or call a licensed disposal contractor.

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SHIPPING INFORMATION

DOT (172.101)

PROPER SHIPPING NAME
Sodium Cyanide, Solid

HAZARD CLASS
Poison B

UN NO. 1689

DOT LABEL(S) Poison

DOT/IMO (172.102)

PROPER SHIPPING NAME
Sodium Cyanide

HAZARD CLASS
Poison B, 6.1

UN NO. 1689

IMO (PAGE 6167)

PROPER SHIPPING NAME
Sodium Cyanide

HAZARD CLASS 6.1

UN NO. 1689

IMO LABEL(S) Poison

IATA/ICAO

PROPER SHIPPING NAME
Sodium Cyanide

HAZARD CLASS 6.1

UN NO. 1689

LABEL(S) Poison

PACKAGING GROUP NO. I

OTHER INFORMATION

REPORTABLE QUANTITY 10 lb/4.54 kg

SHIPPING CONTAINERS
"Wet Flo" railcars and trucks; hopper railcars; Flo-Bins® (3000 lb. net); 2000 lb. bag in a box; 100 kilo, 100 lb., and 200 lb. steel drums

STORAGE CONDITIONS
Store in properly labeled containers in dry, ventilated, secured areas. Keep containers closed and contents dry. Do not store with acids or acid salts, containers with water or weak alkalis, or oxidizing agents. Do not handle or store food, beverages, or tobacco in cyanide areas. Do not store near combustibles or flammables because of cyanide solution runoff from water used for fire fighting.

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ADDITIONAL INFORMATION AND REFERENCES

For further information, see Du Pont Sodium Cyanide Storage and Handling Bulletin.

DATE OF LATEST REVISION/REVIEW: 8/85
PERSON RESPONSIBLE FOR MSDS: J. C. Watts, Du Pont Co., C&P Dept., Chestnut Run, Wilmington, DE 19898, (302) 999-4946

PMC 1506

OMI INTERNATIONAL CORPORATION
21441 Hoover Road, Warren, MI 48089

24-Hour EMERGENCY Phone Number
313-497-9129

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~~INDUSTRIAL HYGIENE~~

REVISION: 5/29/86

MATERIAL SAFETY DATA SHEET

May be used to comply with OSHA's Hazard Communication Standard, 29CFR 1910. 1200. Standard must be consulted for specific requirements.

Section I

Product Trade Name: UDYLITE: BRY-CAD® 153 Salts
Proprietary Formulation

Hazardous Components — Section II

	CAS No.	Percentage	TLV OSHA ACGIH	Listed: NTP/IARC/OSHA Z/EPA
Sodium Cyanide	143-33-9	80	5 mg/M³ skin	N/A
Cadmium Oxide as Cd	1306-19-0	15 to 20	0.05 mg/M³	IARC C / NTP C
Sodium Hydroxide	1310-73-2	<2.0	2 mg/M³	OSHA Z H

Physical Data — Section III

Appearance and Odor: Tan, odorless solids

Solubility in Water:
- Negligible <0.1% ____
- Slight 0.1-1.0% ____
- Moderate 1.0-10.0% X
- Appreciable >10.0% ____
- Complete(all proportions) ____

Boiling Point N/A
Vapor Pressure N/A
Percent Volatile by Volume N/A
Evaporation Rate N/A
Specific Gravity N/A
pH N/A

Fire and Explosion Hazard Data — Section IV

Flash Point (method used): None

Flammable/Explosive Limits LEL N/A UEL N/A

NFPA Code (0-4): Health 4 Flammability 0 Reactivity 0

Extinguishing Media: Product does not burn. Use media suitable for surrounding fire.

Special Fire-Fighting Procedures: Wear self-contained breathing apparatus and full protective clothing.

Unusual Fire and Explosion Hazards: Contact with acids will liberate toxic and flammable hydrogen cyanide gas.

Health Hazard Data — Section V

Threshold Limit Value: None known or established.

Effects of Overexposure:
Acute: May be fatal through cyanide poisoning via cyanide ingestion or inhalation of hydrogen cyanide gas.
Chronic: Potential irritant to skin and eyes.
Principal Route of Exposure: Inhalation, skin absorption, ingestion.

Emergency First Aid Procedures:
- Eye: Wash with a directed stream of water for 15 minutes. Get medical attention.
- Skin: Immediately wash with soap and water. Remove contaminated clothing.
- Inhalation: Remove to fresh air. Give artificial respiration if not breathing. If breathing is difficult, give oxygen. Seek medical attention.
- Swallowing: Break an amyl nitrite pearl in a clean cloth and hold under nose for 15 seconds. If victim is conscious, induce vomiting by administering syrup of ipecac. Get medical attention immediately.

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Product Trade Name BRY-CAD® 153 Salts

Reactivity Data — Section VI

Stability: Stable X Unstable ____

Incompatibility (Materials to Avoid): Acids

Hazardous Decomposition Products: Hydrogen cyanide gas.

Hazardous Polymerization May Occur ____ Will Not Occur X

Spill or Leak Procedures — Section VII

Steps to be taken in case material is released or spilled:
Work upwind. Sweep up and place into a lined container properly labeled for disposal.

Waste Disposal Method Licensed waste treatment facility.

EPA I.D. Number D003 RQ: (100/45.4)

Special Protection Information — Section VIII

Ventilation:
Local Exhaust Yes Respiratory Protection NIOSH dust mask

Protective Clothing:
Gloves butyl rubber or neoprene Boots Yes
Chemical Safety Goggles Yes Other: full protective clothing
Full Face Shield No

Note: Eye Fountain and Safety Shower must always be available.

Special Precautions — Section IX

Handling & Storage Store away from acids and foods.

Other None

Shipping Information — Section X

DOT Proper Shipping Name Cyanide Mixture, Dry UN 1588

Hazard Class Poison B

DOT Label(s) Poison 6

IATA Class: 6.1 Packing Group: II

IMDGC Class: 6.1 Packing Group: II

Prepared by: Carl N. Gilsdorf, Manager, Quality Assurance Date 5/29/86

This form has been prepared and reviewed by technically knowledgeable people and is based on information OMI International Corporation believes to be reliable. This information is provided solely to provide health and safety guidelines and is not to be intended for any other purpose.

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SECTION I - PRODUCT IDENTIFICATION

Product Name: Cadmium Oxide
Formula: CdO
Formula Wt: 128.40
CAS No.: 1306-19-0
NIOSH/RTECS No.: EV1925000
Common Synonyms: Cadmium fume
Product Codes: 1234

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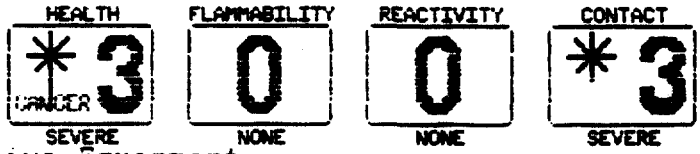
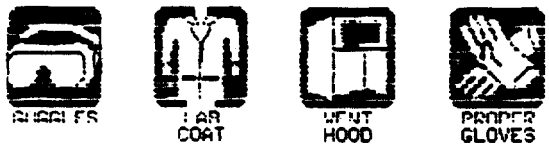
PRECAUTIONARY LABELLING

BAKER SAF-T-DATA* System



Laboratory Protective Equipment



Precautionary Label Statements

POISON! DANGER!
MAY BE FATAL IF SWALLOWED OR INHALED
EXCEPTIONAL HEALTH HAZARD - READ MATERIAL SAFETY DATA SHEET
NOTE: REPORTED AS CAUSING CANCER IN LABORATORY ANIMALS. EXERCISE DUE CARE.
Do not get in eyes, on skin, on clothing.
Do not breathe dust. Keep in tightly closed container. Use with adequate ventilation. Wash thoroughly after handling.

SAF-T-DATA* Storage Color Code: Blue (health)

SECTION II - HAZARDOUS COMPONENTS

Component	%	CAS No.
Cadmium Oxide	99-100	1306-19-0

SECTION III - PHYSICAL DATA

Boiling Point: N/A Vapor Pressure(mmHg): N/A

Continued on Page: 2

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SECTION III - PHYSICAL DATA (Continued)

Melting Point: 900°C (1652°F) DECOMPOSES Vapor Density(air=1): N/A

Specific Gravity: 8.15 Evaporation Rate: N/A
(H_2O=1) (Butyl Acetate=1)

Solubility(H_2O): Negligible (less than 0.1 %) % Volatiles by Volume: 0

Appearance & Odor: Dark brown powder or crystals. Odorless.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point: N/A

Flammable Limits: Upper - N/A % Lower - N/A %

Fire Extinguishing Media
Use extinguishing media appropriate for surrounding fire.

Special Fire-Fighting Procedures
Firefighters should wear proper protective equipment and self-contained breathing apparatus with full facepiece operated in positive pressure mode. Move containers from fire area if it can be done without risk. Use water to keep fire-exposed containers cool.

Unusual Fire & Explosion Hazards
NOTE: Decomposes at melting point.

Toxic Gases Produced
cadmium fumes

SECTION V - HEALTH HAZARD DATA

This substance is listed as a NTP anticipated human carcinogen and an IARC probable human carcinogen (Groups 2A and 2B). TLV(Ceiling) and PEL (Ceiling) are listed for Cadmium Oxide & Fume, as Cd. There is no STEL value established for this product.

Threshold Limit Value (TLV/TWA): 0.05 mg/m^3 (ppm)

Permissible Exposure Limit (PEL): 0.1 mg/m^3 (ppm)

Toxicity: LD_{50} (oral-rat)(mg/kg) - 72
LD_{50} (ipr-rat)(mg/kg) - 12

Continued on Page: 3

TMC 150%

SECTION V - HEALTH HAZARD DATA (Continued)

Carcinogenicity: NTP: Yes IARC: Yes Z List: No OSHA req: No

Effects of Overexposure

Inhalation and ingestion are harmful and may be fatal.
Inhalation of dust may cause headache, coughing, difficulty in breathing, chest pain, severe lung irritation, or pulmonary edema.
Contact with skin or eyes may cause irritation.
Ingestion may cause nausea and vomiting.
Ingestion may cause gastrointestinal irritation.
Chronic effects of overexposure to cadmium compounds may include irreversible lung damage, kidney disease, and other adverse effects.

Target Organs

respiratory system, lungs, kidneys, blood

Medical Conditions Generally Aggravated By Exposure

None Identified

Sites Of Entry

inhalation, ingestion, skin contact, eye contact

Emergency and First Aid Procedures

CALL A PHYSICIAN.
If swallowed, if conscious, immediately induce vomiting.
If inhaled: remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes.
Wash clothing before re-use.

For products sold in the state of California, the state requires that we provide to users and their employees the following message:

WARNING: THIS PRODUCT IS A CHEMICAL KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER.

SECTION VI - REACTIVITY DATA

Stability: Stable Hazardous Polymerization: Will not occur

Conditions to Avoid: heat

Incompatibles: magnesium

Decomposition Products: cadmium fumes

Continued on Page: 4

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SECTION VII - SPILL AND DISPOSAL PROCEDURES

Steps to be taken in the event of a spill or discharge

Wear self-contained breathing apparatus and full protective clothing. With clean shovel, carefully place material into clean, dry container and cover; remove from area. Flush spill area with water.

Disposal Procedure

Dispose in accordance with all applicable federal, state, and local environmental regulations.

EPA Hazardous Waste Number: D006 (EP Toxic Waste)

SECTION VIII - INDUSTRIAL PROTECTIVE EQUIPMENT

Ventilation:	Use general or local exhaust ventilation to meet TLV requirements.
Respiratory Protection:	Respiratory protection required if airborne concentration exceeds TLV. At concentrations up to 1 ppm, a high-efficiency particulate respirator is recommended. Above this level, a self-contained breathing apparatus is advised.
Eye/Skin Protection:	Safety goggles, uniform, apron, rubber gloves are recommended.

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SECTION IX - STORAGE AND HANDLING PRECAUTIONS

SAF-T-DATA* Storage Color Code: Blue (health)

Special Precautions

Keep container tightly closed. Store in secure poison area. Isolate from incompatible materials.

SECTION X - TRANSPORTATION DATA AND ADDITIONAL INFORMATION

DOMESTIC (D.O.T.)

Proper Shipping Name: Chemicals, n.o.s. (Non-regulated)

INTERNATIONAL (I.M.O.)

Proper Shipping Name	Poisonous solids, n.o.s. (Cadmium Oxide)
Hazard Class	6.1
UN/NA	UN2811
Labels	HARMFUL - STOW AWAY FROM FOOD STUFFS

Continued on Page: 5

N/A = Not Applicable or Not Available

The information published in this Material Safety Data Sheet has been compiled from our experience and data presented in various technical publications. It is the user's responsibility to determine the suitability of this information for the adoption of necessary safety precautions. We reserve the right to revise Material Safety Data Sheets periodically as new information becomes available. J. T. Baker Inc. makes no warranty or representation about the accuracy or completeness nor fitness for purpose of the information contained herein.

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U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

Form Approved
OMB No. 44-R1387

MATERIAL SAFETY DATA SHEET

Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

MANUFACTURER'S NAME: Oxy Metal Industries Corporation	EMERGENCY TELEPHONE NO.: (313) 497-9100
ADDRESS (Number, Street, City, State, and ZIP Code): 21441 Hoover Road Warren, Michigan 48089	
CHEMICAL NAME AND SYNONYMS: Cadmium Oxide	TRADE NAME AND SYNONYMS: Cadmium Salt #2
CHEMICAL FAMILY: Metal Oxide	FORMULA: CdO

COPY TO LOCAL I.A.M. 1746

MAY 18 '82

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS	No	No	BASE METAL	No	No
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
THINNERS					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
Does not pertain to.	No	No

SECTION III - PHYSICAL DATA

BOILING POINT (°F.) decomposes at	900°C	SPECIFIC GRAVITY (H_2O=1)	6.95
VAPOR PRESSURE (mm Hg.) 1 mm at	1000°C	PERCENT, VOLATILE BY VOLUME (%)	None
VAPOR DENSITY (AIR=1)	None	EVAPORATION RATE (_____ =1)	None
SOLUBILITY IN WATER	Insoluble		X
APPEARANCE AND ODOR	Brown amorphous powder, odorless.		

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used): None	FLAMMABLE LIMITS: None	Lel: X	Uel: X

EXTINGUISHING MEDIA: Does not pertain to.

SPECIAL FIRE FIGHTING PROCEDURES: Does not pertain to.

UNUSUAL FIRE AND EXPLOSION HAZARDS: As a fine dust Cadmium Oxide may initiate or contribute ~~to a~~ fire in the presence of a spark and open flame.

(Continued on reverse side)

COPY TO LOCAL I.A.M.

Cadmium Salt #2 MAY 18 '82 1746 PMC 1507

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE
None known for product. As Cadmium Fume 0.1 mg/M^3.

EFFECTS OF OVEREXPOSURE
Systemic poison by way of inhalation and ingestion.

EMERGENCY AND FIRST AID PROCEDURES
Flush skin and eyes with water. For eyes get medical attention.

SECTION VI - REACTIVITY DATA

STABILITY			CONDITIONS TO AVOID
	UNSTABLE		
	STABLE	X	

INCOMPATABILITY (Materials to avoid)
Feed or food products. Acids. Organics. Oxidants.

HAZARDOUS DECOMPOSITION PRODUCTS
Not known.

HAZARDOUS POLYMERIZATION			CONDITIONS TO AVOID
	MAY OCCUR		
	WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Cautiously sweep up and return to original container.

WASTE DISPOSAL METHOD
Refer to a licensed industrial waste contractor.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type)
Chemical cartridge respirator for exposure above T.L.V. Limit.

VENTILATION			
	LOCAL EXHAUST	Yes	SPECIAL No
	MECHANICAL (General)	No	OTHER No

PROTECTIVE GLOVES	EYE PROTECTION
rubber gloves	chemical safety goggles

OTHER PROTECTIVE EQUIPMENT
No

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING
Avoid excessive skin contact. Do not breathe solids. Do not get in eyes, on skin, on clothing.

OTHER PRECAUTIONS
For Industrial Use Only. Do Not Take Internally.

JUL 2 0 1977

THE INDIUM CORPORATION OF AMERICA
1676 Lincoln Ave. • Utica, NY 13502

Emergency Telephone No. 315-797-1630

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OCT 15 1987
INDUSTRIAL HYGIENE

Material Safety Data Sheet

Common Name: Potassium Cyanide

Quick Identifier: KCN

PMC1508

SECTION 1—HAZARDOUS INGREDIENTS/IDENTITY

Hazardous Component(s) (chemical and common name(s))	OSHA PEL	ACGIH TLV	% (optional)	CAS NO.
Potassium Cyanide	5 mg/m3	5 mg/m3	100	151-50-8

Safety Precautions: Do not breathe dust, mist or HCN gas. Do not get in eyes. Avoid contact with skin and clothing. Do not carry foodstuffs, beverages, or tobacco where contamination with cyanide is possible. Wash thoroughly after handling. Wash contaminated clothing before reuse.

SECTION 2—PHYSICAL AND CHEMICAL CHARACTERISTICS

Boiling Point: Not available

Specific Gravity (H_2O = 1): 1.52

Vapor Density (Air = 1): Not volatile

Vapor Pressure (mm Hg): Negligible

Solubility in Water: 41.7% @ 25°C

Reactivity in Water: NA

Appearance and Odor: Solid, white/none: ammoniacol if damp.

Melting Point: 634.5°C (1174°F)

SECTION 3—FIRE AND EXPLOSION DATA

Flash Point: NA F. C.

Method Used: NA

Flammable Limits in Air % by Volume: LEL Lower NA; UEL Upper NA

Auto-Ignition Temperature: NA

Extinguisher Media: ☐ Foam ☐ "Alcohol" Foam ☐ CO_2 ☐ Dry Chemical ☒ Water Spray ☐ Other ☐ N.A.

Special Fire Fighting Procedures: Potassium Cyanide dissolve readily in water, therefore cyanide solution runoff may occur if containers are opened. Runoff should be contained to avoid environmental or safety problems. Contained cyanide solution can be detoxified with hypochlorite.

Unusual Fire and Explosion Hazards: Will not burn. Potassium Cyanide will not be destroyed in an ordinary fire involving combustible materials such as paper or wood.

Do not use carbon dioxide (CO2) which reacts with potassium cyanide to produce hydrogen cyanide if moisture is present. (See "incompatibility" below).

SECTION 4—PHYSICAL HAZARDS (REACTIVITY DATA)

Stability: Unstable ☐ Stable ☒ Conditions to Avoid: NA

Incompatibility (Materials to Avoid): Lg. amts. of highly toxic, flammable HCN gas willbe evolved from contact with acids. Reacts violently with strong oxidiyers. Water or weak alkaline solution can produce dangerous amts. of HCN. Moisture will cause slow decomp, releasing poisonous HCN and ammonia gas.

Hazards Decomposition Products

Hazardous Polymerization: May Occur ☐ Will Not Occur ☒ Conditions to Avoid: NA

May be used to comply with OSHA's Hazard Communication Standard, 29CFR 1910. 1200. Standard must be consulted for specific requirements.

Date Prepared: 4/87

DAP

PMC 1508

SECTION 5—HEALTH HAZARDS

1. Acute	Inhalation	Rapid respiration; asphyxia and death can occur
	Eyes	Burning and irritation; tearing blurring of vision
	Skin	Irritation, Rash
	Ingestion	No data
2. Chronic	Inhalation	Rapid respiration
	Eyes	Burning and irritation; tearing, blurring of vision; permanent eye dam.
	Skin	Irritation, Rash, Significant skin permeation can occur.
	Ingestion	No data

Signs and Symptoms of Exposure: Nausea; headache, dizziness, vomiting, weakness, rapid respiration, lowered blood pressure, unconsciousness, convulsions and fatality.

Medical Conditions Generally Aggravated by Exposure: Individuals with preexisting diseases of the central nervous system may have increased susceptibility to the toxicity of excessive exposures.

Chemical Listed as Carcinogen or Potential Carcinogen — National Toxicology Program Yes ☐ No ☒ — I.A.R.C. Monographs Yes ☐ No ☒ — OSHA Yes ☐ No ☒

Emergency and First-Aid Procedures: See Attached.

* Target Organs: CVS.CNS, liver, kidneys, skin

SECTION 6—SPECIAL PRECAUTIONS AND SPILL/LEAK PROCEDURES

Precautions to be Taken in Handling and Storage: Containers of this material may be hazardous when emptied, since emptied containers retain product residues. Store away from incompatible materials.

Steps to be Taken in Case Material is Released or Spilled: Sweep up and shovel into a covered container. Cover and keep spillage dry. Flush spill area with a dilute solution of sodium or calcium hypochlorite. Comply with Federal, State and local regulations on reporting releases.

Waste Disposal Methods (Consult federal, state, and local regulations): Comply with Federal,State. and Local regulations.

SECTION 7—SPECIAL PROTECTION INFORMATION/CONTROL MEASURES

Respiratory Protection (Specify Type): NIOSH/MSHA approved respirators

Ventilation — Local Exhaust: Recommended — Mechanical (General): Required

Protective Gloves: Recommended (rubber) — Eye Protection: Chemical splash gaggles

Other Protective Clothing or Equipment: Coveralls

Work/Hygienic Practices: Normal safety and work practices that are consistent with good personal hygiene.

SECTION 8—REFERENCES

Dangerous Properties of Industrial Materials; N. Irving Sax 1984

DuPont; Wilmington, DE.

NIOSH Pocket Guide To Chemical Hazards 1985

PMC 1508

Potassium Cyanide MSDS cont'd.

First Aid And Medical Treatment

Actions to be taken in case of cyanide exposure should be planned and practiced before beginning work with cyanides. In most cases, cyanide poisoning causes a deceptively healthy pink to red skincolor; however, if a physical injury or lack of oxygen is involved, the skin color may be bluish.

Treatment for cyanide poisoning can be provided in two ways, "First Aid" and Medical Treatment." Both require immediate action to prevent further harm or death. First Aid using amyl nitrite and oxygen is generally given by a layman before medical help arrives. Medical treatment involves intravenous injections and must be administered by qualified medical personnel. Even if a doctor or nurse is present, the need for fast treatment dictates using first aid treatment with amyl nitrite and oxygen while medical treatment materials for intravenous injection are being prepared. Experience shows that first aid given promptly is usually the only treatment needed.

Medical treatment is given if the victim does not respond to first aid. It provides a larger quantity of antidote including sodium thiosulfate to chemically destroy cyanide in the body. However, even under optimum conditions, amyl nitrite can be administered faster and should be used even if medical treatment follows. Do not overreact. Fast treatment is needed, but a conscious person usually does not need treatment beyond oxygen. Amyl niture and medical treatment kits for cyanide poisoning are available, with doctor's prescription from pharmacies.

PMC1508

Potassium Cyanide MSDS cont'd.

A. First Aid - Directions for giving amyl nitrite antidote and oxygen.

1. Conscious: For inhalation and/or absorption if the victim is alert, oxygen may be all that is needed. But if he is not fully conscious or shows signs of poisoning , follow paragraph #2 below. For swallowing, see paragraph C below.

2. Unconscious But Breathing: Break up amyl nitrite ampule in a cloth and hold lightly under the victim's nose for 15 seconds, then take away for 15 seconds. Repeat 5-6 times. If necessary, use a fresh ampule every 3 minutes until the victim regains consciousness (usually 1-4 ampules). Give oxygen to aid recovery. Where more severe poisoning has occurred, consider holding the amyl nitrite under the nose continuously for the first ampule or more.

3. Not Breathing: Give artificial respiration, preferably with an oxygen resuscitator. Give amyl nitrite antidote by placing a broken ampule inside the resuscitator face piece, being careful that the ampule does not enter the victims mouth and cause choking.

   If using manual artificial respiration, give amyl nitrite antidote as in paragraph A-2 above except keep the first amyl nitrite ampule under the nose with replacement every 3 minutes.

4. Amyl Nitrite Notes:

   a. Amyl nitrite is highly volatile and flammable; do not smoke or use around source of ignition.

   b. If treating poison victim in a windy or drafty area provide something - A rag, shirt, wall, drum, cupped hand, etc. - to prevent the amyl nitrite vapors from being blown away.

   c. Rescuer should avoid amyl nitrite inhalation so they won't become dizzy and lose competence.

   d. Lay the victim down for treatment to maintain a good blood supply to the victims head. Since amyl nitrite dilutes the blood vessels and lowers blood pressure, lying down will help prevent unconsciousness.

   e. Do not over use, excessive use may put victim in shock.

Potassium Cyanide MSDS cont'd.

B. First Aid - Inhalation of Cyanide - Carry the victim to fresh air. Lay victim down. Administer amyl nitrite antidote and oxygen (Paragraph A.) Check for and remove contaminated clothing. Keep patient quiet and warm. Call a physician.

C. First Aid - Swallowing Cyanide

1. Conscious: Immediately give patient one pint of 1% sodium thiosulfate solution (or plain water) by mouth and induce vomiting with finger in throat. Repeat until vomit fluid is clear. Never give anything by mouth to an unconscious person. Call a physician.

2. Unconscious: Follow first aid procedure as in paragraphs A-2 and A-3 (and/or medical treatment in Paragraph E) and call a physician. If the victim revives, then proceed with paragraph C-1.

D. First Aid - Skin or Eye Contact (Skin Absorption)

1. Eye Contact: Immediately flush eyes with plenty of water, remove contaminated clothing, and keep victim quiet and warm. Call a physician.

2. Skin Contact: Wash skin to remove the cyanide while removing all contaminated clothing, including shoes. Do not delay. Skin absorption can occur from cyanide dust, solutions, or HCN vapor, absorption is slower than inhalation, usually measured in minutes compared to seconds for inhalation.

   Follow first aid procedures in Paragraph A if treatment is needed, but even severe skin contact usually will not require treatment if 1) no inhalation or swallowing has occurred and 2) the cyanide is promptly washed from the skin and contaminated clothing and shoes are removed. If skin contact is prolonged, HCN poisoning may occur with nausea, unconsciousness, and then death possible if the source of cyanide intake is not remvoed and treatment provided. Even after washing the skin, the victim should be watched for at least 1 to 2 hours becauseabsorbed cyanide can continue to work into the bloodstream. Wash clothing before reuse and destroy contaminated shoes.

E. Medical Treatment

Medical treatment is normally provided by a physician, but might be provided by a professionally trained "qualified medical person" where needs exist and where state and local laws permit.

Potassium Cyanide MSDS cont'd.

While preparing for sodium nitrite and sodium thiosulfate injections, use amyl nitrite and oxygen as outlined in paragraph A. When ready and if the victim is not responding to first aid, first inject the solution of sodium nitrite (10 mL of a 3% solution) intravenously at the rate of 2.5 mL/minute, then immediately inject the sodium thiosulfate (50 mL of a 25% solution) at the same rate, taking care to avoid extravasation.

This is a fairly lengthy treatment (24 minutes) since a total of 10+ 50, or 60 mL is injected at a rate of 2.5 mL/minute. Consideration should be given to the size and condition of the victim as treatment is proceeding. The above sodium nitrite injection is about one third of a lethal dose, so care should be taken to avoid excessive use. It is not essential that full quantities be given, just because treatment was started. Injections can be stopped at any point if recovery is evident.

Watch patient continuously for 24-48 hrs if cyanide exposure was severe. If there is any return of symptoms during this period, repeat this treatment using one-half the amounts of sodium nitrite and sodium thiosulfate solutions. Caution should be used to avoid overuse of medical treatment chemicals as the prescribed dose is about 1/3 the lethal dose for an average individual.

If signs of excessive methemoglobinemia develop (i.e., blue skin and mucous membranes, vomiting, shock and coma), 1% methylene blue solution should be given intravenously. A total dose of 1 to 2 mg/kg of body weight should be administered over a period of five to ten minutes and should be repeated one hour if necessary. In addition, oxygen inhalation will be helpful. Transfusion of whole fresh blood may be considered if there has been mechanical injury with external or internal bleeding and simultaneous cyanide exposure.

UTC IHL

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MAY 18 '82 1746

PMC 1508

Supplier: Phillip Bros. Chem
Middletown Ct.

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

Form Approved
OMB No. 44-R1337

MATERIAL SAFETY DATA SHEET

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Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

MANUFACTURER'S NAME Copper Pigment & Chemical Inc.	EMERGENCY TELEPHONE NO. (201)-636-4300
ADDRESS (Number, Street, City, State, and ZIP Code) Arbor Street, Sewaren, N.J. 07077	
CHEMICAL NAME AND SYNONYMS Potassium Cyanide	TRADE NAME AND SYNONYMS
CHEMICAL FAMILY	FORMULA KCN

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
In contact with acids it liberates poisonous and flamable hydrocyanic acid gas. Not to be stored near nitrate-nitrite mixtures of peroxides.		

SECTION III - PHYSICAL DATA

BOILING POINT (°F.)		SPECIFIC GRAVITY (H_2O=1)	
VAPOR PRESSURE (mm Hg.)		PERCENT, VOLATILE BY VOLUME (%)	
VAPOR DENSITY (AIR=1)		EVAPORATION RATE (_____ =1)	
SOLUBILITY IN WATER 1 part in 2 parts water.			
APPEARANCE AND ODOR White deliquescent granular powder. Odor of HCN.			

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	FLAMMABLE LIMITS	Lel	Uel
EXTINGUISHING MEDIA			

SPECIAL FIRE FIGHTING PROCEDURES Potassium Cyanide will not burn or support combustion. If exposed to water as thru perforations in steel containers potassium Cyanide will dissolve & small amounts of HCN gas may form by hydrolysis.

UNUSUAL FIRE AND EXPLOSION HAZARDS Do not use carbon dioxide type extinguishers.

PMC 1508

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE

EFFECTS OF OVEREXPOSURE Large doses-patient becomes unconscious within a few seconds. Smaller doses-dizziness, confusion headache vomiting.

EMERGENCY AND FIRST AID PROCEDURES Carry patient to fresh air have him lie down. Remove contaminated clothing-keep patient warm. Start Treatment immediately using Cyanide first aid kit. Call physician.

SECTION VI - REACTIVITY DATA

STABILITY			CONDITIONS TO AVOID
	UNSTABLE	X	
	STABLE		

INCOMPATABILITY (Materials to avoid) All acids.

HAZARDOUS DECOMPOSITION PRODUCTS

HAZARDOUS POLYMERIZATION			CONDITIONS TO AVOID
	MAY OCCUR		
	WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED Sweep up solids & dispose in proper fashion.

WASTE DISPOSAL METHOD Cyanide waste is treated with sodium hypochlorite at a pH 8.5 to 10.0. Dispose in accordance with local, state and federal regulations.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type) Dust respirators approved by Bureau of Mines for dust.

VENTILATION			
	LOCAL EXHAUST X	SPECIAL	
	MECHANICAL (General) X	OTHER	

PROTECTIVE GLOVES

EYE PROTECTION Metal Safety spectacles with side shield.

OTHER PROTECTIVE EQUIPMENT

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING Do not store near acids, nitrate-nitrite mixtures. Store in dry area.

OTHER PRECAUTIONS Do not get in eyes, on skin or clothing.

MAY 18 '82 1746

Form Approved
Budget Bureau No. 44-R1387
Approval Expires April 30, 1971

UTC IHC

Supplier: Phillip Bros. Chem.
Middletown, Ct.

PMC 1509

Form No. LSB-005-4
May 1969

U.S. DEPARTMENT OF LABOR

WAGE AND LABOR STANDARDS ADMINISTRATION
Bureau of Labor Standards

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MATERIAL SAFETY DATA SHEET

MAY 18 '82 1746

SECTION I

MANUFACTURER'S NAME: Copper Pigment * Chemicals, Inc.	EMERGENCY TELEPHONE NO.: (201)-636-4300
ADDRESS (Number, Street, City, State, and ZIP Code): Arbor Street, Sewaren, N.J. 07077	
CHEMICAL NAME AND SYNONYMS: Copper Cyanide	TRADE NAME AND SYNONYMS: Cupticin
CHEMICAL FAMILY: Cyanide	FORMULA: $Cu(CN)_2$

SECTION II HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)

SECTION III PHYSICAL DATA

BOILING POINT (°F.) Melting Point °F	474	SPECIFIC GRAVITY (H_2O=1)	
VAPOR PRESSURE (mm Hg.)	None	PERCENT VOLATILE BY VOLUME (%)	
VAPOR DENSITY (AIR=1)	None	EVAPORATION RATE (=1)	None
SOLUBILITY IN WATER	Insoluble		

APPEARANCE AND ODOR: White to cream colored powder.

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used): Non-flammable	FLAMMABLE LIMITS	Lel	Uel
EXTINGUISHING MEDIA			
SPECIAL FIRE FIGHTING PROCEDURES			
UNUSUAL FIRE AND EXPLOSION HAZARDS: None			

PMC 1509

SECTION V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE: 150 to 180 mg.

EFFECTS OF OVEREXPOSURE: Poisoning may occur by ingestion, or inhalation of hydrogen cyanide liberated by the action of strong acids.

EMERGENCY AND FIRST AID PROCEDURES: Carry patient to fresh air have him lie down start treatment immediately using cyanide first aid kit. Call physician.

SECTION VI REACTIVITY DATA

STABILITY			CONDITIONS TO AVOID
	UNSTABLE		
	STABLE	X	

INCOMPATABILITY (Materials to avoid): Acids, Oxydizing Agents

HAZARDOUS DECOMPOSITION PRODUCTS: Hydrogen Cyanide

HAZARDOUS POLYMERIZATION			CONDITIONS TO AVOID
	MAY OCCUR		
	WILL NOT OCCUR	X	

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Gather carefully and flush with water into the waste treatment system. Do not let it get in touch with acids or oxydizing materials.

WASTE DISPOSAL METHOD: As prescribed for cyanides and heavy metals by the local, state and federal regulations.

SECTION VIII SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type): Respirators of approved type

VENTILATION			
	LOCAL EXHAUST: Operating areas should be provided with adequate ventilation	SPECIAL	
	MECHANICAL (General)	OTHER	

PROTECTIVE GLOVES: Gauntlet type rubber

EYE PROTECTION: Chemical safety glasses

OTHER PROTECTIVE EQUIPMENT: Rubber or plastic clothing to avoid skin contact.

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Do not ship or store next to strong acids or oxydizing agents.

OTHER PRECAUTIONS: Do not get in eyes, on skin or clothing.

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1746

MAY 18 '82

UTCTHL 62

Allied Chemical
An Allied Company

SODA ASH

PRODUCT SAFETY DATA SHEET

PMC 1510

A. GENERAL INFORMATION

TRADE NAME (COMMON NAME OR SYNONYM)	X CAS NO ☐ ALLIED PRODUCT CODE #
Soda Ash	497-19-8

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CHEMICAL NAME
Sodium Carbonate

FORMULA	MOLECULAR WEIGHT
Na_2CO_3	105.99

ADDRESS (No., STREET, CITY, STATE AND ZIP CODE)

Allied Chemical
P.O. Box 1139R
Morristown, N.J. 07960

CONTACT	PHONE NUMBER	ISSUED DATE	REVISED DATE
Director, Product Safety	(201) 455-4157	June 12, 1980	Nov., 1982

B. FIRST AID MEASURES

EMERGENCY PHONE NUMBER
(201) 455-2000

Skin: Wash with plenty of water.
Eyes: Flush with plenty of water for at least 15 minutes and get medical attention.
Ingestion: Drink large quantity of water to dilute the material. Do not induce vomiting.
Get medical attention for irritation, ingestion or discomfort from inhalation.

C. HAZARDS INFORMATION

HEALTH

INHALATION
Inhalation of product dust may irritate nose, throat and lungs.

INGESTION
Although low in toxicity, ingestion can be harmful - consult a physician.
May irritate mouth, esophagus, stomach, etc. LD_{50} (rat): 2.8 gm/kg. See reference (a).

SKIN
May cause skin irritation from prolonged contact.

EYES
May irritate or burn eyes.

PERMISSIBLE CONCENTRATION: AIR (SEE SECTION J) None established BIOLOGICAL
No TLV established.

UNUSUAL CHRONIC TOXICITY

CC124 256 (7/81)

C. HAZARDS (Cont.)

NA – Not Applicable

PMC 1510

FIRE AND EXPLOSION

FLASH POINT °C	AUTO IGNITION TEMPERATURE °C	FLAMMABLE LIMITS IN AIR (% BY VOL.)
Not Flammable EN CUP ☐ CLOSED CUP	NA	NA

UNUSUAL FIRE AND EXPLOSION HAZARDS

D. PRECAUTIONS/PROCEDURES

FIRE EXTINGUISHING AGENTS RECOMMENDED

NA

FIRE EXTINGUISHING AGENTS TO AVOID

NA

SPECIAL FIRE FIGHTING PRECAUTIONS

NA

VENTILATION

Local exhaust if dusty condition prevails.

NORMAL HANDLING

Avoid eye contact or prolonged skin contact. Avoid breathing dust. When dissolving, add to water cautiously and with stirring; solutions can get hot.

RAGE

ore in a cool, dry area away from acids. Prolonged storage may cause product to cake from atmospheric moisture.

SPILL OR LEAK

Shovel up dry chemical into an empty container with a cover. Flush residue with plenty of water. (See Section I for disposal methods).

SPECIAL PRECAUTIONS/PROCEDURES/LABEL INSTRUCTIONS

Avoid simultaneous exposure to soda ash and lime dust. In the presence of moisture the two materials combine to form caustic soda (NaOH), which may cause burns. Label signal word: "CAUTION!"

E. PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY PROTECTION

Where required, use a respirator approved by NIOSH for product dusts.

EYES AND FACE

Wear hard hat (or other head covering) and chemical safety goggles.
Do not wear contact lenses

HANDS, ARMS AND BODY

Wear long sleeve shirt and trousers and gloves for routine product use
tor gloves are sufficient for dry product, wear impervious gloves when handling solutions

HER CLOTHING AND EQUIPMENT

PMC 1510

F. PHYSICAL DATA

MATERIAL IS (AT NORMAL CONDITIONS):	APPEARANCE AND ODOR	
☐ LIQUID ☒ SOLID ☐ GAS ☐ _____	White powder. Odorless.	
BOILING POINT °C MELTING POINT 854 °C	SPECIFIC GRAVITY (H_2O = 1) 2.533	VAPOR DENSITY (AIR = 1) NA
SOLUBILITY IN WATER (% by Weight) 17% solution at 20°C	pH 1% solution; pH = 11.3	VAPOR PRESSURE (mm Hg at 20° C) NA
EVAPORATION RATE (Butyl Acetate = 1) ☐ (Ether = 1) ☒ NA	% VOLATILES BY VOLUME (At 20° C) NA	

G. REACTIVITY DATA

STABILITY	CONDITIONS TO AVOID
☐ UNSTABLE ☒ STABLE	

INCOMPATIBILITY (MATERIALS TO AVOID)

Contact with acids will release carbon dioxide gas.

HAZARDOUS DECOMPOSITION PRODUCTS

HAZARDOUS POLYMERIZATION	CONDITIONS TO AVOID
☐ MAY OCCUR ☒ WILL NOT OCCUR	

H. HAZARDOUS INGREDIENTS (Mixtures Only)

MATERIAL OR COMPONENT/C.A.S. #	WT. %	HAZARD DATA (SEE SECT. J)
NA		

PMC 1510

I. ENVIRONMENTAL

DEGRADABILITY/AQUATIC TOXICITY	OCTANOL/WATER PARTITION COEFFICIENT

EPA HAZARDOUS SUBSTANCE? ☐ YES ☒ NO IF SO, REPORTABLE QUANTITY: _____ # — 40 CFR 116-117

WASTE DISPOSAL METHODS (DISPOSER MUST COMPLY WITH FEDERAL, STATE AND LOCAL DISPOSAL OR DISCHARGE LAWS)

If permitted by applicable disposal regulations, bury in a solid waste landfill or dissolve and neutralize as follows: Dissolve in water using caution as solution can get hot. Neutralize with acid and flush to sewer with plenty of water. Good ventilation is required during neutralization due to release of CO_2 gas. Neutralized waste may have to be disposed of by an approved contractor.

RCRA STATUS OF UNUSED MATERIAL: — 40 CFR 261

Not a hazardous waste.

J. REFERENCES

PERMISSIBLE CONCENTRATION REFERENCES

REGULATORY STANDARDS — D.O.T. CLASSIFICATION: Not regulated — 49 CFR

GENERAL

(a) Allied Chemical data, unpublished.

K. ADDITIONAL INFORMATION

This product is not for food or drug use.

THIS PRODUCT SAFETY DATA SHEET IS OFFERED SOLELY FOR YOUR INFORMATION, CONSIDERATION AND INVESTIGATION.

ALLIED CORPORATION PROVIDES NO WARRANTIES, EITHER EXPRESS OR IMPLIED, AND ASSUMES NO RESPONSIBILITY FOR THE ACCURACY OR COMPLETENESS OF THE DATA CONTAINED HEREIN.

PMC 1511

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U. S. DEPARTMENT OF LABOR

WAGE AND LABOR STANDARDS ADMINISTRATION

Bureau of Labor Standards

MATERIAL SAFETY DATA SHEET

UTC IN LAB

SECTION I

MANUFACTURER'S NAME: American Chemical & Refining Company, Inc. Mark Chagnon	EMERGENCY TELEPHONE NO.: 203-757-9231
ADDRESS (Number, Street, City, State, and ZIP Code): 36 Sheffield Street Waterbury, CT 06704	
CHEMICAL NAME AND SYNONYMS: Argenous Cyanide	TRADE NAME AND SYNONYMS: Silver Cyanide
CHEMICAL FAMILY: Cyanide	FORMULA: AgCN

SECTION II HAZARDOUS INGREDIENTS

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

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
N.A.*		

SECTION III PHYSICAL DATA

BOILING POINT (°F.)	N.A.*	SPECIFIC GRAVITY (H_2O=1)	3.95
VAPOR PRESSURE (mm Hg.)	N.A.*	PERCENT VOLATILE BY VOLUME (%)	N.A.*
VAPOR DENSITY (AIR=1)	N.A.*	EVAPORATION RATE (_____ =1)	N.A.*
SOLUBILITY IN WATER @ 20°C	0.0023%		
APPEARANCE AND ODOR	White or grayish, odorless powder		

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	None	FLAMMABLE LIMITS None	LEL	UEL
EXTINGUISHING MEDIA	Non-flammable			
SPECIAL FIRE FIGHTING PROCEDURES	None			
UNUSUAL FIRE AND EXPLOSION HAZARDS	Contact with acids or acid salts will liberate highly toxic and flammable hydrocyanic acid gas.			

*N.A. - not applicable

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SECTION V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE

5 mg/M^3 (as CN) - skin

EFFECTS OF OVEREXPOSURE

Highly toxic, weakness, dizziness, confusion, headache, vomiting, unconsciousness.

EMERGENCY AND FIRST AID PROCEDURES

Give prompt treatment. Maintain respiration. Administer amyl nitrite.

Follow instructions on label.

SECTION VI REACTIVITY DATA

STABILITY			CONDITIONS TO AVOID
	UNSTABLE		
	STABLE	X	

INCOMPATABILITY (Materials to avoid)

Contact with acids or acid salts releases poisonous gas.

HAZARDOUS DECOMPOSITION PRODUCTS

Hydrogen cyanide.

HAZARDOUS POLYMERIZATION			CONDITIONS TO AVOID
	MAY OCCUR		
	WILL NOT OCCUR	X	

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Do not breathe gas or dust. Do not get in eyes, on skin or on clothing.

WASTE DISPOSAL METHOD

Sweep up spillage. Send to a refinery for disposal. Do not flush to sewer which may contain acids.

SECTION VIII SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type)

Use dust respirator (U.S. Bureau of Mines approved) when handling under dusty conditions.

VENTILATION	LOCAL EXHAUST	SPECIAL
	Maintain adequate ventilation	Air or oxygen in emergencies
	MECHANICAL (General)	OTHER

PROTECTIVE GLOVES	EYE PROTECTION
Used when handling material	Chemical safety goggles

OTHER PROTECTIVE EQUIPMENT

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Wash thoroughly after handling. Keep container closed and away from acids.

Store in dry place. Keep away from feed and foodstuffs. (storage and work areas)

OTHER PRECAUTIONS

Wash contaminated clothing before reuse.

Budget Bureau No. 44-R1387
Approval Expires April 30, 1971

Form No. LSB-C
May

UTC IHL

U.S. DEPARTMENT OF L OR

PMC 1512

WAGE AND LABOR STANDARDS ADMINISTRATION
Bureau of Labor Standards

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MATERIAL SAFETY DATA SHEET

CURT TUCOLCHAVE 1746
MAY 18 '82

SECTION I

MANUFACTURER'S NAME: IMC CHEMICAL GROUP, INC.	EMERGENCY TELEPHONE NO.: 617-268-5100
ADDRESS (Number, Street, City, State, and ZIP Code): 52 Sobin Park, Boston, Massachusetts 02210	
CHEMICAL NAME AND SYNONYMS: POTASSIUM CARBONATE, CARBONATE OF POTASH	TRADE NAME AND SYNONYMS: POTASSIUM CARBONATE
CHEMICAL FAMILY: ALKALI	FORMULA: K_2CO_3 (Hydrated or Calcined)

SECTION II HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)

SECTION III PHYSICAL DATA

BOILING POINT (°F.)	N A	SPECIFIC GRAVITY (H_2O=1)	N A
VAPOR PRESSURE (mm Hg.)	N A	PERCENT VOLATILE BY VOLUME (%)	N A
VAPOR DENSITY (AIR=1)	N A	EVAPORATION RATE (_____=1)	N A
SOLUBILITY IN WATER			

APPEARANCE AND ODOR: Odorless white hygroscopic granular material

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	FLAMMABLE LIMITS	Lel	Uel

EXTINGUISHING MEDIA

SPECIAL FIRE FIGHTING PROCEDURES

UNUSUAL FIRE AND EXPLOSION HAZARDS

PMC 1512

SECTION V. HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE: None

EFFECTS OF OVEREXPOSURE: Causes skin and mucous membrane irritation

EMERGENCY AND FIRST AID PROCEDURES
Remove from skin as soon as possible. Flush area thoroughly with water.
For eyes flush for 15 minutes with water, get immediate medical attention.

SECTION VI. REACTIVITY DATA

STABILITY			CONDITIONS TO AVOID
	UNSTABLE		
	STABLE	X	

INCOMPATABILITY *(Materials to avoid)*: Acids

HAZARDOUS DECOMPOSITION PRODUCTS: None

HAZARDOUS POLYMERIZATION			CONDITIONS TO AVOID
	MAY OCCUR		
	WILL NOT OCCUR	X	

SECTION VII. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

WASTE DISPOSAL METHOD: Dissolve and wash away with large quantities of water.

SECTION VIII. SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION *(Specify type)*: Nose mask

VENTILATION		
	LOCAL EXHAUST	SPECIAL
	MECHANICAL *(General)*	OTHER

PROTECTIVE GLOVES: None

EYE PROTECTION: None

OTHER PROTECTIVE EQUIPMENT: None

SECTION IX. SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

OTHER PRECAUTIONS

COPY TO LOCAL I.A.M.

MAY 18 '82 1746

PMC 1515

Form Approved
Budget Bureau No. 44-R1387
Approval Expires April 30, 1971

Form No. LSB-005-4
May 1969

U.S. DEPARTMENT OF LABOR

WAGE AND LABOR STANDARDS ADMINISTRATION
Bureau of Labor Standards

MATERIAL SAFETY DATA SHEET

DISTRIBUTED BY:
J.F. HENRY CHEMICAL CO. INC.
FT. OF FENWICK ST. P.O. BOX 2050
NEWARK, N.J. 07114
(201) 242-0200

October, 1971

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SEP 20 1982
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SECTION I

MANUFACTURER'S NAME: Monsanto Company	EMERGENCY TELEPHONE NO.: (314) 694-1000
ADDRESS (Number, Street, City, State, and ZIP Code): 800 North Lindbergh Blvd., St. Louis, Missouri 63166	
CHEMICAL NAME AND SYNONYMS: Sodium Phosphate Tribasic - Crystalline	TRADE NAME AND SYNONYMS: TSP Crystalline
CHEMICAL FAMILY: Sodium Phosphates	FORMULA: $4(Na_3PO_4 \cdot 12H_2O) \cdot NaOH$

SECTION II HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
Not a hazardous material as defined in 29 CFR Section 1501.2		
which pertains to this data sheet.		

SECTION III PHYSICAL DATA

BOILING POINT (°F.)	NA	SPECIFIC GRAVITY (H_2O=1)	
VAPOR PRESSURE (mm Hg.)	NA	PERCENT VOLATILE BY VOLUME (%)	
VAPOR DENSITY (AIR=1)	NA	EVAPORATION RATE (_____=1)	
SOLUBILITY IN WATER	Appreciable		
APPEARANCE AND ODOR	White product - No odor.		

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	NA	FLAMMABLE LIMITS NA	Lel	Uel
EXTINGUISHING MEDIA	NA			
SPECIAL FIRE FIGHTING PROCEDURES	NA			
UNUSUAL FIRE AND EXPLOSION HAZARDS	NA			

While the information and recommendations set forth herein are believed to be accurate as of the date hereof, MONSANTO COMPANY MAKES NO WARRANTY WITH RESPECT THERETO AND DISCLAIMS ALL LIABILITY FROM RELIANCE

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SECTION V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE	None established.
EFFECTS OF OVEREXPOSURE	May cause skin irritation - Severe eye irritant.
EMERGENCY AND FIRST AID PROCEDURES	Skin - Flush with water.
	Eye - Flush with water for at least 15 minutes - Get medical attention.

SECTION VI REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE	X	

INCOMPATABILITY *(Materials to avoid)*

HAZARDOUS DECOMPOSITION PRODUCTS

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Normal good housekeeping procedures.

WASTE DISPOSAL METHOD Landfill.

SECTION VIII SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION *(Specify type)*

VENTILATION	LOCAL EXHAUST If dust is a problem.	SPECIAL
	MECHANICAL *(General)*	OTHER

PROTECTIVE GLOVES	Good practice.	EYE PROTECTION	Yes - goggles.

OTHER PROTECTIVE EQUIPMENT

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Normal good housekeeping practices.

OTHER PRECAUTIONS

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Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

MANUFACTURER'S NAME: Pfizer Chemical Division	EMERGENCY TELEPHONE NO.: 212-573-1456
ADDRESS (Number, Street, City, State, and ZIP Code): 235 E. 42nd St. New York, N.Y. 10017	
CHEMICAL NAME AND SYNONYMS: Rochelle Salt, USP, FCC	TRADE NAME AND SYNONYMS: Potassium Sodium Tartrate -- Sodium Potassium Tartrate
CHEMICAL FAMILY: Aliphatic Acid salt	FORMULA: $KNaC_4H_4O_6 \cdot 4H_2O$

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS Not			BASE METAL Not		
CATALYST Applicable			ALLOYS Applicable		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
Not Applicable (not a mixture)		

SECTION III - PHYSICAL DATA

BOILING POINT (°F.) Not Applicable	(solid)	SPECIFIC GRAVITY (H_2O=1)		1.790
VAPOR PRESSURE (mm Hg.) Not Applicable		PERCENT, VOLATILE BY VOLUME (%)	At 100°C, loses	$3H_2O$
VAPOR DENSITY (AIR=1) Not Applicable		EVAPORATION RATE (_____ =1)	Not Applicable	
SOLUBILITY IN WATER at 26°C	66g/100 ml	Melting Point		70°-80°C
APPEARANCE AND ODOR White crystalline powder, odorless, cooling saline taste.				

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used) Not Established	FLAMMABLE LIMITS Solid	LEL	UEL
EXTINGUISHING MEDIA If involved in fire, water or CO_2 may be used.			
SPECIAL FIRE FIGHTING PROCEDURES None normally required.			
UNUSUAL FIRE AND EXPLOSION HAZARDS None			

(Continued on reverse side)

SECTION V - HEALTH HAZARD DATA PMC 1518

THRESHOLD LIMIT VALUE
Not established (generally recognized as safe for use in foods).

EFFECTS OF OVEREXPOSURE
As with other mild organic salts, excessive contact may ca
eye irritation, or minor skin or respiratory irritation.

EMERGENCY AND FIRST AID PROCEDURES

Flush skin contact with water and flush eye contact immediately with plenty of water. Get medical care for eyes if irritation persists.

SECTION VI - REACTIVITY DATA

STABILITY			CONDITIONS TO AVOID
	UNSTABLE		Not Applicable
	STABLE	X	

INCOMPATABILITY *(Materials to avoid)*
Acids, calcium or lead salts, magnesium sulfate, silver nitrate.

HAZARDOUS DECOMPOSITION PRODUCTS
Not Established

HAZARDOUS POLYMERIZATION			CONDITIONS TO AVOID
	MAY OCCUR		Not Applicable
	WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

A normal brush down and wash up

WASTE DISPOSAL METHOD

Any normal disposal procedure which is in conformance with pertinent federal, state or local regulations.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION *(Specify type)*
None normally required

VENTILATION	LOCAL EXHAUST	SPECIAL
	Dust exhaust at point of use	
	MECHANICAL *(General)*	OTHER

PROTECTIVE GLOVES	EYE PROTECTION
Standard work gloves	Chemical goggles

OTHER PROTECTIVE EQUIPMENT
None

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING
Store in tightly closed containers.

OTHER PRECAUTIONS
Do not ingest; relatively large doses (2-4 g in adults) can have a cathartic effect.

GPO 834-810

This MSDS is based on a limited review of Pfizer's files and standard toxicology handbooks.
The information herein is furnished without warranty of any kind. This information should be used only as a supplement to information already in your possession concerning this product. The determination of whether and under what conditions the product should be used by your employees is yours to make.

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ISSUE DATE: 4/88

MATERIAL SAFETY DATA SHEET

MANUFACTURER/ADDRESS
Pfizer Chemical Division
235 East 42nd St.
New York, N.Y. 10017

PRODUCT IDENTIFICATION

PFIZER PRODUCT NAME: Rochelle Salt, USP/FCC

PFIZER MSDS NO.: R002

EMERGENCY PHONE NUMBER(S): (718)-780-8456

CHEMICAL NAME AND MOLECULAR FORMULA: Potassium Sodium Tartrate $KNaC_4H_4O_6 \cdot 4H_2O$

CAS NO.(S): 304-59-6

SYNONYMS: Sodium Potassium Tartrate

CHEMICAL FAMILY: Aliphatic Acid Salt

HAZARDOUS COMPONENTS

MATERIALS OR COMPONENTS	%	HAZARD DATA (TLV, LD50, LC50, etc.)
Material is a single component entity.		

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PHYSICAL PROPERTIES

BOILING POINT (°F)	Not Applicable-Solid	SPECIFIC GRAVITY (H_2O = 1)	Not Applicable-Solid
VAPOR PRESSURE (mm Hg.)	Not Applicable-Solid	PERCENT VOLATILE BY VOLUME (%)	Not Applicable-Solid
VAPOR DENSITY (AIR = 1)	Not Applicable-Solid	EVAPORATION RATE (= 1)	Not Applicable-Solid
SOLUBILITY IN WATER	Appreciable	pH 10 % SOLN	7 - 8
APPEARANCE & ODOR	White crystalline powder, odorless with cooling saline taste.		

FIRE & EXPLO DATA

FLASH POINT (Method used)	Not Applicable	FLAMMABLE LIMITS	Lel: NA	Uel: NA

EXTINGUISHING MEDIA: If involved in fire, extinguish with water, foam or CO_2.

SPECIAL FIRE FIGHTING PROCEDURES: None Required

UNUSUAL FIRE AND EXPLOSION HAZARDS: None Reported

REACTIVITY DATA

STABILITY		CONDITIONS TO AVOID
UNSTABLE		Avoid exposure to high temperatures (loses water).
STABLE	XX	

INCOMPATIBILITY (Materials to avoid): Strong acids, silver nitrate, calcium, lead or magnesium salts.

HAZARDOUS DECOMPOSITION PRODUCTS: None Known

HAZARDOUS POLYMERIZATION		CONDITIONS TO AVOID
May Occur	Will Not Occur	
	XX	Not Applicable

TOXICITY

ORAL/PARENTERAL: No Data Available

DERMAL (acute): No Data Available

EYE: No Data Available

INHALATION: No Data Available

CHRONIC:

Generally recognized as safe. No specific data available. Rat feeding of disodium tartrate where 1150mg/kg was fed for 17 days without fatalities. Increased levels of 3680mg/kg for 19 days, killed 3 of 6 test animals.

Carcinogenicity:	NTP?	IARC Monographs?	OSHA Regulated?
	Not Listed	Not Listed	No

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HEALTH HAZARD INFORMATION

Effects of Exposure

ORAL INGESTION
Generally recognized as safe for use in foods or as a laxative. Adverse effects, dependent on amount ingested, include nausea, vomiting, diarrhea, abdominal pain, thirst and possibly cardiovascular collapse and/or renal failu

EYE CONTACT
May, due to the dusting, be a mild irritation.

SKIN CONTACT
Direct, prolonged contact may cause irritation.

INHALATION
Dusts may be slightly irritating to the respiratory tract.

Emergency First Aid

ORAL INGESTION
Dependent on the amount ingested and if victim is conscious, give 2-3 glasses of water and induce vomiting.

EYE CONTACT
Wash contacted eye with plenty of water for at least 15 minutes. Seek medical assistance should irritation persist.

SKIN CONTACT
Wash contacted area with water. Launder contaminated clothing before reuse.

INHALATION
Remove victim to source of fresh air.

SPILL OR LEAK

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Sweep/scoop material into recovery containers. Flush area with water to remove final traces.

WASTE DISPOSAL METHOD (Comply with applicable federal, state, and local regulations.)

Comply with applicable federal, state or local regulations. Consider landfill or incineration.

SPECIAL PROTECTION INFO.

RESPIRATORY PROTECTION (Specify type)
Normal dust stop mask.

VENTILATION				
	LOCAL EXHAUST	Sufficient to control	SPECIAL	None
	MECHANICAL (general)	dust.	OTHER	None

PROTECTIVE GLOVES
Normal Work Gloves

EYE PROTECTION
Safety Glasses

OTHER PROTECTIVE EQUIPMENT
None Required

SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Avoid exposure to higher than normal storage temperatures.

OTHER PRECAUTIONS

None Required

This MSDS is based on a limited review of Pfizer's files and standard toxicology handbooks.

The information herein is furnished without warranty of any kind. This information should be used only as a supplement to information already in your possession concerning this product. The determination of whether and under what conditions the product should be used by your employees is yours to make.

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MATERIAL SAFETY DATA SHEET

(R) 2/22/88

CODE 16561

SECTION 1

Manufacturer's Name MacDermid Incorporated	EMERGENCY TELEPHONE 203-575-5700
ADDRESS (Number, Street, City, State, Zip Code) 526 Huntingdon Avenue Waterbury, CT. 06708	MFSA EMERGENCY 24 HOUR HOTLINE: (Medical) (313) - 644 - 5626
CFR-49 - DOT Proper Shipping Name Non-hazardous Material	
CHEMICAL NAME AND SYNONYMS N/A	TRADE NAME AND SYNONYM Rocheltex
CHEMICAL FAMILY Organic Salts	FORMULA Mixture

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVE & SOLVENTS	% N/A	TLV (UNITS)	ALLOYS & METALLIC COATINGS	% N/A	TLV (UNITS)
PIGMENTS	"		BASE METAL	"	
CATALYST	"		ALLOYS	"	
VEHICLE	"		METALLIC COATINGS	"	
SOLVENTS	"		FILLER METAL PLUS OR CORE FLUX	"	
ADDITIVES	"		OTHERS	"	
OTHERS	"				

HAZARDOUS MIXTURES OR OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (UNITS)
Potassium Hydroxide (1310-58-3)	25-40	2 mg/M^3

SECTION III - PHYSICAL DATA

BOILING POINT (F)	> 212	SPECIFIC GRAVITY (H_2O = 1)	1.29
VAPOR PRESSURE (MM. HG.)	Aqueous	PERCENT VOLATILE BY VOLUME (%)	N/A
VAPOR DENSITY (AIR = 1)	"	EVAPORATION RATE (= 1)	Aqueo
SOLUBILITY IN WATER	Complete		

APPEARANCE AND ODOR

Clear, pale yellow liquid - slight odor

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

		LEL	UE
FLASH POINT (METHOD USED) Non-flammable	FLAMMABLE LIMITS N/A		

EXTINGUISHING MEDIA

As for surrounding materials

SPECIAL FIRE FIGHTING PROCEDURES

Wear self-contained breathing apparatus

UNUSUAL FIRE AND EXPLOSION HAZARDS

Will produce acrid fumes under fire conditions.

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SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE

Not established for product. See Section II

EFFECTS OF OVEREXPOSURE UNLESS OTHERWISE STATED CHRONIC OR LONG-TERM HEALTH EFFECTS UNKNOWN!

Irritation to eyes, skin and mucous membranes

EMERGENCY AND FIRST AID PROCEDURES

EYES: Flush with water for 15 minutes. Contact physician.
SKIN: Wash thoroughly with water.
INTERNAL: Give water, contact physician. Do not induce vomiting
INHALATION: Remove to fresh air.

SECTION VI - REACTIVITY DATA

UNSTABLE		**CONDITIONS TO AVOID**
STABLE	X	N/A

INCOMPATIBILITY (MATERIALS TO AVOID)

Strong acids

HAZARDOUS DECOMPOSITION PRODUCTS

None known

HAZARDOUS POLYMERIZATION		**CONDITIONS TO AVOID**
MAY OCCUR		N/A
WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED - WEAR PROTECTIVE CLOTHING. NEVER DISCHARGE DIRECTLY INTO SEWERS OR WATERWAYS

Flush to chemical drain with cold water.

WASTE DISPOSAL METHOD - ALWAYS CHECK AND COMPLY WITH GOVERNMENT DISPOSAL REGUALTIONS

Neutralize carefully with dilute acid to pH 6-8. Discharge liquid to chemical drain according to local, state, federal regulations.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (SPECIFY TYPE)

Not normally required if area well ventilated.

VENTILATION	**LOCAL EXHAUST**	**SPECIAL**
	N/A	N/A
	MECHANICAL (GENERAL)	**OTHER**
	X	N/A

PROTECTIVE GLOVES	**EYE PROTECTION**
Rubber	Splash proof goggles/face shield

OTHER PROTECTIVE EQUIPMENT

Rubber apron

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Keep in closed containers in a cool, dry location away from strong acids.

OTHER PRECAUTIONS

Avoid eye and skin contact. Always wash clothing before re-use.

PREPARED BY: MacDermid Incorporated **DATE:** 2/22/88

16561

SAFETY & WARNING INFORMATION

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Industrial Hygiene – General Requirements

(To be attached to every MacDermid Material Safety Data Sheet.)

INGESTION

All food should be kept in a separate area away from the working location. Eating, drinking, smoking and carrying of tobacco products should be prohibited in areas where there is a potential for significant exposure to this material. Before eating, drinking or smoking, hands and face should be thoroughly washed.

SKIN CONTACT

Skin contact should be prevented through the use of impervious clothing, gloves and footwear. A face shield should be worn when use conditions could result in exposure to the material.

EYE CONTACT

Eye contact should be prevented through the use of chemical safety glasses, goggles or face shield.

INHALATION

This material should only be handled in open or well-ventilated areas. Where adequate ventilation is not available and there is possibility of vapor, aerosol or mist generation, control of inhalation can be achieved through the use of a NIOSH-approved, half-face-piece cartridge, air-purifying respirator.

General Storage Requirements for Hazardous Materials

CORROSIVE MATERIALS

Corrosive materials must not be above, below or adjacent to: Flammable Solids, Oxidizing Materials, Cyanide Bearing Materials (Poison).

FLAMMABLE LIQUIDS

Keep Flammable Liquids in a segregated area, preferably outside of your facility or in a Flammable Liquid storage cabinet.

DOUBLE LABELED MATERIALS

(Example: Corrosive Liquid, Poisonous NOS). Primary hazard is Corrosive, secondary hazard is Poison. Consider both hazards in storing the material. In this example, do not store near Flammable Solids, Oxidizing or Cyanide Bearing materials because of the corrosive element. Preferably keep double labeled materials separate from all other diamond labeled materials.

ACIDS/ALKALINES

Acid bearing material should be stored separate from Alkaline bearing material.

Although the information and recommendations set forth in this sheet are believed to be correct as of the date hereof, MacDermid, Inc. makes no further representations as to the completeness or accuracy of such information and recommendations.

MacDermid, Inc. shall in no event be responsible for any damages whatsoever, directly or indirectly resulting from the publication or use of or reliance upon such information and recommendations.

No other warranty, either express or implied, of merchantability or fitness or any other nature with respect to the product or the information or recommendations herein is made hereunder.

MacDermid INCORPORATED
(203) 575-5700

✚ EMERGENCY DIRECTORY ASSISTANCE
(313) 644-5626

mfsa

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ENTHONE INCORPORATED

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MATERIAL SAFETY DATA SHEET

ALUMON®

P.O. BOX 1900
NEW HAVEN, CT 06508

EMERGENCY PHONE NUMBERS			
PLANTS	203-934-8611	(8:30am-5pm	EST)
	312-598-3210	(8:30am-5pm	CST)
MFSA	313-644-5626	(24 hours)	
CHEMTREC	800-424-9300	(Transportation)	

PRODUCT CODE#: 2200
DATE ISSUED: 5/4/87
SUPERCEDES: 7/86
PREPARER: J.A. Zehnder

II. HAZARDOUS INGREDIENTS

COMPONENT	COMMON NAME	CAS NO.	OSHA-PEL	ACGIH-TLV	%
Sodium hydroxide	Caustic soda	1310-73-2	2 mg/m3	2 mg/m3(1)	
Zinc oxide		1314-13-2	10 mg/m3(2)	10mg/m3(2)	
Sodium cyanide		143-33-9	5 mg/m3(3)	5 mg/m3(3)	
Cuprous cyanide	copper cyanide	544-92-3	5 mg/m3(3)	5mg/m3(3)	

(1) Ceiling value (2) as dust (3) Skin contact

III. PHYSICAL PROPERTIES

SPECIFIC GRAVITY (WATER =1)	NI	BOILING POINT, °F	NA
EVAP.RATE (BUTYL ACETATE=1)	NA	MELTING POINT, °F	NI
VAPOR PRESSURE, mmHg	NA	SOLUBILITY IN WATER	essentially complete
VAPOR DENSITY (AIR=1)	NA	APPEARANCE	light grey powder
pH (AS IS)	NA	ODOR	caustic

IV. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT, °F	NA	FLAMMABLE LIMITS (AIR)	NA	LEL	NA	UEL

EXTINGUISHING MEDIA

[X] Not Combustible [X] Water fog or spray [ ] Carbon Dioxide [ ] Dry Chemical [ ] Alcohol Foam [X] Foam [ ] Sand or Earth

SPECIAL FIRE FIGHTING PROCEDURES

Wear self-contained breathing apparatus (SCBA) and complete personal protective equipment when potential for exposure to vapors or products of combustion exists.

UNUSUAL FIRE AND EXPLOSION HAZARDS

In the presence of water, material may react with amphoteric metals (such as aluminum, zinc, or tin) generating hydrogen gas which will burn or explode if ignited.

V. HEALTH HAZARD DATA

EFFECTS OF ACUTE EXPOSURE:

INHALATION: Inhalation of dust may be fatal and can cause severe burns to upper respiratory tract.

INGESTION: Small amounts can cause death.

SKIN: Absorption through skin may be fatal.
May cause irritation, rash.

EYES: Causes severe burns with damage to eyes and possible blindness.

EFFECTS OF CHRONIC EXPOSURE:

May range from general discomfort to convulsions and death depending on severity of exposure.

CARCINOGEN: Not listed by NTP, IARC, OSHA

REFERENCE:

EMERGENCY AND FIRST AID PROCEDURES

INHALATION: Lay down victim in fresh air. If victim is unconscious and not breathing, resuscitate and simultaneously administer amyl nitrite as prescribed by your First Aid Policy. If conscious, administer oxygen and if necessary, amyl nitrite antidote. Keep victim quiet and warm. Seek immediate medical attention.

INGESTION: Never give anything by mouth to an unconscious person. Give victim suitable antidotes while administering oxygen. Follow Company Policy concerning administration of antidotes, or water, and inducing vomiting. Seek immediate medical attention.

SKIN: Wash skin to remove cyanide while removing all contaminated clothing, including shoes. Do not delay. Skin absorption can occur from cyanide dust, solutions, or HCN vapor.

EYES: Immediately flush eyes with plenty of water for at least 15 minutes holding lids apart to ensure flushing of entire surface. Washing eyes within several seconds of exposure is essential to minimize damage. Seek immediate medical attention.

UTC IHL
R-3/29/79
ARD:rs

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U. S. DEPARTMENT OF LABOR

WAGE AND LABOR STANDARDS ADMINISTRATION

Bureau of Labor Standards

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MATERIAL SAFETY DATA SHEET

SECTION I

MANUFACTURER'S NAME: MACDERMID, INC.	EMERGENCY TELEPHONE NO.: 203-754-6161
ADDRESS (Number, Street, City, State, and ZIP Code): 526 HUNTINGDON AVENUE, WATERBURY, CONNECTICUT 06720	
CHEMICAL NAME AND SYNONYMS	TRADE NAME AND SYNONYMS: Rocheltex
CHEMICAL FAMILY	FORMULA

SECTION II HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS	--		BASE METAL	--	
CATALYST	--		ALLOYS	--	
VEHICLE	--		METALLIC COATINGS	--	
SOLVENTS	--		FILLER METAL PLUS COATING OR CORE FLUX	--	
ADDITIVES	--		OTHERS	--	
OTHERS	--				

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
Potassium Hydroxide	2	2 mg/M^3

SECTION III PHYSICAL DATA

BOILING POINT (°F.)	> 212	SPECIFIC GRAVITY (H_2O=1)	1.280
VAPOR PRESSURE (mm Hg.)	Aqueous	PERCENT VOLATILE BY VOLUME (%)	NA
VAPOR DENSITY (AIR=1)	NA	EVAPORATION RATE (_____ =1)	NA
SOLUBILITY IN WATER	Complete		
APPEARANCE AND ODOR	Clear, pale yellow liquid. Slight odor.		

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	Non Flammable Liquid	FLAMMABLE LIMITS	NA	LEL / UEL
EXTINGUISHING MEDIA	As required for surrounding fire.			
SPECIAL FIRE FIGHTING PROCEDURES	None			
UNUSUAL FIRE AND EXPLOSION HAZARDS	None			

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SECTION V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE: Not established for product. See Section II.

EFFECTS OF OVEREXPOSURE: Irritation to eyes, skin, and mucous membranes.

EMERGENCY AND FIRST AID PROCEDURES: Eyes - wash with water for 15 minutes - contact physician.

Skin - wash thoroughly with water.

Internal - Give water - contact physician.

SECTION VI REACTIVITY DATA

STABILITY			CONDITIONS TO AVOID
	UNSTABLE		
	STABLE	X	

INCOMPATABILITY (Materials to avoid): Strong acids

HAZARDOUS DECOMPOSITION PRODUCTS: Oxides of carbon

HAZARDOUS POLYMERIZATION			CONDITIONS TO AVOID
	MAY OCCUR		
	WILL NOT OCCUR	X	

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Flush to drain with cold water.

WASTE DISPOSAL METHOD: Neutralize carefully with dilute acid. Discharge liquid to drain.

SECTION VIII SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type): Not normally required

VENTILATION	LOCAL EXHAUST	SPECIAL
	MECHANICAL (General) X	OTHER

PROTECTIVE GLOVES: Rubber

EYE PROTECTION: Splash proof goggles/face shield.

OTHER PROTECTIVE EQUIPMENT: Rubber apron

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Keep in closed containers in a cool, dry location away from strong acids.

OTHER PRECAUTIONS

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VI. PRECAUTIONS FOR SAFE HANDLING AND USE

SPILL PROCEDURES:

Do not inhale dust. Avoid contact with skin, eyes and clothing. Wear protective equipment. Sweep or shovel into clean container and cover. Flush spill area with dilute solution of sodium or calcium hypochlorite. Dispose of according to Local, State and Federal regulations.

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STORAGE AND HANDLING PRECAUTIONS:

Store in a cool, dry place. Keep away from acids and oxidizers. Loosen cover cautiously when opening.

ADDITIONAL INFORMATION:

Wash thoroughly after handling.
Decontaminate clothing before disposal.

VII. CONTROL MEASURES

VENTILATION: Local exhaust recommended.

RESPIRATOR: Use NIOSH approved respirator when air concentration is greater than the TLV or PEL. Self-contained respirator is preferred.

EYE PROTECTION: [ ] Safety glasses [X] Chemical safety goggles [X] Face shield

PROTECTIVE GLOVES: [X] Neoprene [ ] Natural rubber Other: Butyl rubber

OTHER PROTECTIVE CLOTHING OR EQUIPMENT:

Chemically resistant coveralls, hat, and shoes or boots.

WORK / HYGENIC PRACTICES:

Do not consume, handle or store food, beverages or tobacco in areas where this product is present.

ADDITIONAL INFORMATION:

For waste disposal of operating solutions consult Enthone Waste Disposal Procedures. For major spills consult Enthone for disposal assistance. Dispose of in accordance with local, state, and federal regulations.

CAS = Chemical Abstract Service
NI = No relevant information available
NA = Not applicable
Trade Secret = Claimed as allowed under 29 CFR 1910.1200

PEL = OSHA Permissible Exposure Limit
TLV = ACGIH Threshold Limit Value
NTP = National Toxicology Program
IARC = Int'l Agency for Research on Cancer

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MATERIAL SAFETY DATA SHEET

Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

MANUFACTURER'S NAME: ENTHONE, INC.	EMERGENCY TELEPHONE NO.: 203 - 934-8611
ADDRESS (Number, Street, City, State, and ZIP Code): P. O. Box 1900, New Haven, CT 06508	
CHEMICAL NAME AND SYNONYMS: N/A	TRADE NAME AND SYNONYMS: ALUMON®
CHEMICAL FAMILY:	FORMULA:

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES		%	TLV (Units)
DOT Class Label	Caustic Soda	80	2 mg/M³
Poison B Poison-Cyanide Mix Dry	Cyanide, as CN	2	5 mg/M³
	Zinc Oxide	< 20	5 mg/M³
	Balance is non-hazardous		

SECTION III - PHYSICAL DATA

BOILING POINT (°F.)	-	SPECIFIC GRAVITY (H_2O=1)	-
VAPOR PRESSURE (mm Hg.)	-	PERCENT, VOLATILE BY VOLUME (%)	-
VAPOR DENSITY (AIR=1)	-	EVAPORATION RATE (_____ =1)	-
SOLUBILITY IN WATER	soluble		
APPEARANCE AND ODOR	white to light grey powder with caustic odor		

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	None	FLAMMABLE LIMITS	Lel	Uel
EXTINGUISHING MEDIA	Not Flammable			

SPECIAL FIRE FIGHTING PROCEDURES: Avoid using water on the product. The use of water will generate large quantities of the heat by reaction with the sodium hydroxide and may cause spattering. Use of water will dissolve the sodium cyanide and may thus spread the cyanide into sewers or drains where acid conditions may cause the liberation of highly toxic HCN.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Contact of the product with water may cause liberation of small amounts of toxic HCN which will be destroyed in a flaming fire. Heat may release volatile HCN which is very poisonous. Contact of the product with acids, acid salts, or acidic rinses liberates highly toxic and flammable HCN gas. In water solution, product may react with metals to generate hydrogen gas which is flammable.

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(Continue on reverse side)

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE: N/A

EFFECTS OF OVEREXPOSURE: May be fatal if swallowed or if dust or mist from solution is inhaled. Inhalation of highly toxic hydrocyanic acid, generated by contact of the product with acid, may be fatal. Product may cause severe skin and eye burns.

EMERGENCY AND FIRST AID PROCEDURES - Always have on hand cyanide antidote kits and Amyl Nitrite.

EXTERNAL: Flush skin or eyes with plenty of cool water for 15 minutes while removing contaminated clothing and shoes; for eyes also get immediate medical attention.

INHALATION: Remove patient to fresh air. Have patient lie down and keep warm. If breathing has stopped, apply artificial repiration. Administer amyl nitrite by inhalation for ¼ - ½ of every minute. Apply oxygen if available. Summon an ambulance to take patient to hospital. Cyanide Antidote Kit should accompany patient in ambulance.

SECTION VI - Reactivity Data

STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE shelf life	1 yr.	

INCOMPATABILITY (Materials to avoid): Moisture, oxidizers, acids (very important)

HAZARDOUS DECOMPOSITION PRODUCTS: in a fire - cyanides, cyanogen

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	x	Unless subject to high heat or contact with acids (then toxic HCN will be formed)

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SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Stay upwind. Keep acid away from area. Do not breathe gas, dust or mist from product or solutions. Avoid contact with skin, eyes and clothing. Keep product dry if at all possible. Contain spill! Prevent material from getting into waters or into sewers. If spilled into waters or sewers, notify proper authorities immediately. If in solution prevent contact with metals as hydrogen may be generated.

WASTE DISPOSAL METHOD: for spills and leaks: If material is in dry state, shovel up into steel containers, sweep up all powder, dam area and treat residual with sodium hypochlorite to destroy remaining cyanide. If material is in solution, contain spill and absorb on sand or gravel. Shovel up into steel containers. Take solids to chemical waste treatment facility for chlorination to destroy cyanide.

For Waste Disposal of Operating Solution, Consult Enthone Operating Instructions.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type): Type for caustic mist.

VENTILATION	LOCAL EXHAUST: Yes, for operating solution of Alumon.	SPECIAL
	MECHANICAL (General)	OTHER

PROTECTIVE GLOVES	Yes, rubber	EYE PROTECTION	Yes, goggles

OTHER PROTECTIVE EQUIPMENT: apron

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Keep dry; store indoors at max. of 120°F.; avoid contact with moisture, oxidizers, acids.

OTHER PRECAUTIONS: Avoid dust inhalation. Wear gloves, apron, goggles at all times when handling. Avoid all contact with acids or acidic materials as such contact will release poisonous gas. Avoid contact of the powder with oxidizing agents as violent reaction may occur.

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Manufacturer's Name & Address:
AMERICAN CHEMICAL & REFINING CO., INC.
CONTACT: MR. KALMAN Le BOW
36 SHEFFIELD ST., P.O.BOX 120
WATERBURY, CT 06720

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Emergency Telephone Number:
(203) 757-9231

Chemtrec Toll Free Number:
(800) 424-9300

Section 01 : General Information

Common Name: POTASSIUM SILVER CYANIDE
Chemical Name: POTASSIUM SILVER CYANIDE
Chemical Family: CYANIDE SALT
Chemical Formula: KAg(CN)2
Preparation Date: 070787
Last Revision Date: 012387
Revision Number: 8701B

Section 02 : Hazardous Ingredients

Section 2A: Hazardous Ingredients

L/I	Chemical & Common Name	CAS-Reg-No	%'age	Applicable Exposure Limits: PEL-OSHA	Applicable Exposure Limits: TLV-ACGIH
1.	Potassium Silver Cyanide	506-61-6	100	.01mg/m3asAg	.01mg/m3asAg

Section 2B: Carcinogenic Ingredients

L/I	Chemical & Common Name	CAS-Reg-No	%'age	Reference Source: IARC	Reference Source: OSHA
1.	None				

Section 2C: Mutagenic Ingredients

L/I	Chemical & Common Name	CAS-Reg-No	%'age	Reference Source: IARC	Reference Source: OSHA
1.	None				

Section 2D: Teratogenic Ingredients

L/I	Chemical & Common Name	CAS-Reg-No	%'age	Reference Source: IARC	Reference Source: OSHA
1.	None				

Section 03 : Health Hazard Data

Acute Health Effects:
Toxic effect studies in animals showed overexposure may lead to asphyxia, dyspnea, ataxia, tremors, coma and eventual death caused by the interruption of the metabolic process.

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Human health effects of overexposure initially include: skin irritation with discomfort or rash, eye irritation or burns with tearing or blurred vision and very possibly permanent eye damage. There can be nonspecific discomfort such as nausea, headaches, dizziness, vomiting and weakness. Higher exposures may lead to rapid respiration, lowered blood pressure, unconsciousness, convulsions and eventual death. Evidence suggests that there is significant permeation through the skin and that individuals with a preexisting disease of the central nervous system may have increased susceptibility to more toxic effects of overexposure.

Chronic Health Effects:
Chronic exposure to cyanide are non-specific and rare.

Routes Of Entry:
May be fatal if inhaled, absorbed through the skin or swallowed. Contact with acid rapidly liberates dangerous amounts of HCN gas. Contact with water or weak alkali solutions can liberate smaller but still dangerous amounts of HCN gas. Can cause severe burns to the eye and irritation to the skin areas.
Move the affected person from the hazardous exposure area. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's rescue procedures and know the location of rescue equipment before the need arises. The following toxicity data are the "Reported (Estimated) Human Response to Various Concentrations of HCN Vapors" according to a NIOSH criteria data document. 300ppm...Rapidly fatal, 100-200ppm...fatal within .5-1 hr, 45-54ppm... tolerated for .5-1 hr. without immediate or delayed effects, 20-40ppm...slight symptoms after several hours, 10ppm...TLV/TWA for a normal 8 hr. day, no adverse effect. 2-5ppm...odor threshold.

Medical Conditions Aggravated By Exposure:
Inhalation or ingestion of cyanide salts or solutions may be rapidly fatal. Larger doses by inhalation or swallowing may cause the victim to rapidly lose consciousness, stop breathing, and expire. In some cases there are convulsions. At low levels of exposure, the earlier symptoms include weakness, headache, confusion, nausea, and vomiting.

Emergency And First Aid Procedures:
Treatment for cyanide poisoning can be provided in two ways, "First Aid" and "Medical Treatment". Both require immediate action to prevent further harm or death. First aid using amyl nitrite and oxygen is generally given by a person qualified to administer first aid before medical help arrives. Medical treatment involves intravenous injections and must be administered by qualified medical personnel. Experience has shown that if first aid is given promptly this is the only treatment needed.
Medical treatment is given if the victim does not respond to first aid. It provides a larger quantity of antidote including sodium thiosulfate to chemically destroy cyanide in the body. Amyl nitrite and medical treatment kits for cyanide poisoning can be obtained from a laboratory supply facility dealing with safety supplies.
CONSCIOUS: for inhalation and/or absorption if the victim is alert, oxygen may be all that is needed. If the victim is not fully conscious or shows signs of poisoning, then continue the following instructions.
UNCONSCIOUS AND BREATHING: Break an amyl nitrite ampoule in a cloth and hold under the victim's nose for 15 seconds. Remove for 15 seconds and then repeat procedure 5-6 times. If necessary, use a fresh ampoule every 3 minutes until the victim regains consciousness (usually 1-4 ampoules). Give oxygen to aid recovery. Where more severe poisoning has occurred, consider holding the amyl nitrite under the nose continuously for the first ampoule or more.

NOT BREATHING: Give artificial respiration, preferably with an oxygen resuscitator. Give amyl nitrite by placing the broken ampoule in the face piece of the resuscitator, being careful not to allow the ampoule to enter the victim's mouth. If using manual artificial respiration, give the amyl nitrite antidote as in the previous paragraphs except keep the ampoule under the nose with replacement every 3 minutes.
MEDICAL TREATMENT: Medical treatment is normally provided by a physician, but in extreme cases might be provided by a professionally trained "qualified medical person" where a need exists and where state and local laws permit.
Sodium nitrite and sodium thiosulfate are given intravenously. If the victim is not responding to amyl nitrite, a solution of sodium nitrite (10 ml of a 3% solution) is given intravenously at the rate of 2.5 ml/minute, then immediately inject the thiosulfate (50 ml of a 25% solution) at the same rate, taking care to avoid extravasation. This is a fairly lengthy treatment (approx. 25-30 min.). Consideration must be given to the weight and condition of the patient. The sodium nitrite is about one third of a lethal dose, so care should be taken to avoid excessive use. It is not essential that the full quantities be given; injections can be stopped at any point if recovery is evident. The patient must be carefully watched for a 24-48 hour period if the cyanide exposure was severe. Further treatment can be administered, but only by a qualified physician, and that is if the patient has developed methemoglobinemia (blue skin).

Section 04 : Chemical Data

Boiling Point:	N/A
Vapor Pressure:	N/A
Vapor Density:	N/A
Specific Gravity:	2.36
Per Cent Volatile By Volume:	N/A
Evaporation Rate Based On:	N/A
Evaporation Rate:	N/A

Solubility (Specify Solvents):
25% soluble in water @ 20C. The cyanide salt dissolved in water forms an equilibrium between ionized cyanide and highly volatile hydrogen cyanide; although in very small quantity, extreme care should be taken when dissolving the salt.

Appearance & Odor:
White crystalline material, with no discernible odor. The material is extremely sensitive to light. It will darken if exposed to strong light source.

Section 05 : Physical Hazard Data

Flash Point:	N/A
Flammable Limits:	Non-flammable
Lel:	N/A
Uel:	N/A

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Flammability Data:
The material will not burn. The cyanide salt or solution will not be destroyed in an ordinary fire involving combustible materials such as wood or paper. The compound would require a very hot fire in order to decompose.

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Extinguishing Media:
DO NOT use carbon dioxide which can react with the cyanide in the presence of moisture to form hydrogen cyanide which is very flammable. Water would be best used to extinguish the fire.

Usual Fire Fighting Procedures:
Firefighters should wear proper protective equipment and self-contained breathing appartus with full facepiece in the positive pressure mode. The cyanide material can pose a threat to the environment during a fire in that hosing down the fire with water can dissolve the cyanide and wash it to the environment, causing undo contamination. The runoff should try to be contained and then detoxified with hypochlorite solution.

Unusual Fire Fighting Procedures:
Closed containers of cyanides exposed to the heat of fire may explode. The closed containers can be hosed down with water to keep them cool. Toxic HCN gases can be released in an intense fire.

Incompatibility:
Contact with acid solutions forms highly toxic and flammable hydrogen cyanide. Will react violently with strong oxidizing agents, i.e.,nitrates, permanganates.

Hazardous Decomposition Products:
Containers should be securely closed as moisture will cause slow decompositon nd the formation of toxic HCN and ammonia gases.

Hazardous Polymerization:
Will not occur.

Stability:
This material is stable

Section 06 : Spill Or Leak Procedures

Steps To Be Taken In Case Material Is Released Or Spilled:
Soak up the spill or powder with an inert material and return to the recycling facility for the recovery of the precious metal material. This material cannot be washed to any sewer or drain.

Waste Disposal Method:
Must be disposed of in accordance with all Federal, State, and local regulations. Do not flush cyanide to any sewer or drain that may contain acid disposal as this will cause the evolution of hydrocyanic gas which is extremely poisonous and toxic; also, this substance is highly toxic to marine life. Comply with all regulatory agencies in the event of a major release to the environment. Flush spill area with a dilute solution of sodium or calcium hypochlorite and remove to a waste treatment system for further disposal. Under Federal and State Regulations, cyanide bearing precious metal materials are now considered hazardous waste and therefore, must be manifested to a permitted recycling facility or reclamation.

Section 07 : Exposure Control Information

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Respiratory Protection:
Do not breath dust or gas. Wear an approved dust respirator when there is danger of inhaling cyanide dust. The respirator should be one approved by the Mining Enforcement and Safety Administration or by NIOSH. Minimum respiratory protection is required for levels of cyanide above 5 mg/m3. For greater than 50 mg/m3 a self-contained breathing apparatus with a full facepiece operated in the pressure demand or other positive pressure mode. A combination respirator which includes a Type C supplied air respirator with a full facepiece operated in pressure demand or other positive pressure or continuous flow mode and an auxiliary self-contained breathing apparatus, also in the same modes. For any emergency escape, any gas mask providing protection against hydrogen cyanide and particulates can be worn.

Ventilation - Local Exhaust:
Local exhaust ventilation to keep dust, mist and HCN gas below exposure limits.

Ventilation - Special:
General dilution ventilation control could be an added safeguard in the area of cyanide operation.

Ventilation - Mechanical:
N/A

Ventilation - Other:
N/A

Protective Gloves:
Employees should be provided with and required to wear impervious gloves to prevent any possibility of skin contact with the chemical substance.

Eye Protection:
The individual or employee must wear approved chemical splash goggles and/or face shield to avoid eye contamination.

Other Protective Equipment:
Employees should be provided with and required to use impervious clothing to prevent any possibility of skin contact with this hazardous substance.

Work Practices:
Skin that becomes contaminated with this substance should be immediately washed or showered with soap.

Hygienic Practices:
Eating and smoking should not be permitted in areas where these hazardous substances are handled, processed, or stored. Employees who handle these materials should wash their hands thoroughly with soap and water before eating, smoking, or using the toilet facilities. OSHA cautions that since this substance may penetrate the skin, especially if broken, control of the vapor or dust inhalation may not be sufficient to prevent absorption of an excessive dose and therefore recommends proper hygienic practices at all times.

Section 08 : Special Precautions

Precautions To Be Taken In Handling & Storage:
Store in a dry, well ventilated area away from food stores or beverages.

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Other Precautions:
Containers should be kept closed when not in use to avoid the absorption of moisture. Do not store with other chemicals that are incompatible.

Section 09 : Special Health Precautions

Special Health Precautions:
Although some of the heavy metals that may be present in this product are listed as EP toxic under Federal Regulations, they are relevant only under effluent guidelines pertaining to the Clean Water Act, and RCRA, for waste disposal: therefore, the hazardous quality of the cyanide herein precedes all hazardous conditions of this product.
All information, recommendations and suggestions appearing herein concerning our product are based upon data believed to be reliable, however, it is the user's responsibility to determine the safe handling and suitability for his or her own use of the product described herein. Since the actual use by others is beyond our control, no guarantee, expressed or implied, is made by American Chemical & Refining Company, Inc. as to the effects of such use, the results obtained, or the safety and toxicity of the product nor does the Company per se assume any liability arising out of use, by others. of the product referred to herein. Nor is the information herein to be construed as absolutely complete since more information may be desirable or necessary when particular or exceptional conditions or circumstances exist, or because of applicable laws or government regulations.

PREPARED/REVISED BY: KALMAN Le BOW
TITLE: COORDINATOR of ENVIRONMENTAL REGULATIONS

Section 10 : Transportation

As mentioned in Section 06 :(SEE DISPOSAL METHOD), this substance is now a hazardous waste and must be treated accordingly. When the substance is to be sent to a Designated Facility for reclaim, it must be manifested and have the proper shipping name and labels on the drum, according to EPA and DOT regs.
PROPER SHIPPING NAME: RQ Waste Silver Cyanide (Solution)
HAZARD CLASS: Poison B
ID.#: UN 1684, Poison label (skull & crossbone)
A hazardous waste label must be included on the drum. All information is to be shown on the side of the drum, not on the top. All information is to be printed or typed. The Hazard Class,(Poison B) is not to be put on the drum.The Poison label satisfies this requirement. RQ, means Reportable Quantity, this satisfies the new regs for CERCLA.

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Update as of, March 30, 1984

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U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

Form Approved
OMB No. 44-R1387

MATERIAL SAFETY DATA SHEET

Required under USDL Safety and Health Regulations for Ship Repairing, Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

MANUFACTURER'S NAME: American Chemical & Refining Company, Inc.	EMERGENCY TELEPHONE NO.: (203)-757-9231
ADDRESS (Number, Street, City, State, and ZIP Code): 36 Sheffield Street, Waterbury, Connecticut 06720	
CHEMICAL NAME AND SYNONYMS: Potassium Dicyanoargentate (1)	TRADE NAME AND SYNONYMS: Potassium Silver Cyanide
CHEMICAL FAMILY: Metallic Cyanide	FORMULA: KAg (CN)$_2$

SECTION II - HAZARDOUS INGREDIENTS

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

HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (Units)
NA		
CAS #506-61-6 Potassium Silver Cyanide		

SECTION III - PHYSICAL DATA

BOILING POINT (°F.)	NA	SPECIFIC GRAVITY (H_2O=1)	2.36
VAPOR PRESSURE (mm Hg.)	NA	PERCENT, VOLATILE BY VOLUME (%)	NA
VAPOR DENSITY (AIR=1)	NA	EVAPORATION RATE (_____ =1)	NA
SOLUBILITY IN WATER	25% @ 20° C		
APPEARANCE AND ODOR	White crystalline material - no odor, sensitive to light.		

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used): None	FLAMMABLE LIMITS: NA	Lel	Uel

EXTINGUISHING MEDIA
Non-flammable; however, if in the vicinity of a fire do not hose down with water as the cyanide will go into solution and pose a threat to the environment or mix with acidic chemicals & form hydrocyanic gas which is extremely toxic & hazardous.

SPECIAL FIRE FIGHTING PROCEDURES

UNUSUAL FIRE AND EXPLOSION HAZARDS
CO_2 or foam would be less hazardous to use.

(Continued on reverse side)

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SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE
5 mg/M as cyanide

EFFECTS OF OVEREXPOSURE
Weakness, dizziness, headache, nausea, vomiting and eventual unconsciousness

EMERGENCY AND FIRST AID PROCEDURES
Flush skin & eyes with large amounts of water, remove contaminated clothing immediately. If hydrocyanic gas is evolved, remove patient to fresh air, and if need be, give O2. If unconscious give artificial respiration and call a physician at once. Do not give anything orally to an unconscious person.

SECTION VI - REACTIVITY DATA

STABILITY			CONDITIONS TO AVOID
	UNSTABLE		
	STABLE	X	

INCOMPATABILITY (Materials to avoid)
Do not add acid or acid salts to the cyanide or strong oxidizing agents

HAZARDOUS DECOMPOSITION PRODUCTS
Hydrocyanic gas under acidic conditions.

HAZARDOUS POLYMERIZATION			CONDITIONS TO AVOID
	MAY OCCUR		
	WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Soak up spill with an inert material and return to refinery for recovery of sil

Material should not be washed into any sewer or drain.

WASTE DISPOSAL METHOD
Dispose of in accordance with State & Federal Regulations.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type)
A self-contained breathing apparatus if HCN gas is present. Dry chemical, a dust mist canister type

VENTILATION	LOCAL EXHAUST	SPECIAL
	Adequate exhaust	
	MECHANICAL (General)	OTHER
	Use in well ventilated area.	

PROTECTIVE GLOVES	EYE PROTECTION
Impervious rubber or other imprevious material.	Chemical safety goggles

OTHER PROTECTIVE EQUIPMENT

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING
Adequate body protection

OTHER PRECAUTIONS
Store away from food - wash hands after using.

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Consumer Product Testing

Supplier: Philipp Brothers Chemical
New Field St.
Middletown, Conn.

Bldg. No. 2-158
1275 Bloomfield Avenue
Fairfield, New Jersey 07006

Company Incorporated
(201) 575-7688
(201) 575-7689

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MATERIAL SAFETY DATA SHEET

PREPARED FOR:

ENGELHARD

Engelhard Industries Division
Engelhard Minerals & Chemicals Corporation
70 Wood Avenue South
Iselin, New Jersey 07730

Department Name: Silver Salts and Powders
Department Number: 031
10/80

Required under USDL Safety and Health Regulations

SECTION I — SOURCE AND NOMENCLATURE

Product Name and Synonyms: Potassium Silver Cyanide
Trade Name and Synonyms: ---
Chemical Family: ---
Formula: $KAg(CN)_2$
Manufacturer's Name: Engelhard Minerals and Chemicals Corporation
Emergency Telephone No.: 201-575-7688 (7689)
Address (Number, Street, City, State, Zip Code): 70 Wood Avenue South, Iselin, New Jersey 07730

SECTION II — HAZARDOUS INGREDIENTS

Hazardous Materials or Components	%	TLV (Units)
Base Metal	54.2	0.01/Mg/M^3

SECTION III — PHYSICAL DATA

Boiling Point (°F) --- (°C)
Percent, Volatile By Volume (%): NA
Vapor Pressure (mmHg.) at 20° C: ---
Appearance and Odor: White crystalline powder. Cyanide odor.
Vapor Density (Air = 1): ---
Freezing Point (°F) --- (°C)
Solubility in water wt. at 20°C: Soluble
Evaporation Rate (=1): NA
Specific Gravity (H_2O =1): ---

SECTION IV — FIRE AND EXPLOSION HAZARD DATA

Flash Point (Method Used): NA
Flammable (Explosion) Limits in Air % by volume: Upper NA; Lower NA

Extinguishing Media: Water may be used on fires near Potassium Silver Cyanide.

Specific Fire Fighting Procedures: Firefighters must use recommended protective equipment. Self contained breathing apparatus must be used.

Unusual Fire and Explosion Hazards: Cyanogen, Hydrogen Cyanide

SECTION V — HEALTH HAZARD DATA

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THRESHOLD LIMIT VALUE Soluble Silver Compounds 0.01 Mg/M^3

EFFECTS OF OVEREXPOSURE ROUTES OF EXPOSURE: Eye, skin and respiratory tract.

SYMPTOMS: May produce cyanide rash. Systemic absorption causes respiratory depression & cyanc

ORAL TOXICITY: Highly toxic. LD_{50} (Rat) < 50 mg/kg (no survivors)

INHALATION TOXICITY: Do not breath vapors. Respiratory depression and cyanosis may occur.

DERMAL TOXICITY: Moderately toxic. LD_{50} (Rabbit) > 200 mg/kg (no deaths); may cause cyanide rash

SKIN IRRITATION: See Dermal Toxicity.

EYE IRRITATION: Corrosive. Material is very toxic when absorbed through the eye

SECTION VI — REACTIVITY DATA

Stability	Unstable		Conditions to Avoid: Exposure to light, overheating
	Stable	X	

Incompatibility (Materials to Avoid) Acids react to release hydrogen cyanide gas.

Hazardous Decomposition Products Hydrogen cyanide

Hazardous Polymerization	May Occur		Conditions to Avoid
	Will Not Occur	X	---
Corrosion	Aluminum	---	
	Steel	---	

Determined in accordance with requirement no. _____, by procedure no. _____

Determined in accordance with requirement no. _____, by procedure no. _____

SECTION VII — SPILL OR LEAK PROCEDURES

Steps to be taken in case material is released or spilled

Evacuate area. Use protective clothing during clean up. Flush area with large amounts of water. Contain waste water.

Waste Disposal Method

Dispose of in approved hazardous waste disposal facility.

SECTION VIII — SPECIAL PROTECTION INFORMATION

Respiratory Protection (Specify type) Self-contained breathing apparatus.

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

Protection Gloves Impervious gloves should be worn.

Eye Protection Chemical type goggles should be worn.

Other Protective Equipment Normal industrial protective clothing and shoes must be worn.

SECTION IX — SPECIAL PRECAUTIONS

Precautionary Labeling Class B poison.

Precautions to be taken in handling and storing Avoid exposure to light. Industrial precautionary label required. Protect against physical damage. Do not store near acids.

Other Precautions Avoid contact with acids, which releases hydrogen cyanide. Avoid overheating

SECTION X — EMERGENCY AND FIRST AID PROCEDURES

Eye Contact	Flush thoroughly with water for at least 15 minutes. Get immediate medic attention. Highly toxic when absorbed into the eye.
Skin Contact	Remove contaminated clothing. Wash contact areas with soap and water. Wash clothing before reuse.
Inhalation	Exposure to hydrogen cyanide causes irritation, respiratory depression and cyanosis. Use amyl nitrite under the nose. Call a physician if unconscious.
Ingestion	Induce vomiting immediately by giving two glasses of water. Call a physician Never give anything by mouth to an unconscious person

The burden of safe use of our materials must rest entirely with the user. We cannot assume responsibility for the completeness or accuracy of any information supplied by us concerning the hazards or recommended use of chemicals.

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INDUSTRIAL HYGIENE

ENTHONE INCORPORATED

MATERIAL SAFETY DATA SHEET

ENSTRIP® S

P.O. BOX 1900
NEW HAVEN, CT 06508

EMERGENCY PHONE NUMBERS				
PLANTS	203-934-8611	(8:30am-5pm EST)	PRODUCT CODE#:	2501
	312-598-3210	(8:30am-5pm CST)	DATE ISSUED:	7/24/87
MFSA	313-644-5626	(24 hours)	SUPERCEDES:	8/78
CHEMTREC	800-424-9300	(Transportation)	PREPARER:	F.R. Hirtler FRH

II. HAZARDOUS INGREDIENTS

COMPONENT	COMMON NAME	CAS NO.	OSHA-PEL	ACGIH-TLV	%
Sodium m-Nitrobenzenesulfonate		127-68-4	NI	NI	100

III. PHYSICAL PROPERTIES

SPECIFIC GRAVITY (WATER =1)	NI	BOILING POINT, °F	NA
EVAP.RATE (BUTYL ACETATE=1)	NA	MELTING POINT, °F	NI
VAPOR PRESSURE, mmHg	NA	SOLUBILITY IN WATER	essentially complete
VAPOR DENSITY (AIR=1)	NA	APPEARANCE	off-white powder
pH (AS IS)	NA	ODOR	slightly aromatic

IV. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT, °F	None	FLAMMABLE LIMITS (AIR)	NA	LEL	NA	UEL

EXTINGUISHING MEDIA

[ ] Not Combustible [X] Water fog or spray [X] Carbon Dioxide [ ] Dry Chemical [ ] Alcohol Foam [X] Foam [ ] Sand or Earth

SPECIAL FIRE FIGHTING PROCEDURES

Wear self-contained breathing apparatus (SCBA) and complete personal protective equipment when potential for exposure to vapors or products of combustion exists.

UNUSUAL FIRE AND EXPLOSION HAZARDS

Product will self-sustain combustion when ignited.

V. HEALTH HAZARD DATA

EFFECTS OF ACUTE EXPOSURE:

INHALATION: Can cause irritation.

INGESTION: Can cause irritation to mouth, throat, esophagus, and stomach.

SKIN: Can cause irritation.

EYES: Can cause severe irritation.

EFFECTS OF CHRONIC EXPOSURE:

None known.

CARCINOGEN: Not listed by NTP, IARC, OSHA

REFERENCE:

EMERGENCY AND FIRST AID PROCEDURES

INHALATION: Remove person from contaminated area. If breathing has stopped, resuscitate and administer oxygen if available.
Seek immediate medical attention.

INGESTION: Never give anything by mouth to an unconscious person, obtain immediate medical attention. If vomiting occurs spontaneously, keep airway clear. If swallowed DO NOT INDUCE VOMITING, give large amounts of water.
Seek immediate medical attention.

SKIN: Immediately wash contaminated skin with plenty of water for 15 minutes. Remove contaminated clothing and footwear. Wash clothing before reuse. Discard footwear if it cannot be decontaminated.
Seek immediate medical attention.

EYES: Flush eyes with plenty of water, holding lids apart to ensure flushing of *entire* surface to prevent or relieve irritation.
If irritation persists, seek medical attention.

VI. PRECAUTIONS FOR SAFE HANDLING AND USE

SPILL PROCEDURES:

Avoid contact with skin, eyes, and clothing. Wear protective equipment (See section VII). Sweep or shovel spilled material into clean plastic lined container and cover. Flush spill area with copious amounts of water. Dispose of in accordance with Local, State and Federal regulations.

STORAGE AND HANDLING PRECAUTIONS:

Store in a cool, dry place. Keep away from acids and oxidizers. Loosen cover cautiously when opening.

ADDITIONAL INFORMATION:

Wash thoroughly after handling.

VII. CONTROL MEASURES

VENTILATION: Local exhaust recommended.

RESPIRATOR: Use NIOSH approved respirator when air concentration is greater than the TLV or PEL. Use cartridge filter for dusts.

EYE PROTECTION: [ ] Safety glasses [X] Chemical safety goggles [ ] Face shield

PROTECTIVE GLOVES: [X] Neoprene [X] Natural rubber Other:

OTHER PROTECTIVE CLOTHING OR EQUIPMENT:

Chemically resistant coveralls, hat, and shoes or boots.

WORK/HYGENIC PRACTICES:

Emergency eye wash and safety shower should be available. Wash thoroughly after handling.

ADDITIONAL INFORMATION:

For waste disposal of operating solutions consult Enthone Waste Disposal Procedures. For major spills consult Enthone for disposal assistance. Dispose of in accordance with Local, State, and Federal regulations.

CAS = Chemical Abstract Service
NI = No relevant information available
NA = Not applicable
Trade Secret = Claimed as allowed under 29 CFR 1910.1200

PEL = OSHA Permissible Exposure Limit
TLV = ACGIH Threshold Limit Value
NTP = National Toxicology Program
IARC = Int'l Agency for Research on Cancer

VIII. REACTIVITY DATA

X	Stable	CONDITIONS TO AVOID:	Stable under normal conditions. See Incompatibility information.
	Unstable		

INCOMPATABILITY (Materials to avoid): Oxidizing agents, acids, acid salts.

HAZARDOUS DECOMPOSITION PRODUCTS: Toxic oxides of nitrogen, sulfur and carbon.

HAZARDOUS POLYMERIZATION		May occur	CONDITIONS TO AVOID: NA
	X	Will not occur	

IX. ADDITIONAL INFORMATION

This Material Safety Data Sheet may be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Enthone, Inc. furnishes the data contained herein in good faith at customer's request without liability or legal responsibility for same whatsoever, and no warranty or guarantee, express or implied, is made with respect to such data; nor does Enthone, Inc. grant permission, recommendation, or inducement to infringe any patent whether owned by Enthone or others. The data is offered solely for your information and consideration. Since conditions of use are beyond Enthone's control, user assumes all responsibility and risk.

PMC 1531

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INDUSTRIAL HYGIENE

MATERIAL SAFETY DATA SHEET

(R) 5/23/88

CODE 13501

SECTION 1

Manufacturer's Name MacDermid Incorporated	EMERGENCY TELEPHONE 203-575-5700
ADDRESS (Number, Street, City, State, Zip Code) 526 Huntingdon Avenue Waterbury, CT. 06708	MFSA EMERGENCY 24 HOUR HOTLINE: (Medical) (313) - 644 - 5626
CFR-49 - DOT Proper Shipping Name Non regulated	
CHEMICAL NAME AND SYNONYMS N/A	TRADE NAME AND SYNOMYMS Metex Strip Aid
CHEMICAL FAMILY Organic Salt	FORMULA Mixture

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVE & SOLVENTS	% N/A	TLV (UNITS)	ALLOYS & METALLIC COATINGS	% N/A	TLV (UNITS)
PIGMENTS	"		BASE METAL	"	
CATALYST	"		ALLOYS	"	
VEHICLE	"		METALLIC COATINGS	"	
SOLVENTS	"		FILLER METAL PLUS OR CORE FLUX	"	
ADDITIVES	"		OTHERS	"	
OTHERS	"				

HAZARDOUS MIXTURES OR OTHER LIQUIDS, SOLIDS, OR GASES	%	TLV (UNITS)
Salt of sulfonic acid (27215-71-0)	100	Not listed

SECTION III - PHYSICAL DATA

BOILING POINT (F)	N/A	SPECIFIC GRAVITY (H_2O = 1)	N/A
VAPOR PRESSURE (MM. HG.)	0	PERCENT VOLATILE BY VOLUME (%)	0
VAPOR DENSITY (AIR = 1)	N/A	EVAPORATION RATE (= 1)	N/A
SOLUBILITY IN WATER	Appreciable		

APPEARANCE AND ODOR

Pale yellow to tan powder - odorless

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED) Non-flammable	FLAMMABLE LIMITS N/A	~~LEL~~	~~UEL~~
EXTINGUISHING MEDIA Waterspray, CO_2, alcohol, foam, dry chemical			
SPECIAL FIRE FIGHTING PROCEDURES If material is smoldering, spread burning material out thinly and douse with water. Wear self-contained breathing apparatus.			
UNUSUAL FIRE AND EXPLOSION HAZARDS Material is an oxygen donor and can support combustion.			

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE

Not established for product.

EFFECTS OF OVEREXPOSURE-UNLESS OTHERWISE STATED, CHRONIC OR LONG-TERM HEALTH EFFECTS UNKNOWN

Possible slight irritation to eyes, skin and mucous membranes.

EMERGENCY AND FIRST AID PROCEDURES

EYES: Flush with water for 15 minutes. Contact physician.
SKIN: Flush with water.
INTERNAL: Give water. Do not induce vomiting. Contact physician.
INHALATION: Remove to fresh air.

SECTION VI - REACTIVITY DATA

UNSTABLE		**CONDITIONS TO AVOID**
STABLE	X	N/A

INCOMPATIBILITY (MATERIALS TO AVOID)

Strong oxidizers, sources of ignition.

HAZARDOUS DECOMPOSITION PRODUCTS

Oxides of sulfur/nitrogen

HAZARDOUS POLYMERIZATION		**CONDITIONS TO AVOID**
MAY OCCUR		N/A
WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED - WEAR PROTECTIVE CLOTHING. NE DISCHARGE DIRECTLY INTO SEWERS OR WATERWAYS

Scoop up with steel shovel. Flush remaining material to chemical drain with water.

WASTE DISPOSAL METHOD - ALWAYS CHECK AND COMPLY WITH GOVERNMENT DISPOSAL REGULATIONS

Dissolve in water, flush to drain. Check government disposal regulations.
Alternate Method: Incineration when allowed by government regulations.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (SPECIFY TYPE)

Not normally required

VENTILATION	**LOCAL EXHAUST**	**SPECIAL**
	N/A	N/A
	MECHANICAL (GENERAL)	**OTHER**
	X	N/A

PROTECTIVE GLOVES	**EYE PROTECTION**
Rubber	Safety goggles

OTHER PROTECTIVE EQUIPMENT

Protective clothing

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Store in cool, dry area away from open flame, sparks and other sources of ignition.

OTHER PRECAUTIONS - AVOID EYE AND SKIN CONTACT. ALWAYS WASH CLOTHING BEFORE RE-USE

Wash thoroughly after handling.

PREPARED BY: MacDermid Incorporated DATE: 5/23/88

13501

SAFETY & WARNING INFORMATION